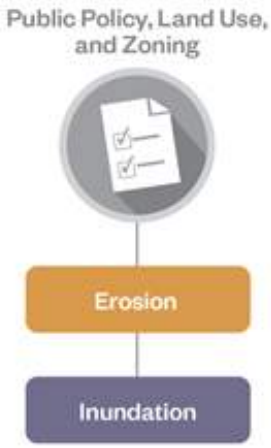
7.2 PUBLIC POLICY, LAND USE, AND ZONING



This section describes existing public policies, land use, and zoning within the lower Esopus Creek study area and evaluates any potential benefits and impacts that may result from implementation of the Proposed Action. The public policy assessment includes a review of the consistency of the Proposed Action with applicable existing public policies within the study area. The land use assessment includes an assessment of potential short- or long-term changes as a result of the Proposed Action and associated potential effects on current and known future land uses and land use patterns within the study area. The zoning assessment includes a review of the compatibility of the Proposed Action with existing zoning regulations in the study area.

7.2.1 BASELINE CONDITIONS

The public policy, land use, and zoning study area includes the area within a quarter-mile along the length of lower Esopus Creek beginning at Ashokan Reservoir in the Town of Olive and ending in the Village of Saugerties at the confluence of lower Esopus Creek and the Hudson River (see **Figure 7.2-1**). The study area is entirely contained within Ulster County, New York and traverses several cities, towns, and villages, including: the Town of Olive, the Town of Marbletown, the Town of Hurley, the Town of Ulster, the City of Kingston, the Town of Saugerties, and the Village of Saugerties.

The following sections describe relevant public policies, land use patterns, and zoning districts applicable to the Proposed Action within the study area.

PUBLIC POLICY

Federal

Coastal Zone Management Act (CZMA) of 1972

The Coastal Zone Management Act (CZMA) of 1972 provides for the management of the nation's coastal resources. Administered by the National Oceanic and Atmospheric Administration (NOAA), the goal of this act is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone" (NOAA 2016). The CZMA establishes a framework for State and territorial coastal management programs, as described in the sections that summarize the New York State Coastal Management Plan and Local Waterfront Revitalization Program below.

Flood Disaster Protection Act of 1973

The Flood Disaster Protection Act of 1973 is applicable to the Proposed Action, as the study area is located within the 100-year FEMA Special Flood Hazard Area (SFHA), as shown in **Figure 7.2-1**. This act requires the purchase of flood insurance mandatory for the protection of property located in SFHAs.

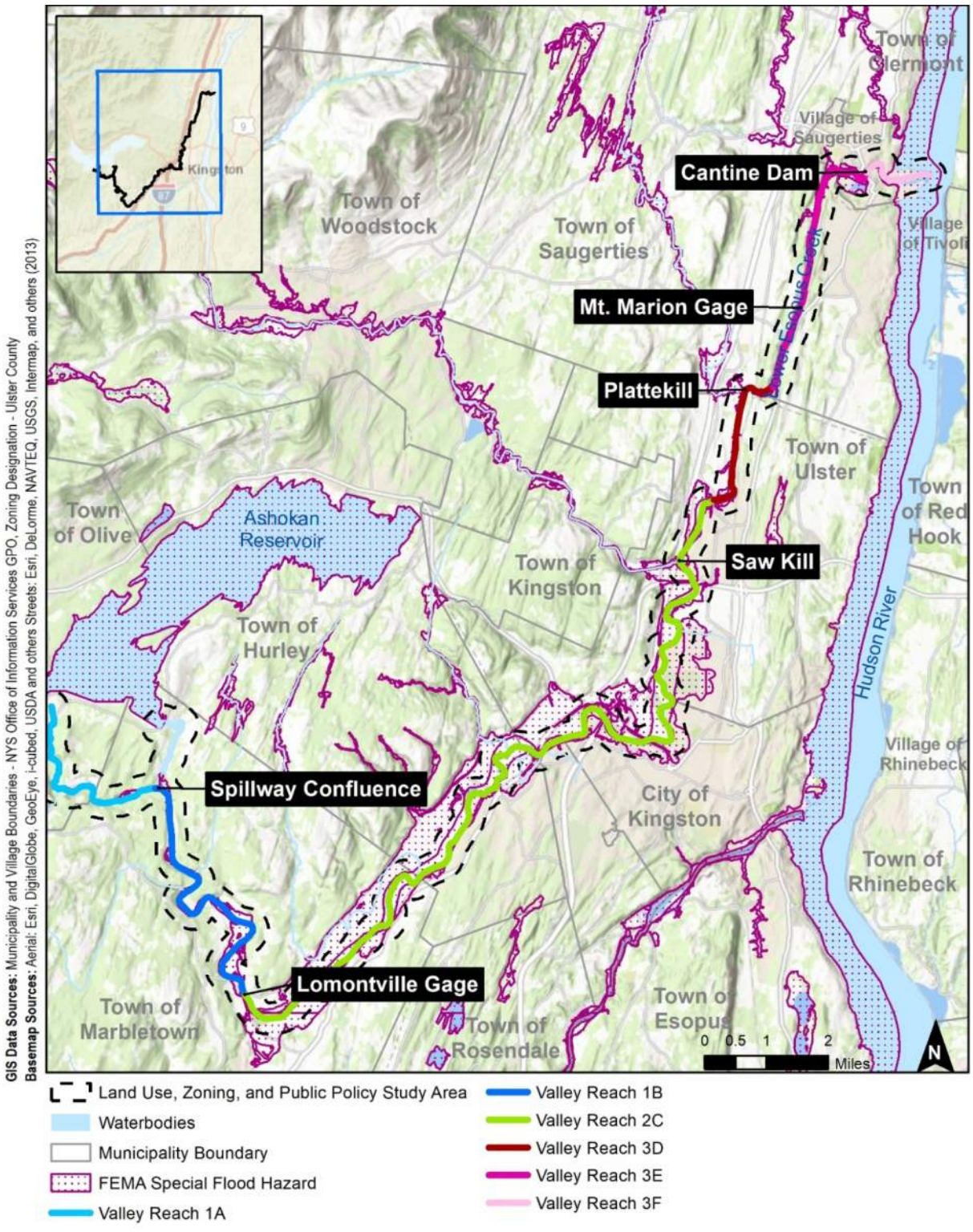


Figure 7.2-1
Lower Esopus Creek
FEMA Special Flood Hazard Area

State

Coastal Management Plan

After enactment of the federal CZMA, the New York State Department of State (NYSDOS) developed a Coastal Management Plan (CMP) and enacted implementing legislation (i.e., the Waterfront Revitalization and Coastal Resources Act) in 1981. The purpose of the CMP is to achieve a balance between economic development and preservation, thus promoting waterfront revitalization and water-dependent uses and protecting open space, scenic areas, and public access to the shoreline, fish, wildlife, and farmland. The CMP also aims to minimize significant adverse impacts to ecological systems and minimize erosion and flood hazards. In addition, the CMP provides coastal communities opportunities to develop local waterfront revitalization plans that are tailored to their specific needs. These local plans may be reviewed and approved by the NYSDOS for consistency with federal and State coastal zone management provisions. The Village of Saugerties, a portion of which falls within the CZMA boundary (**Figure 7.2-2**), developed a local waterfront revitalization program that is described in further detail below.

New York Rising Community Reconstruction Program

Following Hurricane Irene, Tropical Storm Lee, and Superstorm Sandy, the Governor's Office of Storm Recovery (GOSR) established the New York Rising Community Reconstruction (NYRCR) Program. This recovery and resiliency program was established to provide assistance to communities throughout the State, including those in Ulster County, that were damaged by these storms. The program has allotted more than $700 million in federal funds to support planning and implementation of projects developed by communities in partnership with local governments, non-profit organizations, and the public. The Hudson Valley/Westchester County region, which includes communities surrounding lower Esopus Creek, has over 20 New York Rising projects in various stages of implementation. These projects range from shoreline defense measures to erosion reduction and park restoration. Two of the NYRCR projects, the Village of Saugerties Beach and Tina Chorvas Park, located in the Village of Saugerties, fall within the NYRCR Program area and are described further in Section 7.4, "Open Space and Recreation."

LOCAL

Ulster County Open Space Plan

The Ulster County Open Space Plan, established in 2007, provides a framework for the management and protection of open space resources. These include water resources, working landscapes, landforms and natural features, ecological communities, cultural and historic resources, and recreation resources. To provide guidance on these open space resources, Ulster County has established ten "Principles of the Open Space Plan" that seek to safeguard the open space values of Ulster County. Of those ten principles, the following three are applicable to the Proposed Action:

- Preserve and protect open space, unique natural areas and heritage areas and sites, wetlands, water and woodland resources, scenic views, areas of natural beauty, and the rural character of Ulster County;
- Protect water resources and the waterways of the County; and
- Protect and enhance the County's most valuable open space landforms and natural features with coordinated planning and safeguard policies.

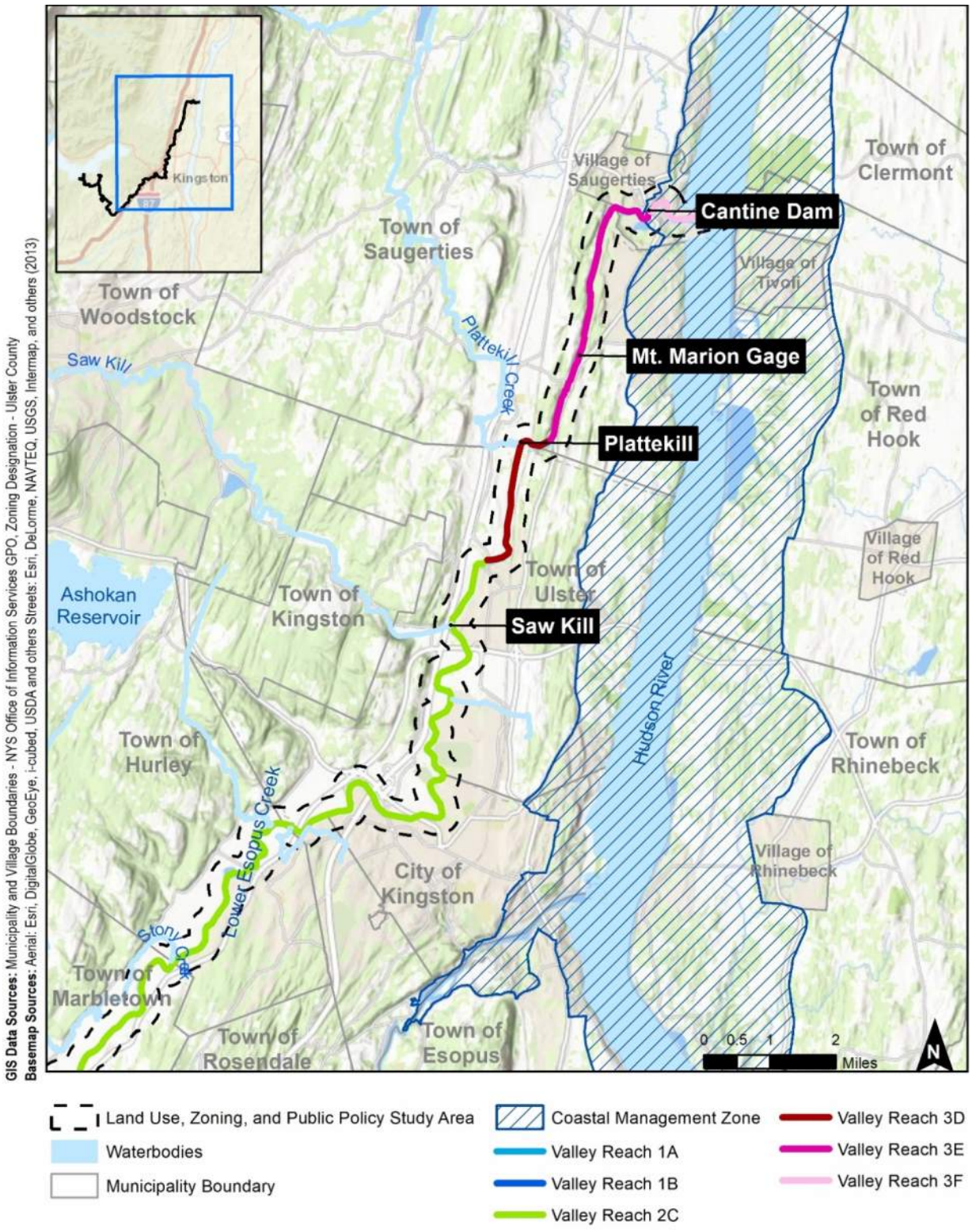


Figure 7.2-2
Lower Esopus Creek
Coastal Management Zone

Marbletown Town Plan

The Marbletown Town Plan is a comprehensive plan adopted in 2005 which aims to highlight community goals, and act as a guidance document for the Town's future. Broadly, the plan outlines six goal categories: (1) Environment, (2) Economy, (3) Development Patterns, (4) Historic and Cultural, (5) Housing, and (6) Infrastructure. Each goal category outlines specific strategies and proposed actions to be taken. Goals that are most relevant to the Proposed Action include: Environment, Economy, and Historic and Cultural.

Items related to the environment include wetland preservation and the recreational use of natural resources and open spaces. Marbletown's Town Plan aims to use zoning requirements and review processes to preserve wetlands from the adverse effects of development such as pollution, erosion, and damage to habitats. Regarding strategies around recreational use of open space, the plan acknowledges that the availability of outdoor areas is a major community asset and defining characteristic of the Town. The plan encourages recreational use of parks, woodlands, and waterways and aims to promote stewardship through recreational opportunities.

Goals related to the economy include promoting four season tourism and sustainable and small businesses. The plan acknowledges that the unique environmental setting of Marbletown draws tourists and residents to the Town and that the expansion of tourism is desirable. The plan also aims to encourage business activities which "promote the sustainable use of natural, historic and cultural resources, and do not create a substantial negative impact to the environment, public safety, public health, and rural character of the Town."

Goals related to the Historic and Cultural strategies include policies to reject proposals that are incompatible with the preservation of historic and cultural properties. The plan recognizes the value of man-made resources such as old stone walls, railways, fording places along Esopus Creek and early and native dwellings and aims to protect them through ordinances, guidelines, and evaluation of site-specific proposals.

Town of Hurley Comprehensive Plan

In 2006, the Town of Hurley Comprehensive Plan was adopted by the Town Board. The plan was developed to establish a framework of management for planning and development within the Town. The plan outlines 14 long-term goals. The goals that are relevant to the Proposed Action include: Environment, Historic Preservation, Open Space, and Recreation.

The plan's environmental goals are focused on drinking water quality, pollution avoidance measures related to underground storage tanks and septic tanks, and stormwater planning. The plan's historic preservation goals center around preserving historically important resources. Finally, the plan's goals related to open space include the preservation and promotion of agricultural land uses and the creation of a land acquisition plan to help ensure open spaces are preserved.

Town goals related to recreation are focused on expanding recreational opportunities (such as an Esopus Creek boat launch and/or additional parks and recreation centers) without overburdening residents economically. The Town has created a committee to develop a recreation plan and capital budget.

Town of Hurley Open Space Plan

The purpose of the Town of Hurley's Open Space Plan is to inventory open space resources in the Town and to provide a collaborative framework for preserving open space. The Town of Hurley, New York Open Space Plan: 2018 was adopted in July 2018 and includes an extensive list of goals related to natural resources, agriculture, and recreation and historic resources. The following goals from the plan's Natural Resources and Recreational and Historic Resources sections are relevant to the Proposed Action:

- Natural Resources: Groundwater, Riparian Zones, and Streams
    - NR.1 – Conserve the riparian zone along Esopus Creek and its tributaries.
    - NR.2 – Pursue land easements or utilize other conservation measures along the entire length of Esopus Creek to create a large greenway that also serves to enhance the riparian buffer while ensuring access for irrigation for agricultural purposes.
- Recreational & Historic Resources: Public Access to Esopus Creek and Historic Preservation
    - RH.1 – Work with property owners, NYSDEC, and the County to increase public access to Esopus Creek.

Town of Ulster Comprehensive Plan

The Town of Ulster Comprehensive Plan was adopted in July 2007. The Comprehensive Plan addresses planning issues to foster growth and development, while preserving the rural and historic character of the Town, maintaining a quality environment, and promoting an active agricultural community. A primary focus of the plan is to promote a mix of commercial, industrial, residential, rural, and suburban land uses while retaining community character and livability. The goals outlined in the report most relevant to the Proposed Action are those related to natural resources protection, as follows:

- Enhance public access and protection of the waterfront lands. Plans with NYSDEC to develop fishing access points and public access points along lower Esopus Creek;
- Create Riparian Protection Zones along lower Esopus Creek; and
- Develop Local Waterfront Revitalization Plans for the Hudson River, Rondout Creek, and Esopus Creek waterfronts.[25]

City of Kingston Comprehensive Plan, Kingston 2025: A Plan for the City of Kingston

The City of Kingston adopted the Kingston 2025 Comprehensive Plan in March 2016. The plan includes strategies to achieve recommended goals, policies, and objectives related to land use, nature, historic resources, housing, transportation, and public facilities by 2025. In addition, the plan proposes recommendations and measures to implement the plan, including revisions to the City's Zoning Law.

The plan includes goals such as promoting a mix of commercial, industrial, residential, rural, and suburban land uses while retaining community character and livability within the community. There are several specific goals related to the protection of natural resources and open space that directly relate to lower Esopus Creek and the Proposed Action, including:

- Strategy 3.3.4: Undertake sea level rise and flooding assessment of Esopus Creek[26]; Create Riparian Protection Zones along Esopus Creek;
- Strategy 3.3.5: Develop and adopt a Natural Resources Inventory and Open Space Plan; and
- Strategy 4.1.4: Enhance Kingston as a livable city where residents want to live and businesses want to locate by taking advantage of the proximity to the Hudson, Rondout, and Esopus waterways, Shawangunk and Catskill Mountains and other natural resources, providing recreational opportunities and increasing quality of life.

[25] While this was a recommendation in the Plan, the Town of Ulster has not yet developed a local Waterfront Revitalization Plan specific to lower Esopus Creek.

[26] The City of Kingston is located along Valley Reach 2C of lower Esopus Creek.

Village of Saugerties - Local Waterfront Revitalization Program (LWRP)

A portion of the Village of Saugerties is located within the CZMA boundary. To address this on a local level, the Village adopted its Local Waterfront Revitalization Program (LWRP) in 1985. This program is consistent with the federal CZMA and the State's CMP. As the Village's principal coastal zone management tool, the program refines and supplements the State's CMP and outlines a comprehensive land and water use plan for natural, public, and developed waterfront resources along the Hudson River and lower Esopus Creek. Specific policies relevant to the Proposed Action include the following:

- Policy 1 – Restore, revitalize, and redevelop deteriorated and underutilized waterfront areas for commercial and industrial, cultural, and recreational and other compatible uses.
- Policy 2 – Facilitate the siting of water-dependent uses and facilities on or adjacent to coastal waters.
- Policy 4 – Strengthen the economic base of smaller harbor areas by encouraging the development and enhancement of those traditional uses and activities which have provided such areas with their unique maritime identity.
- Policy 8 – Protect fish and wildlife resources in the coastal area from the introduction of hazardous wastes and other pollutants which bioaccumulate in the food chain or which cause significant sublethal or lethal effect on these resources. The LWRP notes that strict enforcement of this policy would be undertaken by the appropriate State agency.
- Policy 18 – To safeguard the vital economic social and environmental interests of the State and of its citizens, proposed major actions in the coastal area must give full consideration to those interests, and to the safeguards which the State has established to protect valuable coastal resource areas.

LAND USE

Town of Olive

Land use in the study area within the Town of Olive is entirely residential, as shown in **Figure 7.2-3**.

Town of Marbletown

Within the Town of Marbletown, allowable land uses in the study area are characterized primarily as mixed use, residential, and small business, as shown in **Figure 7.2-4**. Property types include one- and two-family houses, field crops, vacant farmland, manufactured housing, commercial land, office buildings, billboards, and vacant land.

Town of Hurley

Land uses in the study area in the Town of Hurley are generally characterized as rural and residential, as shown in **Figure 7.2-5**. In addition, historic areas and smaller commercial and business land use areas are present within the study area directly adjacent to lower Esopus Creek. Property types include one-family residences, rural vacant land, a religious property, a neighborhood convenience store, shopping centers, and restaurants.

City of Kingston

Land uses in the study area in the City of Kingston are generally characterized as residential, business, and commercial. The existing land uses within the study area are shown below in **Figure 7.2-5**.

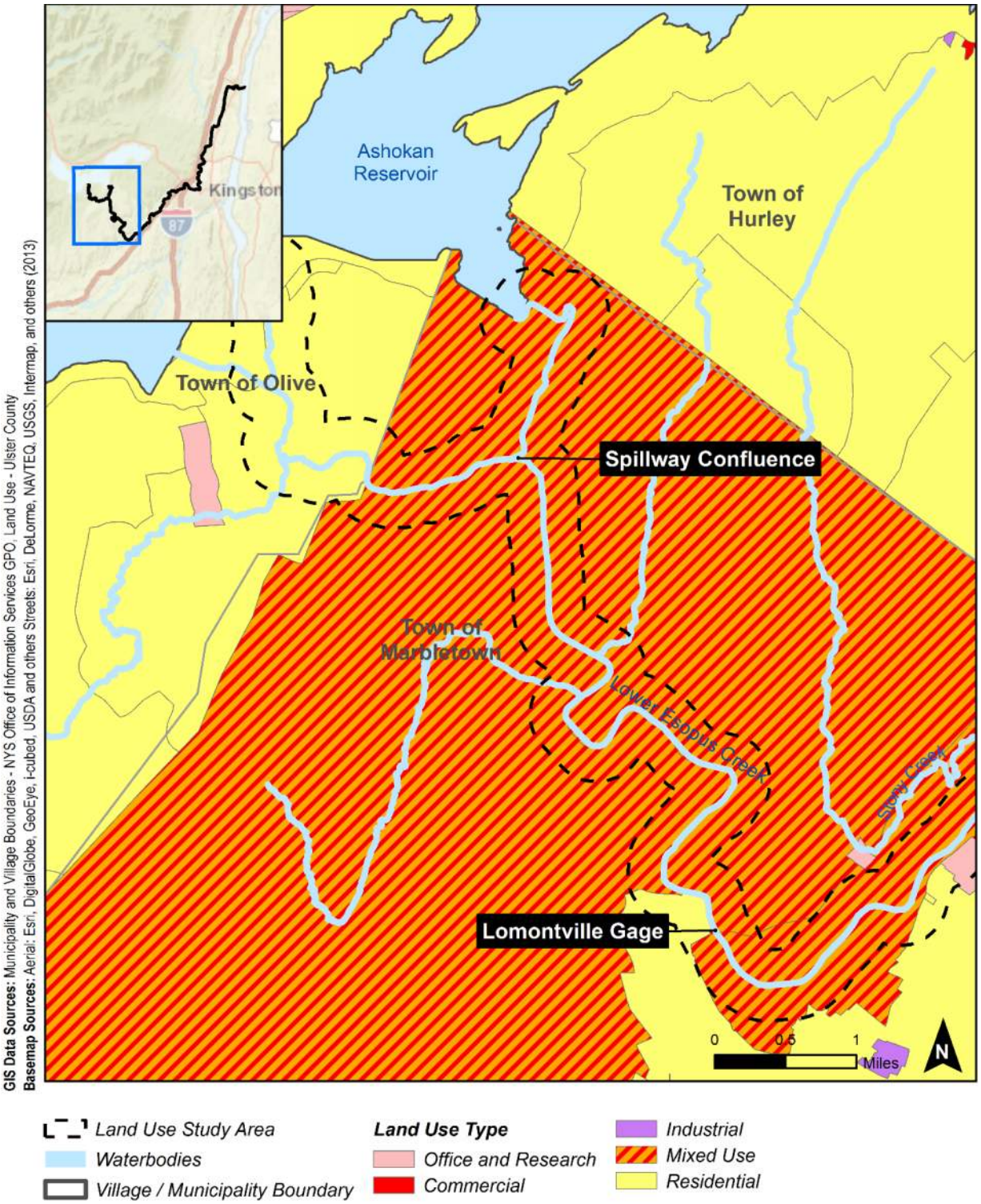


Figure 7.2-3
Lower Esopus Creek
Land Use Designation in Town of Olive

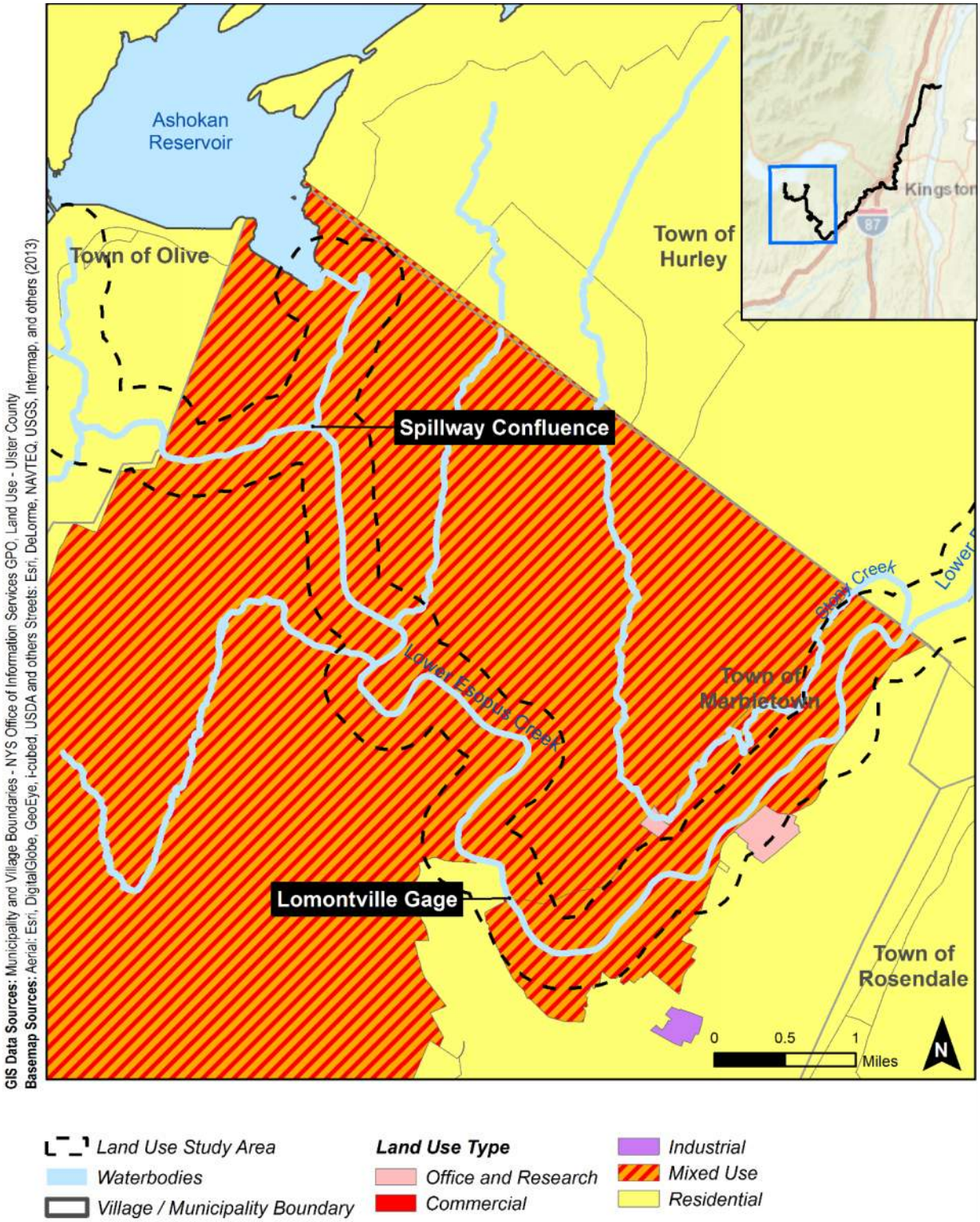


Figure 7.2-4
Lower Esopus Creek
Land Use Designations in the Town of Marbletown

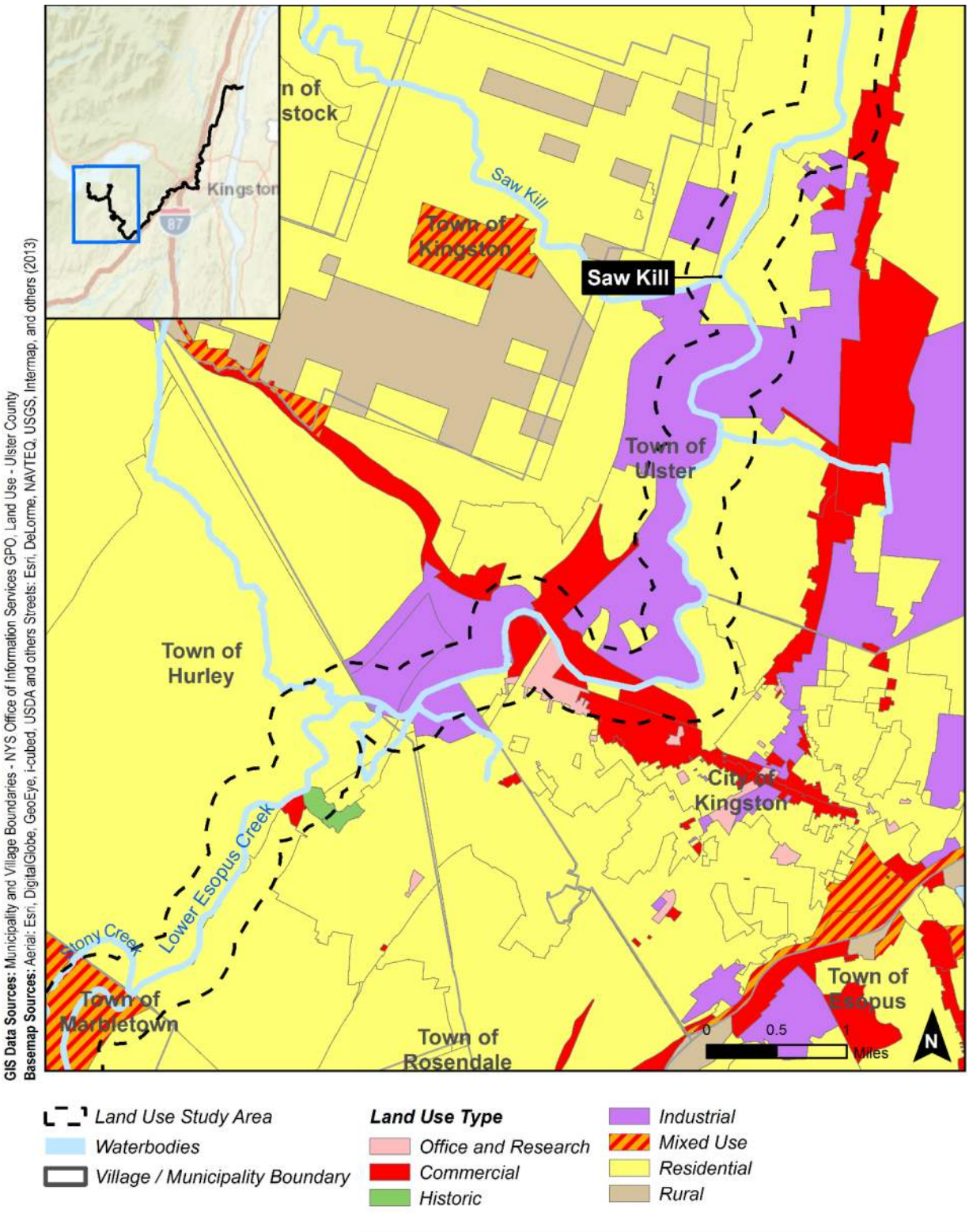


Figure 7.2-5
Lower Esopus Creek
Land Use Designations in the Town of Hurley and City of Kingston

Residential property types include one-family homes, multiple residence homes, three story multiple residences, apartments, rural vacant land, and rural residential properties. Commercial properties include motels, banks, shopping centers, and a church. The business properties include office buildings, storage, a social organization, billboards, a motel, apartments, and residential vacant land.

Town of Ulster

Land uses in the study area in the Town of Ulster are generally characterized as residential, industrial, and commercial as shown in **Figure 7.2-6**. The property types include one-family residences, farmland, retail strip malls, outdoor recreation (golfing), vacant farmland, vacant commercial land, utilities, an auto dealer, and manufactured homes.

Town of Saugerties

Land uses in the study area in the Town of Saugerties are generally characterized as residential, business, and industrial (primarily mine and quarry) land uses, as shown in **Figure 7.2-7**. Residential property types are generally one- and two-family homes, rural vacant land, rural residential land, and small-scale convenience businesses. The business property types consist of automotive, dining, entertainment, shopping centers, office complexes, retail, and high-density residential housing. Industrial property types include industrial and office complexes.

Village of Saugerties

Land uses in the study area in the Village of Saugerties are generally characterized as mixed use, residential, business, and rural land uses. The existing land uses within the study area are shown below in **Figure 7.2-7**. A portion of the study area lies within the Coastal Management Zone Area (CMZA) boundary as seen in **Figure 7.2-2**.

ZONING

Town of Olive

The Town of Olive Zoning Code defines two separate zoning districts within the study area: residential/conservation (CR) which allows for ten acres per dwelling unit, and residential/exurban (ER), which allows for one acre per dwelling unit, as shown in **Figure 7.2-8**. Both zoning districts are low-density residential districts.

Town of Marbletown

The Town of Marbletown Zoning Code defines five zoning districts within the study area. These districts include residential districts (R-1, A-2, A-3, and A-4) with an agricultural overlay district, a general business district (B-2), and agricultural overlay districts A-2, A-3, and A-4. An overlay district is a zoning district with supplementary regulations which are superimposed upon existing use districts.[27] The agricultural overlay district is shown in **Figure 7.2-9**. The residential districts are primarily one- and two-family residences. The B-2 zoning district provides opportunities for low-business development while also promoting traffic safety on a highly trafficked highway. **Figure 7.2-8** shows zoning designations within the Town of Marbletown within the study area.

[27] The agricultural overlay referenced in this chapter is Agricultural District #4, which includes tax parcels in the Town of Hurley, Village of Saugerties, Town of Saugerties, Town of Ulster, City of Kingston, northern Town of Olive, and northern and eastern Town of Marbletown. Much of the land area in the District along lower Esopus Creek includes farms with field crops, but many also have truck crops (one or more vegetable crops that are grown on a large scale for shipment to diverse markets) and mucklands. Farther from lower Esopus Creek, the District has a range of agricultural operations (e.g., a garlic farm in the Town of Marbletown).

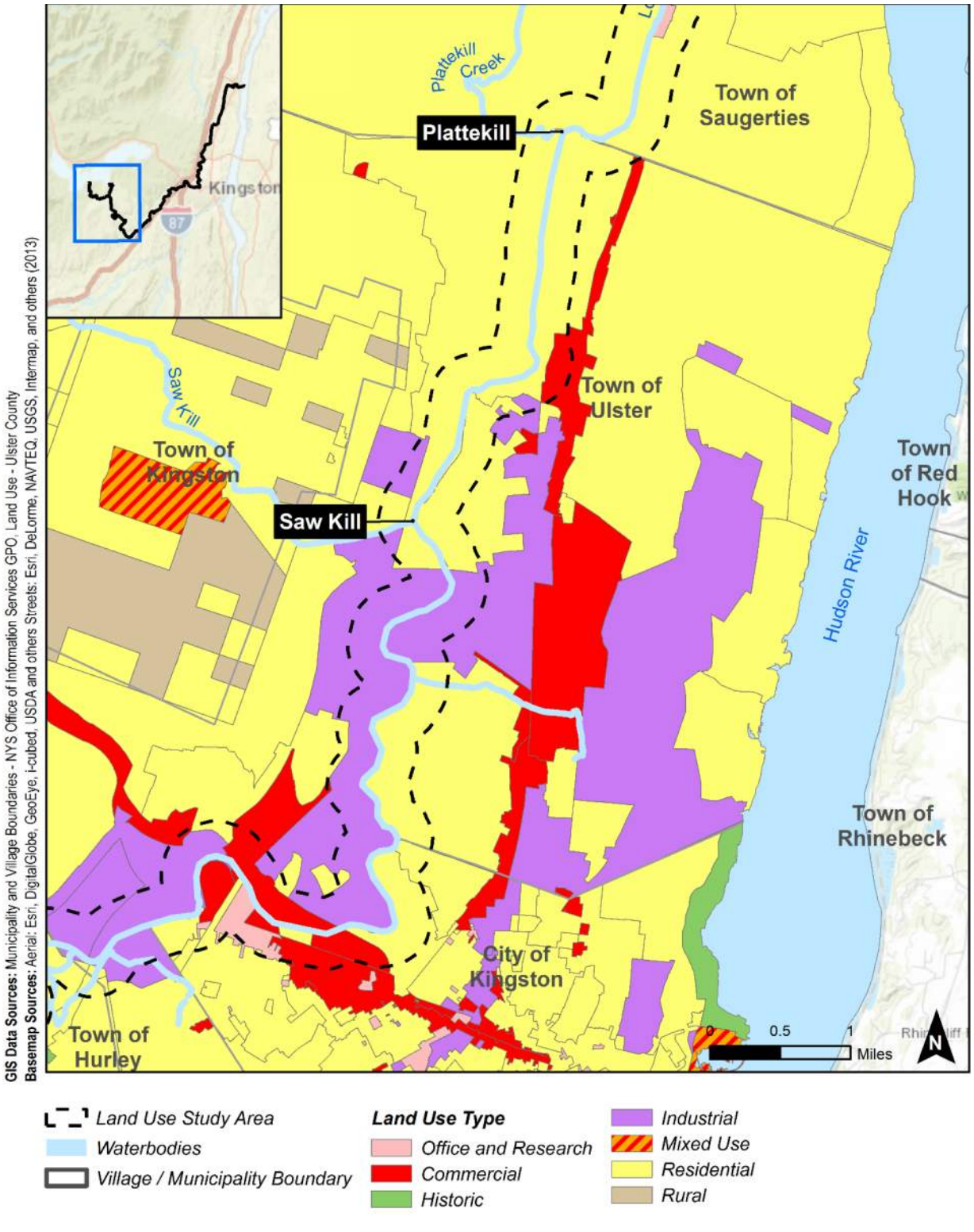


Figure 7.2-6
Lower Esopus Creek
Land Use Designations in Town of Ulster

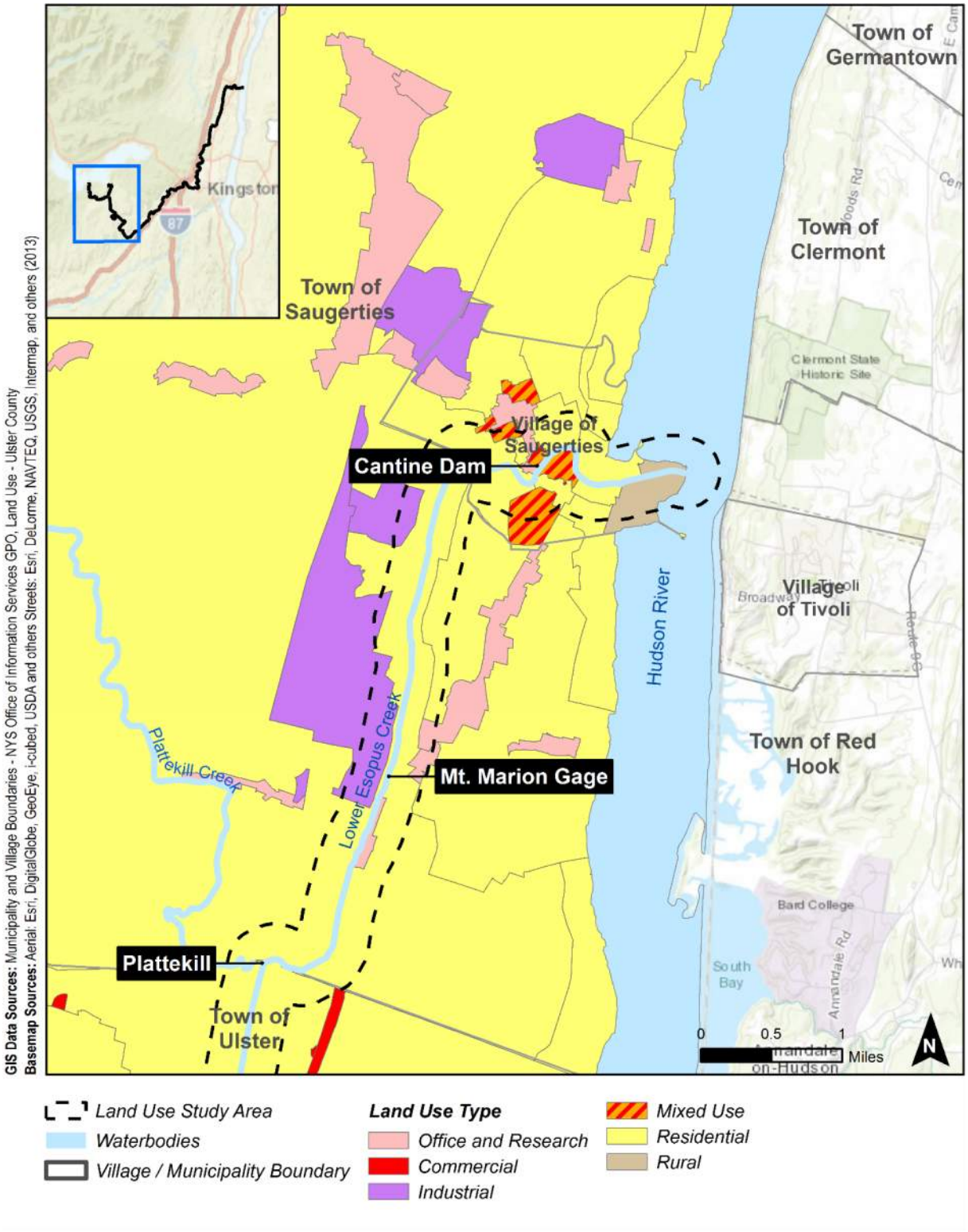


Figure 7.2-7
Lower Esopus Creek
Land Use Designations in Town of Saugerties and Village of Saugerties

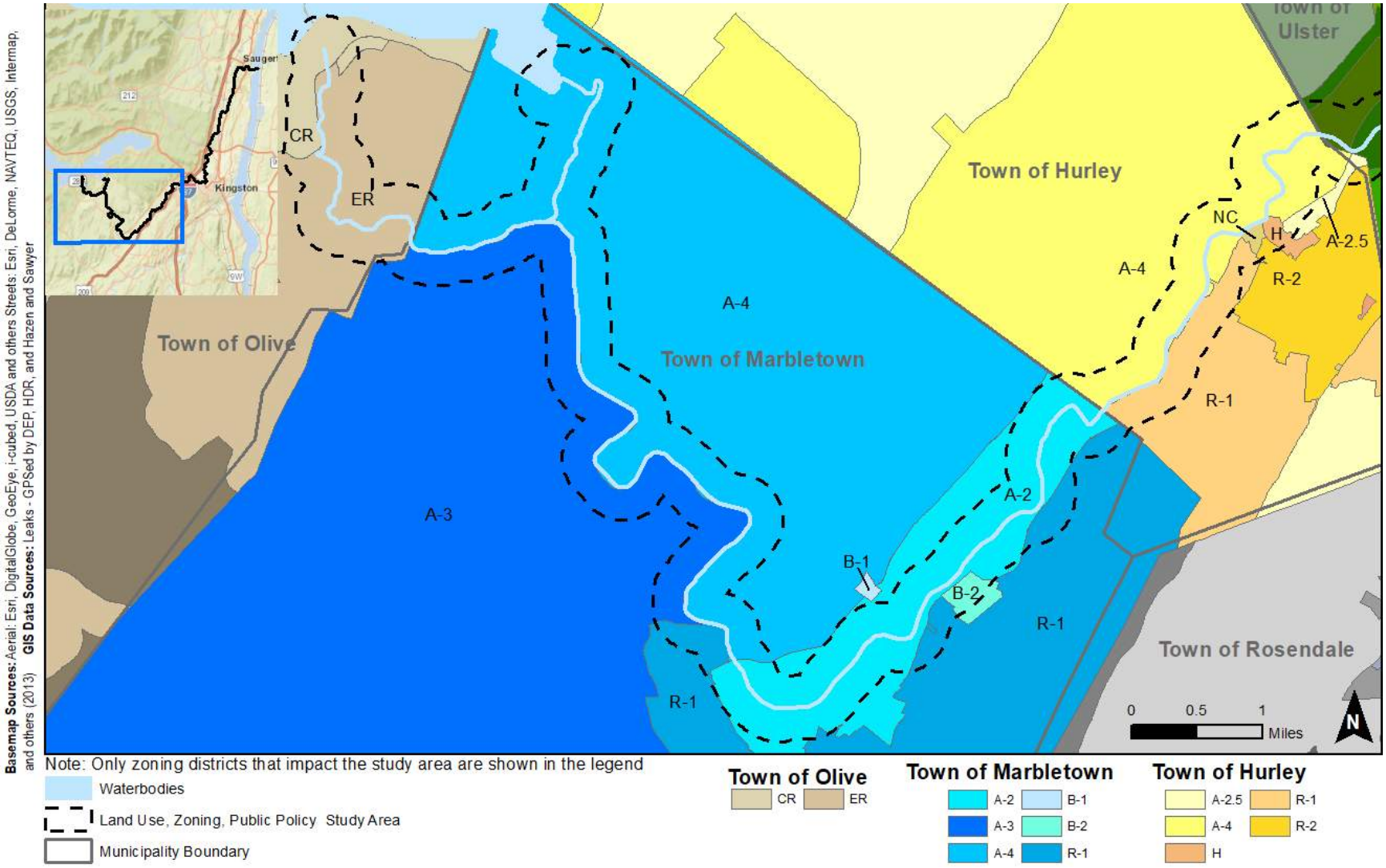


Figure 7.2-8
Lower Esopus Creek
Zoning Districts in Town of Olive, Town of Marbletown, and Town of Hurley

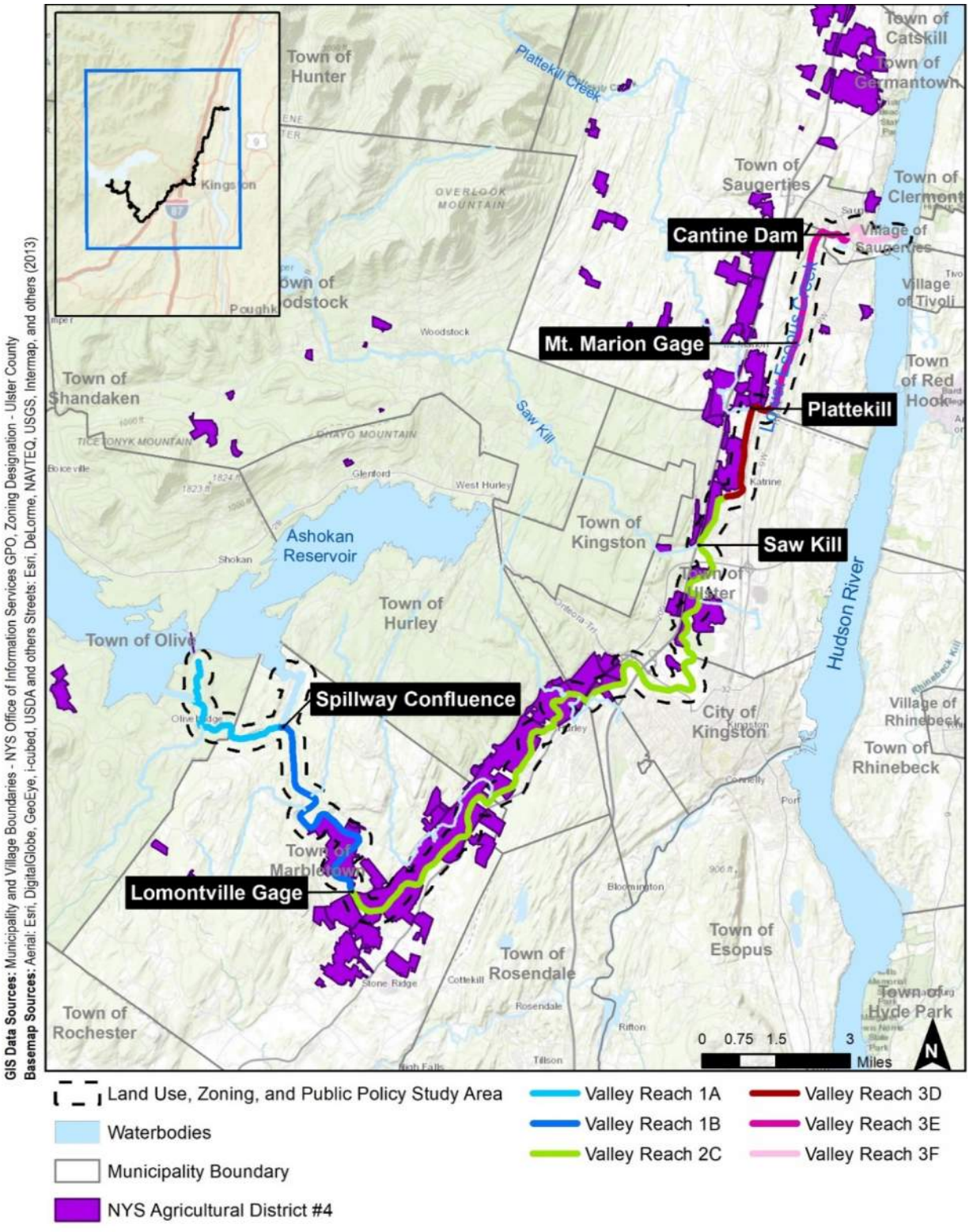


Figure 7.2-9
Lower Esopus Creek
Agricultural District Overlay

Town of Hurley

The Town of Hurley Zoning Code defines six zoning districts within the study area as shown on **Figure 7.2-8**. These districts are characterized as residential districts (A-4, A-2.5, R-1, R-2), historical (H), and neighborhood commercial (NC). A-4 districts are generally characterized as sensitive environmental areas such as the flats along lower Esopus Creek where special care is taken to limit disturbance from development. As a result, A-4 districts are very low-density residential areas. A-2.5 districts are also low-density residential areas which generally have the same sensitive environmental areas, and therefore, also limit development. R-1 districts include moderate-density residential at the periphery of the Town, while R-2 districts are medium-density residential located at the Town centers near community resources and commercial development. The historic district (H) includes a concentration of historic buildings and preserves the historical resources by ensuring new development is compatible with the existing structures. The NC district includes several small business areas such as retail and service uses.

City of Kingston

The City of Kingston Zoning Code defines nine zoning districts within the study area as shown on **Figure 7.2-10.** These districts are characterized as residential (R-1, R-5, R-6, RRR); commercial (C-1, C-2, C-3); and limited office (O-1, O-2). Zoning districts R-1 and RRR generally allow for single-family housing, while R-5 and R-6 are multiple residence districts. Commercial district C-1 includes shopping centers which allow for a range of low-density commercial uses. Commercial district C-2 is the central commercial district, and encourages a concentrated variety of retail, business, and service uses. Commercial district C-3, the general commercial district, provides a wide range of commercial and limited industrial uses along major arterials which require large parcels of land and may involve loud noises, trucking, and other activities that are not permitted in other districts.

Town of Ulster

The Town of Ulster Zoning Code defines six zoning districts within the study area as shown on **Figure 7.2-10**. These districts are characterized as residential districts (R-10, R-30, and R-60), office manufacturing (OM), highway commercial (HC), and industrial (I). The residential districts (R-10, R-30, and R-60) generally allow for single-family housing on varying plot sizes (10,000 square feet, 30,000 square feet, and 60,000 square feet, respectively). The HC district permits commercial uses dependent on State highway access for large volumes of traffic and extensive parking requirements. Industrial zoning districts allow for certain heavy industrial and other non-residential uses not permitted in other districts.

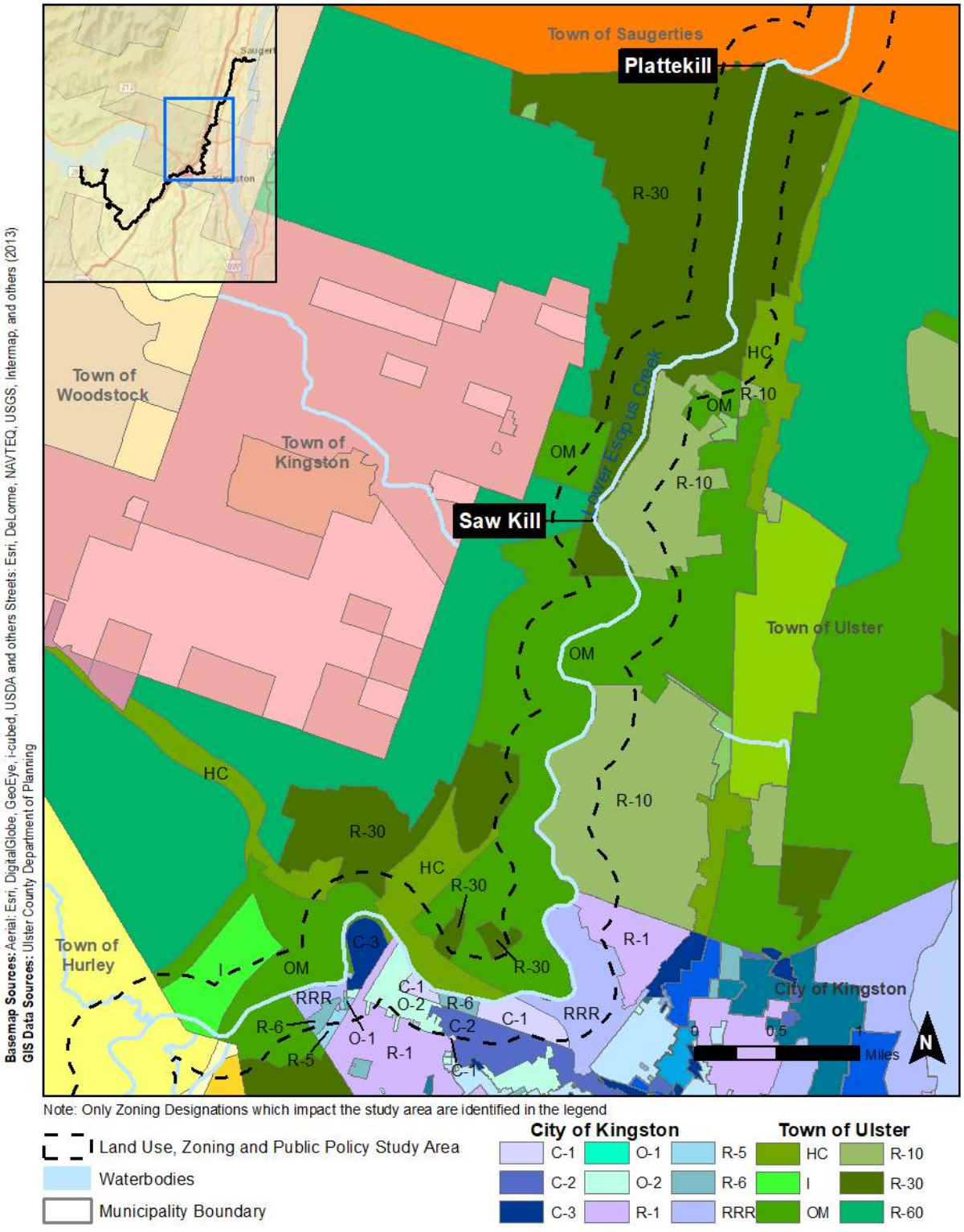


Figure 7.2-10
Lower Esopus Creek
Zoning Districts in the Town of Ulster and City of Kingston

Town of Saugerties

The Town of Saugerties Zoning Code defines six zoning districts within the study area as shown on **Figure 7.2-11**. These districts include medium-density residential (MDR), high-density residential (HDR), highway business (HB), general business (GB), office/light industrial (OLI), and industrial (I). The MDR district allows for flexible uses to promote residences in more rural environments that are also in close proximity to a variety of other land uses. The HDR district provides for concentrated suburban housing adjacent to plentiful community and recreational uses and allows for a variety of housing types. The GB district includes a variety of businesses, usually within 200 feet of highways with adequate traffic capacity, and the HB district includes businesses dependent on State highway access for large volumes of traffic and extensive parking requirements. The OLI district consists of industrial and office complexes with limited intensity imposed on these permitted uses and activities. Industrial zoning districts allow for certain heavy industrial and other non-residential uses not permitted in other districts.

Village of Saugerties

The Village of Saugerties Zoning Code defines eight zoning districts within the study area as shown in **Figure 7.2-11**. These districts are characterized as: residential districts (R-1, R-1W, R-2, R3, A); central business district (B-1); wetlands (W); and planned waterfront (PW). The primary property types within R-1 (single-family), R-1W (single-family waterfront), R-2 (one- and two-family), R3 (mixed residential), and A (very low density) are residential with one- and two-family homes. The central business district (B-1) permits business and residential uses to provide opportunities for diverse new developments while maintaining the character of the district. The planned waterfront (PW) district allows for flexible siting adjacent to lower Esopus Creek for water-related activities. The area zoned as wetlands (W) includes the Saugerties Lighthouse on the northern bank of lower Esopus Creek at its confluence with the Hudson River and is designed to limit uses and protect important environmental features. The lighthouse is also within the Waterfront Overlay District (WD), which includes properties located within 1,000 feet of the Hudson River's mean-high-water mark. The Town of Saugerties describes the purpose of the Waterfront Overlay District as "protect[ing] the water quality, floodways, shorelines, embankments and slopes of the Hudson River, Esopus Creek, and Plattekill Creek within the Town of Saugerties against erosion, filling, diversion or other land activities and development which will degrade property or public enjoyment of these unique resources" (§ 245-26 Waterfront Overlay District).

7.2.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP consulted with municipalities within the study area and Ulster County and has not been informed of any upcoming proposed projects that would affect public policy, zoning regulations, or land use planned or under development within the study area. Therefore, it is assumed that in the future without the Proposed Action, public policies, land use, and zoning regulations would stay the same as baseline conditions.

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

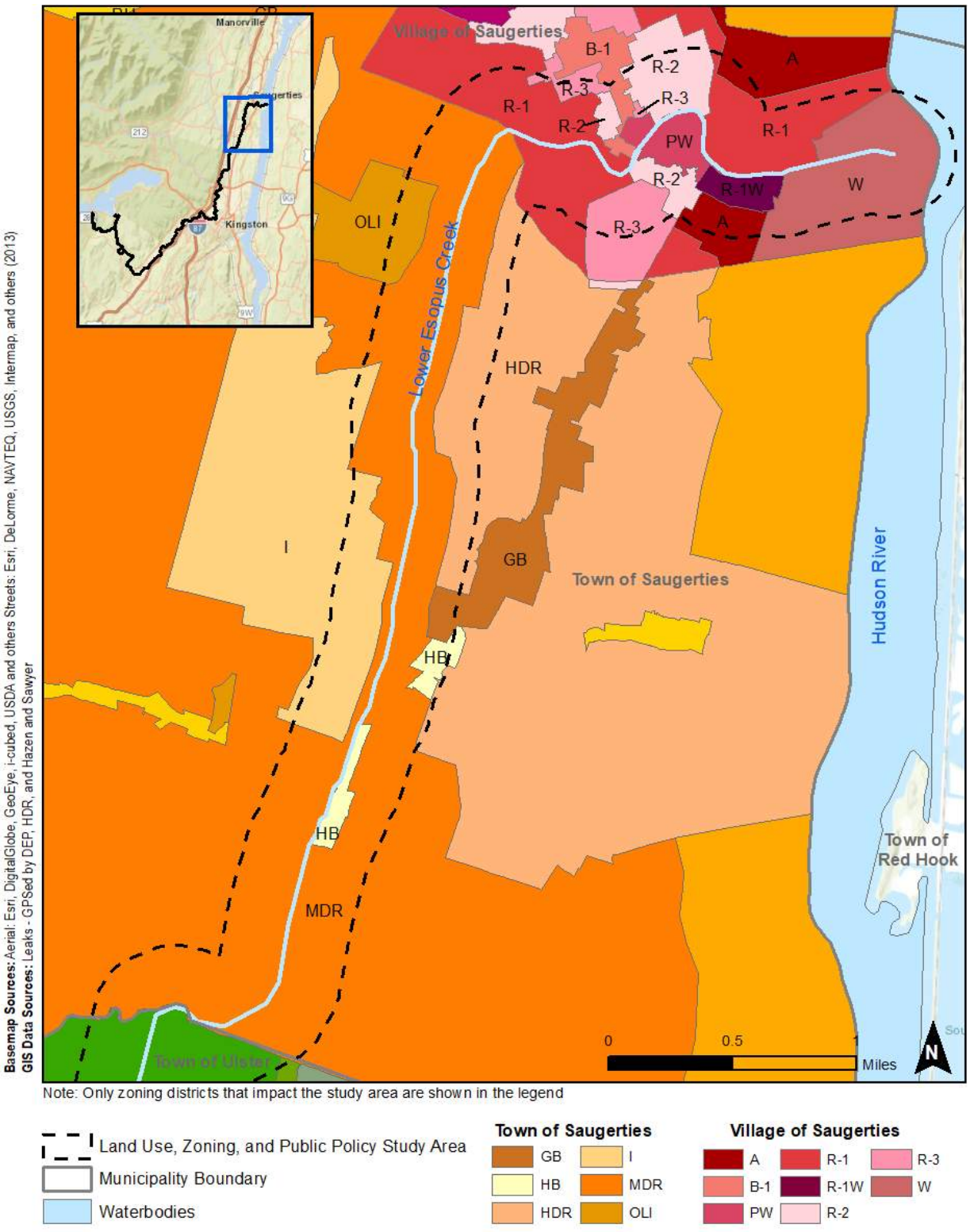


Figure 7.2-11
Lower Esopus Creek
Zoning Districts in Town of Saugerties and Village of Saugerties

7.2.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action. Turbidity levels in flows from Ashokan Reservoir would be similar between the future without and with the Proposed Action and would be within the range and variability of turbidity levels in lower Esopus Creek streamflow.

PUBLIC POLICY

The potential for impacts to public policy associated with the Proposed Action in the lower Esopus Creek study area is discussed below.

Federal

Coastal Zone Management Act (CZMA) of 1972

Since the CZMA establishes a framework for State and territorial coastal management programs, the consistency of the Proposed Action with the CZMA was analyzed under the New York State Coastal Management Plan and Local Waterfront Revitalization Program sections below.

Flood Disaster Protection Act of 1973

As discussed in Section 7.1.1, "Flow Regime and Water Quality in Lower Esopus Creek," the Proposed Action would reduce the number, magnitude and duration of spill events by proactively managing the Ashokan Reservoir water level with releases to meet the CSSO and converting shorter duration, higher streamflow events into longer duration, lower streamflow events. Furthermore, operation of the Reservoir in accordance with the IRP in the future with the Proposed Action would require DEP to throttle releases as necessary so that the combined flow from Ashokan Reservoir (spill and release) does not exceed 1,000 MGD (1,547 cfs). The IRP also requires all releases from Ashokan Reservoir to cease when the Mount Marion gage is within one foot of the flood Action Stage and forecasted to reach flood Action Stage. Finally, as described in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," streamflow in the range of releases in the Proposed Action would not result in flooding. In addition, the EIS is not intended to provide flood frequency estimates for other uses such as floodplain mapping, which must be conducted by FEMA. Therefore, the Proposed Action would be consistent with this Act.

State

Coastal Management Plan

As shown in **Figure 7.2-2**, the portion of the study area that falls within the coastal zone management boundary is located within Valley Reach 3F. However, Valley Reach 3F is downstream of Cantine Dam and is tidally influenced by the Hudson River. These tidal flows are the key driver of the flow regime within Valley Reach 3F. Therefore, the Proposed Action would not affect the goals of the Coastal Management Plan.

New York Rising Community Reconstruction Program

The general goals of the NYRCR Program involve shoreline defense, erosion control, and park restoration. As discussed in Section 7.4, "Open Space and Recreation," the Proposed Action would not affect open space or park restoration activities. As discussed in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," erosion along the lower Esopus Creek would be comparable between the future without and with the Proposed Action. Therefore, the Proposed Action would be consistent with this plan.

Local

Ulster County Open Space Plan

The potential effects of the Proposed Action were evaluated for compatibility with the three applicable principles of the Ulster County Open Space Plan and it was determined that the Proposed Action would be consistent with this plan for the following reasons:

- As discussed in Sections 7.7 through 7.9 describing natural resources, Section 7.4, "Open Space and Recreation," Section 7.5, "Historic and Cultural Resources," and Section 7.6, "Aesthetic (Visual) Resources," the Proposed Action would not cause significant adverse impacts to natural resources, open space and recreation, aesthetic (visual) resources, heritage sites, or rural areas within the study area. In the future with the Proposed Action, the community release would provide a potential benefit to natural resources and open space and recreation by providing sustained flow to lower Esopus Creek year-round.
- As discussed in Section 7.1, "Water Resources and Water Quality," the Proposed Action would not result in significant adverse impacts to water resources.
- As discussed in Section 7.4, "Open Space and Recreation," the Proposed Action would not cause significant adverse impacts to open space or natural features within the study area.

Therefore, the Proposed Action would be consistent with this plan.

Marbletown Town Plan

The potential effects of the Proposed Action were evaluated for compatibility with the three goal categories of the Marbletown Town Plan that are relevant to the Proposed Action. It was determined that the Proposed Action would be consistent with these goals for the following reasons:

- As discussed in Section 7.4, "Open Space and Recreation," and Section 7.8, "Wetlands and Floodplain Forests," impact assessment, the Proposed Action would not cause significant adverse impacts to wetlands within the study area or the recreational use of open spaces within the study area. In the future with the Proposed Action, the community release would provide a potential benefit to natural resources and open space and recreation by providing sustained flow to lower Esopus Creek year-round. Therefore, the Proposed Action would be consistent with this goal.
- The future with the Proposed Action would provide enhanced flood attenuation compared to the future without the Proposed Action by proactively managing the Ashokan Reservoir water level with releases to meet the CSSO. The Proposed Action would also provide sustained flow in the study area year-round through the community release. The rural character of the Town would not be affected by the Proposed Action. Therefore, the Proposed Action would be consistent with this goal.
- As discussed in Section 7.5, "Historic and Cultural Resources," the Proposed Action would not cause significant adverse impacts to any historic or cultural resources within the study area. Therefore, the Proposed Action would be consistent with this goal.

Town of Hurley Comprehensive Plan

The Town of Hurley Comprehensive Plan goals relevant to the Proposed Action were reviewed for consistency with the Proposed Action:

- As discussed in Section 7.1, "Water Resources and Water Quality," the Proposed Action would not cause significant adverse impacts to water resources. As described in Sections 7.7 through 7.9, the community release would provide a potential benefit to natural resources in the future with Proposed Action as compared to the future without the Proposed Action by providing sustained flow to lower Esopus Creek year-round.
- As discussed in Section 7.5, "Historic and Cultural Resources," the Proposed Action would not cause significant adverse impacts to any historic or cultural resources within the study area.
- As discussed in Section 7.4, "Open Space and Recreation," the Proposed Action would not cause significant adverse impacts to open spaces or recreational areas. In the future with the Proposed Action, the community release would provide a potential benefit to open space and recreation by sustaining flow to lower Esopus Creek year-round.

The relevant goals from the Town of Hurley's Open Space Plan were also reviewed for consistency with the Proposed Action:

- As discussed in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," Valley Reach 2C, where the Town of Hurley is located, is susceptible to erosion. However, as noted above, erosion along lower Esopus Creek would be comparable between the future without and with the Proposed Action. Therefore, the Proposed Action would be consistent with the plan's Natural Resources goals (NR.1 and NR.2).
- The community release under the Proposed Action would have the potential to benefit public access to lower Esopus Creek by providing year-round sustained flow to lower Esopus Creek. As discussed in Section 7.5, "Historic and Cultural Resources," the Proposed Action would not cause significant adverse impacts to any historic or cultural resources within the study area. Therefore, the Proposed Action would be consistent with the plan's Recreational and Historic Resources goal (RH.1).

Town of Ulster Comprehensive Plan

The relevant goals outlined above in the Town of Ulster Comprehensive Plan were reviewed for consistency with the Proposed Action. The Proposed Action would be consistent with all applicable goals for the following reasons:

- As discussed in Section 7.4, "Open Space and Recreation," the Proposed Action would not cause significant adverse impacts to waterfront resources or public access to open spaces within the study area and the community release would provide a benefit of sustained flow to lower Esopus Creek year-round. Therefore, the Proposed Action would be consistent with the goal related to enhancing public access and protection of waterfront lands.
- As discussed in Sections 7.7 through 7.9 which describe natural resources, the Proposed Action would not cause significant adverse impacts to natural riparian resources within the study area. As discussed in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," erosion would be comparable between the future without and with the Proposed Action. Therefore, the Proposed Action would be consistent with the goal related to creating Riparian Protection Zones along lower Esopus Creek.
- A Local Waterfront Revitalization Plan has not yet been developed by the Town of Ulster and, therefore, does not apply to the Proposed Action.

City of Kingston Comprehensive Plan, Kingston 2025: A Plan for the City of Kingston

The following goals related to the protection of natural resources and open space within the City of Kingston directly relate to lower Esopus Creek and were reviewed for consistency with the Proposed Action:

- The future with the Proposed Action would consist of changes in streamflow in the study area which have the potential to affect flooding and riparian zones. Assessments have been conducted, consistent with this strategy, and differences between the future without and with the Proposed Action would not contribute to flooding or alter riparian zones as described in Section 7.1, "Water Resources and Water Quality."
- As discussed in Sections 7.7 through 7.9, which evaluate potential impacts and benefits of the Proposed Action on natural resources in the study area and Section 7.4, "Open Space and Recreation," the Proposed Action would not significantly adversely impact natural resources or open spaces within the study area.

Village of Saugerties - Local Waterfront Revitalization Program (LWRP)

Specific LWRP policies relevant to the Proposed Action were reviewed. The Village of Saugerties is located in Valley Reaches 3E and 3F. As noted in Section 6.2, "Operation of Ashokan Reservoir in Accordance with the IRP," effects of the Proposed Action would diminish moving downstream from Ashokan Reservoir. Furthermore, Valley Reach 3F is downstream of Cantine Dam and is tidally influenced by the Hudson River. These tidal flows are the key driver of the flow regime within Valley Reach 3F. Therefore, the Proposed Action would not affect the relevant policies of the LWRP.

LAND USE AND ZONING

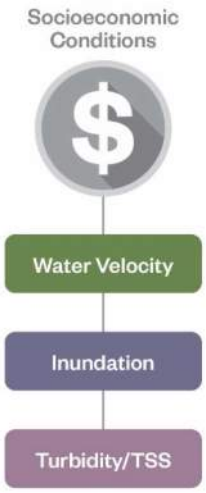
No construction activities would be associated with the Proposed Action in the study area. As discussed in Section 7.1, "Water Resources and Water Quality," erosion would be comparable between the future without and with the Proposed Action. Furthermore, the Proposed Action would provide a sustained flow to lower Esopus Creek year-round, and would enhance flood attenuation by proactively managing the Reservoir water level with releases to maintain the CSSO. Therefore, the Proposed Action is not anticipated to result in significant adverse impacts to the surrounding land uses or zoning districts within the study area.

CONCLUSIONS

Public policies within the study area have been established to protect communities from flooding, maintain the character and recreational opportunities of the communities along lower Esopus Creek, maintain the integrity of historic resources, and limit erosion and disturbance of natural resources. The Proposed Action would provide a flood protection benefit by reducing the number, magnitude and duration of spill events from Ashokan Reservoir. Furthermore, operation of the Reservoir in accordance with the IRP in the future with the Proposed Action would require DEP to throttle releases as necessary so that the combined flow from Ashokan Reservoir (spill and release) does not exceed 1,000 MGD (1,547 cfs). In addition, the IRP requires all releases from Ashokan Reservoir to cease when the Mount Marion gage is within one foot of the flood Action Stage and forecasted to reach flood Action Stage. Streamflow in the range of releases in the future with the Proposed Action would not result in inundation of structures (flooding). Erosion between the future without and with the Proposed Action would be comparable. From a natural resources and recreational perspective, the Proposed Action would provide a benefit of sustained flow to lower Esopus Creek year-round. No significant adverse impacts related to cultural and historic resources are anticipated as a result of the Proposed Action. Therefore, the Proposed Action is consistent with public policies within the study area. The Proposed Action would not involve construction or cause changes to land use or zoning. Therefore, there are no anticipated significant adverse impacts to the lower Esopus Creek study area public policy, land use, and zoning as a result of the Proposed Action.

7.3 SOCIOECONOMIC CONDITIONS

The socioeconomic conditions of an area include its population, housing, and economic activities. This assessment describes the existing socioeconomic conditions for the lower Esopus Creek study area, including housing characteristics, employment, and commercial and agricultural businesses, and evaluates the potential for the Proposed Action to result in effects on the local economy.



Many businesses located within the study area have a portion of their revenue that can be influenced by recreational use and/or the aesthetic qualities of lower Esopus Creek, either seasonally or year-round (e.g., lodging, campgrounds, restaurants). As described further in Section 7.4, "Open Space and Recreation," lower Esopus Creek is the predominant recreational resource in the study area. It provides a number of recreational opportunities such as fishing, swimming, and boating to residents and visitors. As a result, changes in resident spending relative to lower Esopus Creek recreational activities may have the potential to influence the socioeconomic conditions of the study area.

As discussed in Section 7.1, "Water Resources and Water Quality," the operation of Ashokan Reservoir in accordance with the IRP in the future with the Proposed Action has the potential to affect the seasonal magnitude, frequency, and duration of streamflow within lower Esopus Creek and its quality. However, these differences in streamflow and water quality conditions would be comparable between the future without and with the Proposed Action. Further, the influence of flows from Ashokan Reservoir would diminish moving downstream due to other inputs of flow to lower Esopus Creek. This assessment was conducted to evaluate whether the Proposed Action would result in potential effects on socioeconomic conditions within the study area.

7.3.1 BASELINE CONDITIONS

The socioeconomic conditions assessment evaluated the potential for the Proposed Action to result in socioeconomic benefits and impacts to residents and businesses within a 0.5-mile corridor on either side of lower Esopus Creek.[28] Available data from the 12 census tracts that border lower Esopus Creek provided context for the economic conditions within the study area (**Figure 7.3-1**). Demographic information was obtained from U.S. Census Bureau and American Community Survey data for the years 2010 and 2017.

POPULATION/DEMOGRAPHICS

Within the 12 census tracts surrounding lower Esopus Creek, the total population stayed relatively constant from 2010 to 2017, decreasing from 41,454[29] to 41,286[30] people. Ulster County's population also decreased from 182,493 in 2010 to 180,127 in 2017. From 2010 to 2017, the demographic group composition of the population within the 12 census tracts became more diverse (**Table 7.3-1**).

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[28] Note that portions of the socioeconomic assessment also focused on a corridor within the study area adjacent to lower Esopus Creek (i.e., within 500 feet) as discussed in Section 5.3.3, "Socioeconomic Conditions" methodology.

[29] 2010 U.S. Census Bureau Decennial Census, Table P9

[30] 2012 – 2017 American Community Survey 5-Year Estimates, Table B03002

Table 7.3-1. Demographics within the 12 Census Tracts

	2010		2017	
Demographic Group	**Population**	**% of Total Population**	**Population**	**% of Total Population**
Non-Hispanic White	36,542	88.2	33,819	81.9
Hispanic or Latino	2,127	5.1	3,368	8.2
Black or African American alone	1,116	2.7	1,572	3.8
Asian alone	726	1.8	1,112	2.7
Native Hawaiian and other Pacific Islander alone	6	0.01	102	0.2
American Indian and Alaska Native alone	87	0.2	65	0.2
Some other race alone	62	0.1	105	0.3
Two or more races	788	1.9	1,143	2.8
Total Population	41,454	100	41,286	100

Sources: U.S. Census Bureau, 2010 Census; U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates, Table B03002 (published in 2018)

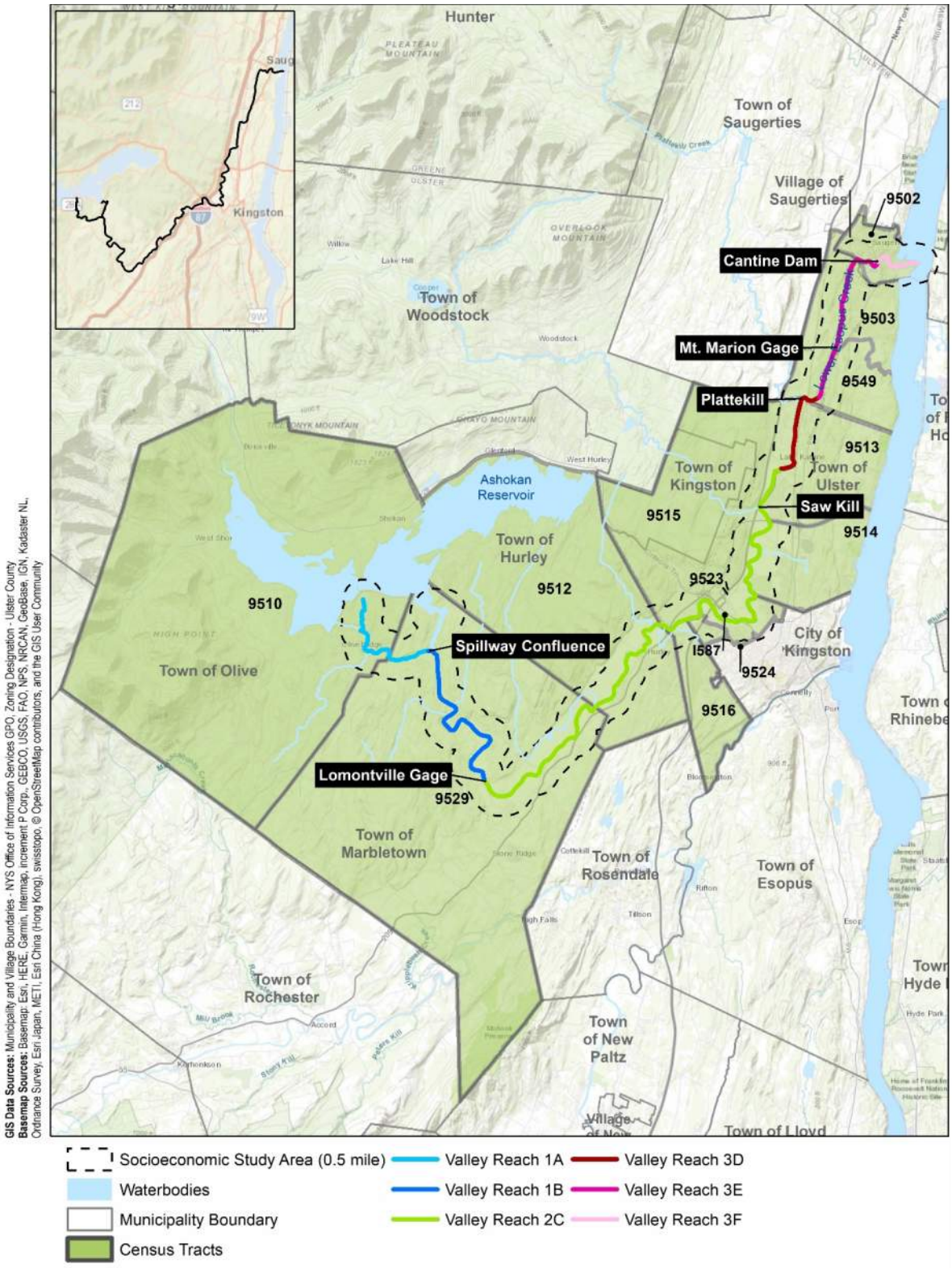

Figure 7.3-1
Lower Esopus Creek
12-Census Tracts

HOUSING, INCOME, AND EMPLOYMENT

HOUSING STOCK

According to the most recent New York State Office of Real Property Tax Services parcel-level data there were approximately 1,740 housing units within a 500-foot corridor adjacent to either side of lower Esopus Creek. **Table 7.3-2** summarizes the various types of residential housing within this corridor.

Table 7.3-2. Housing Stock Adjacent to Lower Esopus Creek by Type

Property Class	Assessor's Code	Parcels	Units	Unit Count Method
Single-Family				
One-Family Year-Round Residence	210	631	631	One unit per parcel
Seasonal Residences	260	29	29	One unit per parcel
Mobile Home	270	19	19	One unit per parcel
Primary residential, also used in agricultural production	241	4	4	One unit per parcel
Estate	250	1	1	One unit per parcel
Total Single-Family	NA	**684**	**684**	
Multifamily				
Apartments	411	11	807	Unit counts verified online
Mobile Home Parks	416	4	118	Unit counts verified online
Two-Family Year-Round Residence	220	33	66	Two units per parcel
Rural Residence with Acreage	240	18	36	According to Assessor's Manual, may have between 1-3, mean (2) assumed
Three-Family Year-Round Residence	230	6	18	Three units per parcel
One-Family Year-Round Residence with Accessory Apartment	215	4	8	Two units per parcel
Residence with Incidental Commercial Use	283	1	3	Unit counts verified online
Total Multifamily	NA	**77**	**1,056**	
Total	NA	**761**	**1,740**	

Note:
NA – Not applicable
Source: Data compiled from NYS Office of Real Property Tax Services parcel-level data, residential properties within 500 feet of lower Esopus Creek from 2007 through 2017. Obtained via request in March of 2018 and 2019.

HOUSING PRICES

Housing prices were obtained for properties within a 0.5 mile of lower Esopus Creek between 2010 and 2017. **Table 7.3-3** provides a summary of this information, including prices for homes along the lower Esopus Creek waterfront.

Table 7.3-3. Housing Prices Within the Study Area

Assessment Year[1]	Within 0.5 Mile of Lower Esopus Creek			Properties Along the Lower Esopus Creek Waterfront[3]		
	Number of Homes	Average Price (Nominal Dollars)[2]	Median Price (Nominal Dollars)	Number of Homes	Average Price (Nominal Dollars)[1]	Median Price (Nominal Dollars)
2010	358	$199,100	$186,529	145	$212,696	$189,500
2011	358	$198,462	$186,750	145	$210,856	$186,000
2012	358	$190,564	$176,537	145	$205,300	$178,000
2013	357	$187,251	$170,500	145	$201,655	$172,619
2014	359	$187,806	$170,750	144	$202,694	$175,482
2015	357	$187,297	$171,083	144	$201,086	$175,537
2016	357	$188,519	$170,500	143	$204,240	$176,942
2017	356	$193,312	$174,761	142	$211,980	$181,765

Notes:
1 Parcels are assessed the year before tax roll publication year. This column cites the year of assessment. Publication year is the assessment year plus one. For example, parcels are assessed for the 2018 tax roll in 2017.
2 Nominal dollars are the dollar value of the assessment year (i.e., they are not adjusted to current dollars).
3 Waterfront properties are those on or across the street from the waterfront adjacent to either side of lower Esopus Creek.
Source: Data compiled by the New York State Department of Tax and Finance's Office of Real Property Tax Services (NYS-ORPS). Accessed March 2018, updated August 2018.

MEDIAN HOUSEHOLD INCOME

Median Household Income (MHI) data obtained for the study area and Ulster County provide context for the economic conditions of the region. Dollar values are presented in nominal dollars. According to the American Community Survey 2013-2017 5-Year Estimates (i.e., a supplemental survey conducted by the U.S. Census Bureau every five years focused on social, economic and demographic characteristics) in 2017, the MHI for Ulster County was $61,652, which is below the New York State MHI of $62,765. However, within the census tracts that border lower Esopus Creek (**Figure 7.3-1**), the MHI varied widely, ranging from $36,156 in the Town of Ulster (Census Tract 9514) to $78,561 in the Town of Hurley (Tract 9512). Four of the tracts (including the Town of Hurley) had MHIs above that of the State, ranging

between $64,000 to $79,000. The other eight fell below the State New York State MHI, with values ranging from approximately $36,000 to just under the New York State MHI.[31]

RESIDENT EMPLOYMENT

According to the American Community Survey 2013-2017 5-Year Estimates, of the 41,286 residents in the 12 census tracts, approximately 20,200 residents were employed in 2017. Approximately 32 percent of these residents were employed in the Education, Health and Social Services sector. Another approximately 14 percent of the employed residents worked in Retail Trade, and approximately nine percent worked in the Arts and Hospitality sector which includes hotels, restaurants, the arts, and entertainment. A total of approximately 33 percent of employed Ulster County residents worked in the following fields combined: professional services (approximately seven percent), manufacturing (approximately seven percent), construction (approximately five percent), finance/insurance/real estate (approximately eight percent) and public administration (six percent). The remaining 12 percent worked in various other sectors including agriculture, information, transportation and utilities.

In 2017, the labor force participation rate, averaged across the 12 census tracts measured as the percent of the working age population that is employed or actively looking for work, was approximately 64 percent. The employment ratio averaged across the 12 census tracts (i.e., the number of employed residents as a percentage of the working age population) was approximately 60 percent.

ECONOMIC ACTIVITIES

BUSINESSES

In 2015, the businesses within the 12 census tracts provided approximately 21,000 jobs according to the U.S. Census Bureau Longitudinal Employer-Household Dynamics (LEHD) data (the most recent data available). Most of the jobs within the census tracts were located in the City of Kingston and the Town of Ulster. Jobs in the following five sectors accounted for about 63 percent of all jobs in the census tracts, distributed approximately as follows:

1. Retail trade (22 percent)
2. Healthcare and social assistance (13 percent)
3. Educational services (10 percent)
4. Accommodation and food services (9 percent)
5. Public administration (9 percent)

Based on an analysis of parcel-level data from the NYS Office of Real Property Tax Services, 16 were identified that have the potential to be economically dependent on lower Esopus Creek (e.g., lodging, campgrounds, restaurants, and public recreational facilities) and are shown in **Table 7.3-4** and **Figure 7.3-2**. Many of these businesses are concentrated around urban centers, including the City of Kingston and the Village of Saugerties. There were no businesses identified along the upstream reaches (Valley Reaches 1A and 1B) that have the potential to be economically dependent on lower Esopus Creek. Within the remainder of the study area, businesses were distributed as follows:

[31] Sources: U.S. Census Bureau, 2010 Census; U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates, Table B19013 (published in 2018)

- A majority of the commercial facilities within the study area were concentrated in the City of Kingston along Valley Reach 2C, the Town of Ulster along Valley Reaches 2C and 3D, and the Town and Village of Saugerties along Valley Reaches 3E and 3F.
- Public recreation and entertainment facilities were more prevalent in the City of Kingston (Valley Reach 2C) and the Town and Village of Saugerties (Valley Reaches 3E and 3F).

AGRICULTURE

In Ulster County, there are a total of approximately 59,000 acres of agricultural land. Farms within the study area represent approximately 3,025 acres of agricultural land. These farms represent approximately five percent of all farmland in Ulster County, according to a 2017 Census of Agriculture County Data published by the U.S. Department of Agriculture (USDA). As shown in **Figure 7.3-2**, most of the farms are located along Valley Reach 2C. Agricultural uses of the farms range from fruit and vegetable production to horse farms.

According to the 2017 Census of Agriculture, the market value of farm products (crops and livestock) produced during the 2017 calendar year within Ulster County was approximately $54.3 million. Assuming that the agricultural land in the study area has a proportional share of Ulster County's agricultural revenue, the gross value of crops and livestock produced in the study area was estimated to be approximately $2.8 million per year.

Table 7.3-4. Businesses Within the Study Area with the Potential to be Economically Dependent on Lower Esopus Creek

Label Number (Figure 7.3-2)	Sector	Business Name	Description	Location
Businesses along Valley Reach 2C				
1	Commercial	The Hurley Mountain Inn	Restaurant, sports bar and nightclub	Valley Reach 2C, Town of Hurley
2	Commercial	Best Western Plus Kingston Hotel and Conference Center	Hotel located along lower Esopus Creek	Valley Reach 2C, City of Kingston
3	Commercial	Super 8 Hotel	Hotel located near lower Esopus Creek	Valley Reach 2C, City of Kingston
4	Recreation	Alapaha Golf Links	Par 3-4 golf course with views of lower Esopus Creek	Valley Reach 2C, City of Kingston
5	Recreation	Green Acres Golf Club	Public golf course located along lower Esopus Creek	Valley Reach 2C, City of Kingston
Businesses along Downstream Reaches (3D, 3E, 3F)				
6	Recreation	NA (unknown campsite)	Parcel classified as a campsite along lower Esopus Creek; no additional information about the business was readily available	Valley Reach 3D, Town of Ulster
7	Recreation	Esopus Bend Nature Preserve	Public park and hiking facility with panoramic views of lower Esopus Creek	Valley Reach 3E, Village of Saugerties
8	Commercial	Tokyo Station	Japanese restaurant with views of lower Esopus Creek	Valley Reach 3E, Village of Saugerties
9	Recreation	I Paddle New York	Canoe and kayak rental service located within walking distance of Saugerties Village Beach	Valley Reach 3E, Village of Saugerties
10	Recreation	Saugerties Village Beach	Beach on lower Esopus Creek with playground, changing facilities, and fixed rafts in lower Esopus Creek for diving	Valley Reach 3E, Village of Saugerties
11	Commercial	Diamond Mills Hotel & Tavern at Diamond Mills	High-end hotel with restaurant and convention center located on Esopus Falls with outdoor seating and views of lower Esopus Creek	Valley Reach 3F, Village of Saugerties
12	Commercial	Saugerties Steamboat Co	Full-service special event venue and boatyard	Valley Reach 3F, Village of Saugerties
13	Commercial	Black Swan Sailing	Operates on lower Esopus Creek and the Hudson	Valley Reach 3F, Village of Saugerties
14	Recreation	Saugerties Marina	Full-service marina including fuel, dockage, boat and kayak rentals, and a fishing tackle and bait shop	Valley Reach 3F, Village of Saugerties
15	Recreation	Saugerties Lighthouse	Bed and breakfast located where lower Esopus Creek meets the Hudson River	Valley Reach 3F, Village of Saugerties

Note:
One additional public recreational facility, Marbletown Beach, is located along Valley Reach 1B.
Sources: NYS Office of Real Property Tax Services parcel-level data, obtained via formal request in March of 2019.
NA – Not applicable

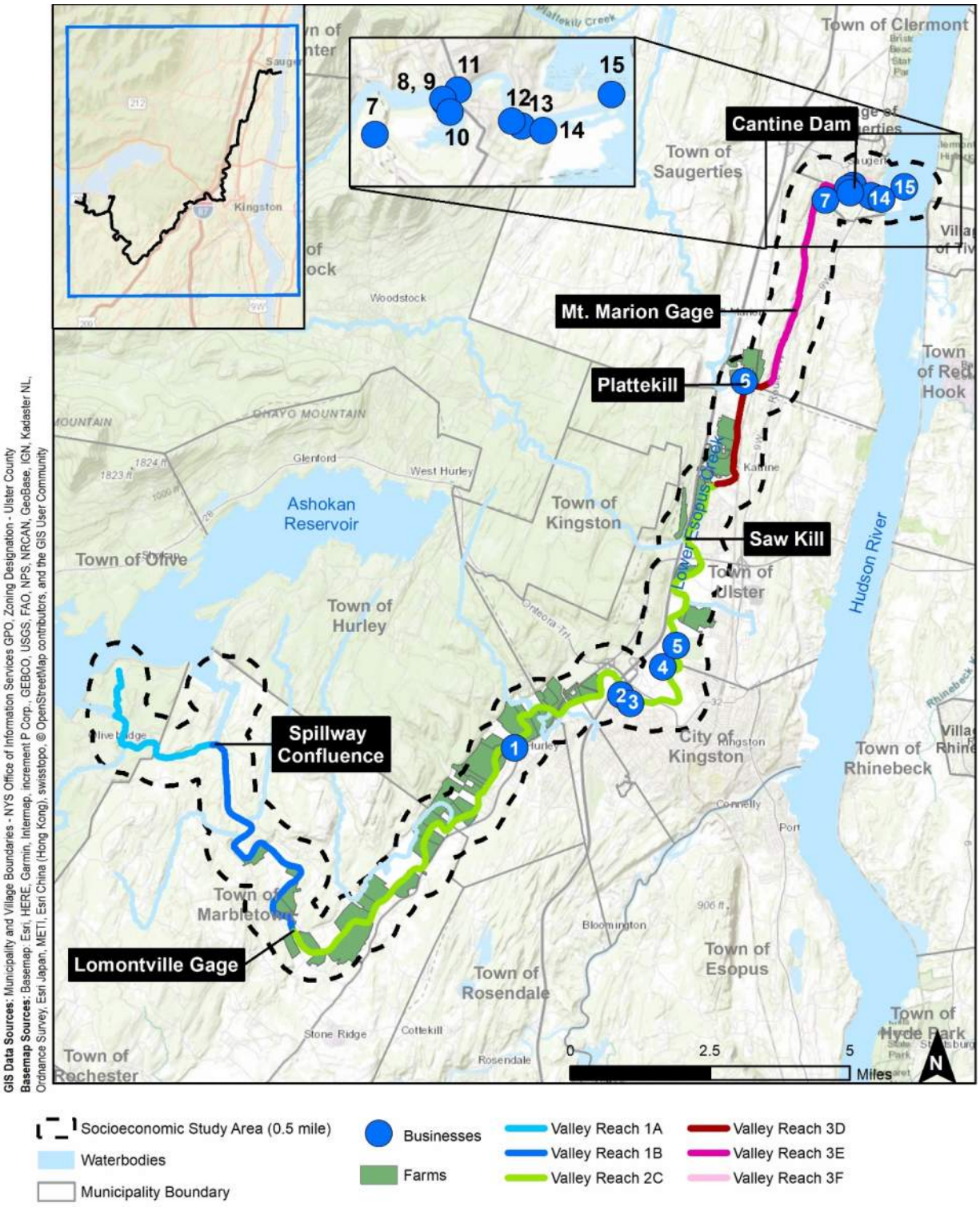

Figure 7.3-2
Lower Esopus Creek
Businesses and Farms within the Socioeconomic Study Area

7.3.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP consulted with the municipalities within the study area and Ulster County and has not been informed of any upcoming new projects within the study area. In addition, there were no reports of any changes in public policy, zoning regulations, or land use that would affect socioeconomic conditions within the study area

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on flows from the contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

7.3.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1.1, "Flow Regime and Water Quality in Lower Esopus Creek"). Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring.

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Releases up to 600 MGD (928 cfs) in the future with the Proposed Action are anticipated to have a potential to affect lower Esopus Creek through the downstream end of Valley Reach 2C. Many residents, a majority of the farms, and some businesses in the study area are located along this reach. Most of the residents and a majority of the businesses in the study area are located along Valley Reaches 3D and 3E, where differences in streamflow and water quality between the future without and with Proposed Action would diminish. A number of businesses and residents are located along Valley Reach 3F, which is tidally influenced. Therefore, these businesses and residents are not anticipated to be affected by the Proposed Action.

Upstream of the spillway confluence, in Valley Reach 1A, the contribution of the community release to lower Esopus Creek streamflow would be the greatest. In the future without the Proposed Action, there would be no flows to Valley Reach 1A from Ashokan Reservoir. Therefore, differences between the future without and with the Proposed Action would have the greatest potential to affect this portion of lower Esopus Creek. However, there are no public recreation opportunities in Valley Reach 1A. Only a few private homes and the Ashokan Center are located along this valley reach, and there are no businesses that potentially rely on lower Esopus Creek for revenue located along this portion of lower Esopus Creek.

To further investigate the potential for indirect and direct socioeconomic effects of differences in lower Esopus Creek streamflow in the future with the Proposed Action, further evaluation was conducted based on:

(1) results of an analysis of housing prices of single-family homes in the study area; and

(2) a socioeconomic questionnaire distributed to businesses (e.g., lodging, retail, farms, and marinas), parks, and residents within the study area. Socioeconomic survey questions for businesses, parks, and residents are provided in **Appendix B**. In addition to qualitative assessment of the socioeconomic survey results, resident questionnaire responses were used as

inputs to IMPLAN modeling, which was performed to determine if potential effects to annual expenditures resulting from anticipated changes to recreational activity between the future without and with the Proposed Action would affect the Ulster County economy.

As noted in Section 5.3.1, "Water Resources and Water Quality" methodology, any changes to Flood Insurance Rate Maps (FIRMs) for insurance purposes would be determined by the Federal Emergency Management Agency (FEMA) and would be separate and distinct from any flooding and inundation analyses conducted under this EIS.

HOUSING PRICE ANALYSIS

There are homes located along the length of lower Esopus Creek (i.e., along all of the valley reaches). Therefore, a housing price analysis was conducted to determine if housing prices were affected by conditions within lower Esopus Creek (see Section 5.3.3, "Socioeconomic Conditions" methodology). To determine this, the rate of change in housing prices was evaluated and compared for the time periods before and after 2013 when the IRP was implemented. As discussed in Section 5.3.3, "Socioeconomic Conditions" methodology, the housing price analysis compared the market value of homes along the lower Esopus Creek waterfront, as determined by Ulster County property assessors, to the market value of single-family homes located within a 0.5 mile of lower Esopus Creek and along the nearby Rondout Creek waterfront (**Table 7.3-5**).[32,33] To investigate whether potential changes in housing prices were attributable to conditions within lower Esopus Creek or Rondout Creek, adjustments were made to account for differences in market value that may have been attributable to other site-specific characteristics of homes (e.g., lot size, building condition, presence of a pool, sewer type, effective year built). Across the full time period evaluated (2007 through 2017), the average annual rate of change in the nominal market value of single-family homes between each area was relatively similar, decreasing at a rate of approximately three percent. The average annual rate of change in the nominal market value of single-family homes the lower Esopus Creek waterfront was also similar to those within a 0.5 mile of lower Esopus Creek and on the Rondout Creek waterfront for the other time periods evaluated: 2007 to 2013 and 2013 to 2017. The average annual rate of change in the nominal market value of single-family homes indicated that external economic factors (e.g., 2008 financial crisis) were the potential drivers for the initial loss and the subsequent recovery of the market value of single-family homes during the full time period evaluated. Based on the analysis, it was concluded that conditions within lower Esopus Creek did not have an observable effect on single-family home housing prices from 2007 through 2017.

[32] The market value of a property is estimated using actual sale prices of similar homes and characteristics of the property. An assessed value is for tax purposes and is usually lower than the market value.

[33] Market value and housing characteristic data of 550 homes within 2,500 feet of lower Esopus Creek and Rondout Creek from 2007 to 2017 were obtained from data compiled by the New York State Office of Property Tax Services (NYS-ORPS) via formal request in March 2018 and January 2019.

Table 7.3-5. Average Annual Rate of Change in Nominal Market Value of a Single-Family Home

	Properties Along the Lower Esopus Creek Waterfront	Properties within a 0.5 mile of Lower Esopus Creek	Properties Along the Rondout Creek Waterfront
Time Period	**Percent Change**		
Average (2007 to 2013)	-3.30%	-3.29%	-3.42%
Average (2013 to 2017)	1.27%	0.41%	1.37%
Average (2007 to 2017)	-1.47%	-1.81%	-1.51%

Sources: Data compiled by New York State Department of Tax and Finance's Office of Real Property Tax Services (NYS-ORPS) for single-family homes from 2007 through 2017. Obtained in March of 2018 and March 2019 via request from Ulster County Information Services.

SOCIOECONOMIC SURVEY RESULTS

In fall 2018, approximately 2,900 questionnaires were mailed to residents and businesses within the study area. As described in Section 5.3.3, "Socioeconomic Conditions" methodology, photos of various streamflow and water quality conditions that are reasonably anticipated to occur in the future without and with the Proposed Action within lower Esopus Creek were presented in the questionnaires. These photos were used by respondents to determine the extent each condition would potentially affect their participation in recreational activities along lower Esopus Creek (and their associated changes in potential spending or revenue). Reported changes in participation in recreational activities and spending were used to assess the potential effects of the Proposed Action on socioeconomic conditions in the study area.

ASSESSMENT OF EFFECTS ON RESIDENTS

A total of 2,656 resident questionnaires were distributed and 296 responses were received; these questionnaire responses are summarized in **Table 7.3-6** and discussed in further detail below.

Table 7.3-6. Summary of Resident Questionnaires Distributed and Received

	Number of Questionnaires Distributed	Number of Questionnaire Responses Received	Number of Questionnaires Analyzed	Average Annual Recreational Activity Expenses	Primary Reported Expenditures
Residents adjacent to lower Esopus Creek[1]	1,156	129	115	$2,510	• Boat purchase and repair • Dock purchase and repair
Residents between 500 feet and a 0.5-mile of lower Esopus Creek	1,500	167	105	$345	• Food and drink • Equipment (e.g., kayaks, paddles, canoes)
Total	2,656	296	220	NA	NA

Notes:
[1] Residents adjacent to lower Esopus Creek were defined as those who live within 500-feet of lower Esopus Creek.
NA – Not applicable
Source: Socioeconomic questionnaire distributed in fall 2018.

Households adjacent to lower Esopus Creek reported that they spend an average of approximately $2,510 annually on recreational activities along lower Esopus Creek as described in Section 5.3.3, "Socioeconomic Conditions" methodology. Residents whose properties were not adjacent to lower Esopus Creek reported that they spend an average of approximately $345 annually on lower Esopus Creek recreational activities. "Boat purchase and repair" and "dock purchase and repair" were the two main expenditure categories for residents living adjacent to lower Esopus Creek, while "food and drinks" and "equipment" (e.g., kayaks, paddles, canoes) were the two main expenditure categories for residents who live between 500 feet and a 0.5 mile from lower Esopus Creek.

Respondents provided the number of days in which they typically participate in various recreational activities along lower Esopus Creek per season including: motor boating; canoeing, rowing, kayaking, or sailing; fishing; swimming; or picnicking. **Table 7.3-7** displays the mean[34], median[35] and interquartile range (IQR)[36] of responses by activity for residents adjacent to lower Esopus Creek.

The table includes days spent participating in any of the above-noted recreational activities. As discussed in Section 5.3.3, "Socioeconomic Conditions" methodology, 105 questionnaire responses received were assessed for residents who live adjacent to lower Esopus Creek and 87 were assessed for residents who live between 500 feet and a 0.5 mile of lower Esopus Creek.

[34] The mean (or average) reflects the total reported recreational days divided by the total number of respondents.
[35] The median value is the 50th percentile of reported recreational days in each category. That is, half of the reported values are below the median.
[36] The IQR is a useful statistic to understand central tendencies of responses without the influence of extreme responses or outliers. The IQR represents the 25th and 75th percentiles of the responses, respectively. The first value of the IQR indicates the number of days at or below which 25 percent of the respondents indicated that they typically participated in a recreational activity. The second value is the number of days at or below which 75 percent of the respondents indicated that they typically participated in a recreational activity. Conversely, this value indicates the number of days at or above which 25 percent of respondents participated in an activity. Fifty percent of respondents reported participation in recreational activities for the number of days between the two values of the IQR.

The findings of the socioeconomic survey assessment for residents were as follows (see **Table 7.3-7**):

- Residents who live adjacent to lower Esopus Creek participate in canoeing, rowing, kayaking, or sailing predominantly during the spring, summer, and fall. The highest participation in these activities occurs in the summer, with a mean (average) of 26 days and a median of 20 days. Swimming and picnicking are also common activities. The highest participation in these activities occurs in the summer, with an average of 23 days and a median of 10 days. Similarly, these residents' participation in fishing is highest in the summer, with an average of 18 days and a median of 6 days.
- Residents who live between 500 feet and within a 0.5 mile of lower Esopus Creek reported participating in recreational activities for fewer days per season as compared to residents who live adjacent to lower Esopus Creek. For example, these residents participate in swimming and picnicking for an average of five days during the summer compared to 23 days reported by residents living adjacent to lower Esopus Creek. The most popular activity of canoeing, rowing, kayaking, or sailing had a mean of six days for this group compared to the mean of 26 days for respondents who live adjacent to lower Esopus Creek.
- Participation in recreational activities was reported to be the highest in the summer followed by the spring and fall seasons. Participation was lowest in the winter for both groups of respondents.

Table 7.3-7. Summary of Reported Seasonal Activity Days for Residents Adjacent to Lower Esopus Creek (n=105)[1]

Activity	Spring			Summer			Fall			Winter		
	Number of Days in Mar, Apr, May			Number of Days in Jun, Jul, Aug			Number of Days in Sep, Oct, Nov			Number of Days in Dec, Jan, Feb		
	Mean	Median	Interquartile Range	Mean	Median	Interquartile Range	Mean	Median	Interquartile Range	Mean	Median	Interquartile Range
Motor Boating	8	0	0 - 7	15	0	0 - 12	8	0	0 - 7	0	0	0 - 0
Canoeing, Rowing, Kayaking, or Sailing	11	5	0 - 15	26	20	0 - 35	11	5	0 - 20	1	0	0 - 0
Fishing	10	1	0 - 10	18	6	0 - 25	9	0	0 - 10	1	0	0 - 0
Swimming	4	0	0 - 1	23	10	0 - 30	5	0	0 - 2	0	0	0 - 0
Picnicking	11	0	0 - 10	23	10	0 - 30	10	0	0 - 10	1	0	0 - 0
Other[2]	9	0	0 - 0	11	0	0 - 2	9	0	0 - 2	7	0	0 - 0

Notes:
[1] The IQR is useful for understanding central tendencies of responses without the influence of extreme responses or outliers. If the mean is outside the IQR, it indicates that outliers are significantly skewing the mean away from the average responses. For example, for swimming in the fall, the middle 50 percent of responses lie between zero and two and 50 percent of all responses are 0 or less, the mean of five does not represent the average response.
[2] Examples of other activities provided by respondents are hiking, walking, ice skating, and bird watching.
Source: Socioeconomic questionnaire distributed in fall 2018.

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To determine how reported recreational use of lower Esopus Creek would change for different streamflow and water quality conditions that may occur in the future without and with the Proposed Action, reported percent change in overall recreational activities was multiplied by reported typical recreational days as described in Section 5.3.3, "Socioeconomic Conditions" methodology.

Table 7.3-8 presents the mean, median, and IQR of the change in respondents' days of participation in each of the recreational activities by season for each water quality and streamflow condition for respondents who live adjacent to lower Esopus Creek. The median change in respondents' recreational days was used as the key indicator to evaluate the representative change in recreational days due to the various water quality and streamflow conditions along lower Esopus Creek. IQR values that show changes in participation in recreational activities of one or more days were used to determine tendencies of respondents' increased or decreased preference to participate in recreational activities for a given streamflow and water quality condition in each season.

The analysis of reported results for residents who live adjacent to lower Esopus Creek is as follows:

- In general, for all the streamflow and water quality conditions, there was no median change in days that indicated respondents would increase their recreational use of lower Esopus Creek regardless of the season or activity.
- Motor boating or "other" recreational activities were the recreational activities that generally exhibited the lowest potential change in days of respondents' participation in recreational activities (either increased or decreased) regardless of the streamflow or water quality condition.
- The analysis showed respondents would have minimal changes in participation in recreational activities in the winter months for all streamflow and water quality conditions.
- The two *clear water* conditions (*moderate flow* and *high flow*) exhibited some potential for increased recreational use of lower Esopus Creek, as follows:
    - The *moderate flow, clear water* condition during the summer exhibited some potential for increased participation in canoeing, rowing, kayaking or sailing; fishing, swimming; and picnicking, based on analysis of upper IQR values indicating increases that ranged from 3.6 to 6.3 days with mean values increasing between 4.7 to 5.5 days, depending on the activity.
    - The *high flow, clear water* condition had a slight potential to increase participation in all recreational activities in the summer and fall, based on mean values ranging from increases of 1 to 3.2 days in the summer and 1 to 1.6 days in the fall. However, since the median and upper IQR values for the *high flow, clear water* condition is either zero or less than one, these mean values indicate tendencies toward changes in participation in recreational activities, not a direct representation of respondents' trends under these conditions.
- The *high flow, very cloudy water* condition presented a reduction in days that respondents would participate in recreational activities, which indicates that this condition was less favorable for recreational activities than clear or cloudy water conditions. In particular:
    - There was a median change of three fewer days of participation in canoeing, rowing, kayaking or sailing in the summer.
    - The lower IQR values for canoeing, rowing, kayaking or sailing; fishing; swimming; and picnicking in the summer ranged from a reduced participation in these activities between

10 and 30 days, and mean values ranged from a reduced participation in these activities between 11 to 16 days, depending on the activity.

  - This streamflow and water quality condition also had potential to reduce respondents' days of participation in all recreational activities in the spring and fall, though not to the same extent as observed in the summer.

- The *very low flow* condition showed the potential to reduce the number of days respondents participate in recreational activities during the spring, summer, and fall, though to a lesser extent than the *high flow, very cloudy water* condition.
  - While the *very low flow* condition exhibited no change in the median number of days respondents would participate in recreational activities overall, the lower value of the lower IQR for days of their participation in canoeing, rowing, kayaking or sailing; fishing; swimming; and picnicking showed reductions of between 8 to 18 days in the summer with mean reductions between 9.9 to 14 days, depending on the activity.
- The *moderate flow, cloudy water* condition exhibited some tendencies for reduced days of participation in recreational activities. While the median change in days for this condition was zero for all seasons and activities, the lower IQR values ranged from a reduction between 2 to 6 days for canoeing, rowing, kayaking or sailing; fishing; swimming; and picnicking during the summer season. Respondents' participation in canoeing, rowing, kayaking or sailing also had a tendency for reduced days in the spring and fall, though the reductions were less pronounced than those in the summer.

In summary, respondents who live adjacent to the lower Esopus Creek tended to have reduced preference for participation in recreational activities during days with a *high flow, very cloudy water* condition, particularly in the summer, and to some extent, in the spring and fall. The *very low flow* condition had some potential to reduce days of participation in recreational activities, more so in the summer than in the spring and fall. While the *moderate flow, cloudy water* condition also had some potential for reduced days of participation in recreational activities, the potential for reduced participation was less pronounced than that of the *high flow, very cloudy water and very low flow* conditions.

The analysis of reported results for residents who live between 500 feet and a 0.5 mile of lower Esopus Creek is as follows:

- Respondents indicated there would be no median change in days of participation in recreational activities along lower Esopus Creek for all streamflow and water quality conditions and seasons.
- In the summer, average (mean) changes to participation in recreational activities ranged from decreases of up to 3 days to increases of up to 1.5 days, depending on the streamflow and water quality condition and activity.
- The *high flow, very cloudy water* condition and the *very low flow* conditions exhibited slight tendencies to reduce days of participation in recreational activities in the summer. During the *high flow, very cloudy water* condition, canoeing, rowing, kayaking or sailing, and swimming activities had lower IQR values that indicated activity reductions of 2 and 1 days, respectively, and mean reductions of 3.3 and 3.1 days, respectively. During the *very low flow* condition, canoeing, rowing, kayaking or sailing, and swimming had lower IQR values of 1.8 and 2.3 days of reduced participation in recreational activities, respectively, and mean values of 2.9 and 2.8 days of reduced participation, respectively. The median change in days of participation in recreational activities for these two streamflow and water quality conditions was zero for all seasons and activities.

Table 7.3-8. Summary of Expected Change in Days of Participation in Recreational Activities for Residents Adjacent to Lower Esopus Creek (n=105)

Lower Esopus Creek Conditions		Change in Days											
		Spring			Summer			Fall			Winter		
		Mean	Median	IQR	Mean	Median	IQR	Mean	Median	IQR	Mean	Median	IQR
Scenario 1 – Moderate Flow, Clear Water	Motor Boating	1.5	0	(0 to 0)	3.0	0	(0 to 0)	1.3	0	(0 to 0)	0	0	(0 to 0)
	Canoeing, Rowing, Kayaking or Sailing	2.4	0	(0 to 2.0)	4.7	0	(0 to 6.0)	1.5	0	(0 to 1.3)	0	0	(0 to 0)
	Fishing	1.4	0	(0 to 1.0)	4.8	0	(0 to 4.8)	1.8	0	(0 to 1.0)	0	0	(0 to 0)
	Swimming	1.5	0	(0 to 0)	5.5	0	(0 to 6.3)	1.3	0	(0 to 0)	0	0	(0 to 0)
	Picnicking	2.3	0	(0 to 0)	4.9	0	(0 to 3.6)	1.4	0	(0 to 0.3)	0	0	(0 to 0)
	Other	2.1	0	(0 to 0)	2.2	0	(0 to 0)	1.2	0	(0 to 0)	0. 5	0	(0 to 0)
Scenario 2 – Moderate Flow, Cloudy Water	Motor Boating	-1.0	0	(0 to 0)	-2.7	0	(0 to 0)	-0.6	0	(0 to 0)	0	0	(0 to 0)
	Canoeing, Rowing, Kayaking or Sailing	-2.3	0	(-1.0 to 0)	-5.6	0	(-6.0 to 0)	-2.1	0	(-1.0 to 0)	-0.1	0	(0 to 0)
	Fishing	-2.0	0	(-0.2 to 0)	-3.9	0	(-3.0 to 0)	-1.4	0	(0 to 0)	0	0	(0 to 0)
	Swimming	-1.0	0	(0 to 0)	-4.5	0	(-4.0 to 0)	-1.0	0	(0 to 0)	0	0	(0 to 0)
	Picnicking	-2.1	0	(0 to 0)	-4.5	0	(-2.0 to 0)	-0.7	0	(0 to 0)	0	0	(0 to 0)
	Other	-2.2	0	(0 to 0)	-3.1	0	(0 to 0)	-2.7	0	(0 to 0)	-0.4	0	(0 to 0)
Scenario 3 – High Flow, Very Cloudy Water	Motor Boating	-4.4	0	(0 to 0)	-8.6	0	(0 to 0)	-3.9	0	(0 to 0)	0	0	(0 to 0)
	Canoeing, Rowing, Kayaking or Sailing	-7.1	-0.2	(-9.0 to 0)	-16.0	-3	(-30.0 to 0)	-6.4	0	(-10.0 to 0)	-0.3	0	(0 to 0)
	Fishing	-6.2	0	(-7.5 to 0)	-12.0	0	(-13.0 to 0)	-5.3	0	(-4.0 to 0)	-0.5	0	(0 to 0)
	Swimming	-2.7	0	(0 to 0)	-14.0	-0.6	(-24.0 to 0)	-2.6	0	(0 to 0)	-0.1	0	(0 to 0)
	Picnicking	-4.8	0	(-1.0 to 0)	-11.0	0	(-10.0 to 0)	-4.0	0	(-2.0 to 0)	-0.2	0	(0 to 0)
	Other	-6.3	0	(0 to 0)	-7.6	0	(0 to 0)	-6.0	0	(0 to 0)	-2.1	0	(0 to 0)
Scenario 4 – High Flow, Clear Water	Motor Boating	1.2	0	(0 to 0)	2.3	0	(0 to 0)	1.2	0	(0 to 0)	0	0	(0 to 0)
	Canoeing, Rowing, Kayaking or Sailing	1.4	0	(0 to 0)	3.2	0	(0 to 0)	1.6	0	(0 to 0)	0	0	(0 to 0)
	Fishing	0.6	0	(0 to 0)	2.6	0	(0 to 0.8)	1.6	0	(0 to 0)	0.1	0	(0 to 0)
	Swimming	1.0	0	(0 to 0)	2.1	0	(0 to 0.2)	1.4	0	(0 to 0)	-0.1	0	(0 to 0)
	Picnicking	1.0	0	(0 to 0)	2.8	0	(0 to 0)	1.0	0	(0 to 0)	-0.1	0	(0 to 0)
	Other	1.0	0	(0 to 0)	1.0	0	(0 to 0)	1.0	0	(0 to 0)	1.0	0	(0 to 0)
Scenario 5- Very Low Flow	Motor Boating	-3.4	0	(0 to 0)	-7.1	0	(0 to 0)	-3.3	0	(0 to 0)	0	0	(0 to 0)
	Canoeing, Rowing, Kayaking or Sailing	-5.4	0	(-5.0 to 0)	-14.0	0	(-15.0 to 0)	-5.1	0	(-4.8 to 0)	-0.2	0	(0 to 0)
	Fishing	-4.8	0	(-5.0 to 0)	-9.9	0	(-8.0 to 0)	-4.0	0	(-3.8 to 0)	-0.3	0	(0 to 0)
	Swimming	-2.6	0	(0 to 0)	-13.0	0	(-18.0 to 0)	-2.6	0	(0 to 0)	-0.1	0	(0 to 0)
	Picnicking	-4.6	0	(-2.0 to 0)	-11.0	0	(-10.0 to 0)	-3.9	0	(-2.0 to 0)	-0.2	0	(0 to 0)
	Other	-3.8	0	(0 to 0)	-5.2	0	(0 to 0)	-3.6	0	(0 to 0)	-1.8	0	(0 to 0)

Note:
Negative values indicate calculated decreases in recreational use of lower Esopus Creek.
Source: Socioeconomic questionnaire distributed in fall 2018.

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Resident questionnaire respondents noted a potential for changes in recreational use of lower Esopus Creek for certain streamflow and water quality conditions; however, differences in these streamflow and water quality conditions between the future without and with the Proposed Action would be subtle and would diminish moving downstream. The conditions shown in the questionnaire photos are representative of conditions that could potentially exist along lower Esopus Creek in the future with the Proposed Action, but would be comparable between the future without and with the Proposed Action due to the influence of flow to lower Esopus Creek from contributing sub-watersheds (Section 7.1.1, "Flow Regime and Water Quality in Lower Esopus Creek").

The *high flow, very cloudy water* and *very low flow* streamflow and water quality conditions were those cited by respondents to have the greatest potential to change recreational use of lower Esopus Creek. Differences in the frequency of occurrence of these conditions between the future without and with the Proposed Action would be greatest in Valley Reach 1A, which would not receive flow from Ashokan Reservoir in the future without the Proposed Action. However, there are no public recreational opportunities and few private residences located along this Valley Reach. Most residents and recreational opportunities are located at the downstream end of Valley Reach 2C and along Valley Reaches 3D, 3E, and 3F where there are other inputs of flow and water quality to lower Esopus Creek. In these downstream reaches, changes to lower Esopus Creek conditions are anticipated to be influenced by factors within the contributing sub-watersheds of lower Esopus Creek that are unrelated to flows from Ashokan Reservoir. In addition, the occurrence of *high flow, very cloudy water* conditions and *very low flow* conditions would be relatively infrequent and of a short duration in both the future without and with the Proposed Action. Overall, the Proposed Action has the potential to improve recreational opportunities associated with swimming, fishing, and boating as compared to the future without the Proposed Action by providing sustained flow to lower Esopus Creek year-round through the community release. Since a majority of the recreational activities occur in the downstream portions of lower Esopus Creek (i.e., Valley Reaches 3D, 3E) the benefit would be small (see Section 7.4, "Open Space and Recreation").

As noted in Section 5.3.3, "Socioeconomic Conditions" methodology, an IMPLAN analysis was conducted for the resident questionnaire responses received. The IMPLAN analysis indicated that the future with the Proposed Action would provide a limited (i.e., minimal) socioeconomic benefit to Ulster County as a result of sustained flow provided by the community release that would have the potential to reduce the occurrence of the *very low flow* condition. Additionally, the IMPLAN analysis indicated that there is the potential for a minimal annual change to socioeconomic conditions associated with the *high flow, very cloudy water* condition. These minimal differences are not anticipated to appreciably affect the Ulster County economy.

ASSESSMENT OF EFFECTS ON BUSINESSES

Approximately 245 questionnaires were sent to businesses within the study area that have the potential for a portion of their revenue to be influenced by recreational use of, or the aesthetic qualities of lower Esopus Creek (e.g., farms, campgrounds, restaurants**)**, either seasonally or year-round. The questionnaires gathered information on how conditions within lower Esopus Creek may affect business revenue. Qualitative results of the business survey are summarized and assessed by business type in **Table 7.3-9**, and the text that follows.

Table 7.3-9. Summary of Business Questionnaires Distributed and Responses Received

Questionnaire Type	Number of Questionnaires Distributed	Number of Questionnaire Responses Received
Retail	193	18
Lodging	15	8
Farms	21	8
Marinas	7	0
Parks	9	7
Total	**245**	**41**

Source: Socioeconomic questionnaire distributed in fall 2018.

The largest percentage (approximately 40 percent) of questionnaire responses received were from the retail sector. The lodging, farms, and parks sectors each comprised 20 percent of the questionnaire responses received (**Table 7.3-9**). A summary and analysis of the questionnaire responses received by sector are presented below.

Retail

Of 18 completed questionnaires from businesses in this sector, 13 retail respondents indicated that lower Esopus Creek conditions do not have the potential to affect their business. Five noted that the conditions of lower Esopus Creek had the potential to affect business operations in the spring, summer, and fall. Two of the retail respondents stated that *moderate flow, cloudy water* conditions could negatively affect their sales, three indicated that *high flow, very cloudy water* conditions could negativly affect their sales and three indicated that the *very low flow* condition could affect their sales. Negative affects to retail businesses were recorded to occur in the spring, summer, and fall. According to the noted respondents, these conditions could negatively affect the influx of customers to their businesses as a result of reduced use of lower Esopus Creek for recreational activities or aesthetic purposes, which in turn, could decrease retail sales. One retail questionnaire respondent noted that the *moderate flow, clear water* condition could have the potential to increase annual sales if it occurred for most of the year (75 percent of the time).

Lodging

Seven lodging establishments provided responses to the questionnaire. Three indicated their establishments do not have the potential to be affected by conditions in lower Esopus Creek. Four of the respondents in this sector indicated that lower Esopus Creek conditions may have the potential to negatively affect occupancy rates during *very low flow* conditions and during *high flow, very cloudy water* conditions in the spring, summer, and fall. One respondent noted a reduction in occupancy rates could also occur in the winter. According to the noted respondents, these conditions could negatively affect the influx of visitors to the area as a result of reduced use of lower Esopus Creek for recreational activities or aesthetic purposes, which in turn, could decrease occupancy rates. The *high flow, clear water* condition was reported as having the potential to increase occupancy rates for one lodging establishment for all four seasons.

Farms

Of the seven farms that completed the questionnaire, four indicated that lower Esopus Creek conditions would have no effect on farm operations. Three respondents noted that conditions of lower Esopus Creek may have the potential to change farm operations. These respondents indicated that farm operations could be more strongly affected by changes in flow conditions than by changes in water quality, a few noting that *very low flow* conditions could affect annual agricultural product sales and farm operating costs related to the need to alter irrigation practices. Three farmers that responded to the questionnaire noted *high flow* conditions, regardless of water quality, had the potential to negatively affect farm sales and operating costs as a result of the potential for increased flooding of fields, water quality changes, and a need to alter irrigation practices.

Parks

Seven parks completed the questionnaire. Four of the parks indicated that lower Esopus Creek conditions have the potential to affect park operations in the spring, summer, and fall. One of these parks could also have the potential to be affected in the winter. Only one of the parks responded that they collect fees. Only two parks indicated how conditions could affect park attendance. These respondents indicated that *clear water* conditions could increase park attendance while *cloudy* and *very cloudy water* and *very low flow* conditions could negatively affect park attendance in the spring, summer, and fall.

Marinas

No questionnaire responses were received from marinas.

Similar to residents, the majority of businesses are located at the downstream end of Valley Reach 2C and along Valley Reaches 3D, 3E, and 3F, downstream of other inputs of flow and water quality to lower Esopus Creek. In these reaches, changes to conditions within lower Esopus Creek are anticipated to be influenced by factors within the lower Esopus Creek watershed that are unrelated to flows from Ashokan Reservoir. In addition, the occurrence of *high flow, very cloudy water* conditions and *very low flow* conditions are relatively infrequent and of a short duration in both the future without and with the Proposed Action in these locations. Because conditions between the future without and with the Proposed Action would be comparable downstream of Valley Reach 1A and would diminish moving downstream, potential differences in conditions in lower Esopus Creek between the future without and with the Proposed Action that could affect businesses in the study area are anticipated to be minor overall. It is not anticipated that these differences could appreciably impact or benefit socioeconomic conditions along lower Esopus Creek or in Ulster County as a whole.

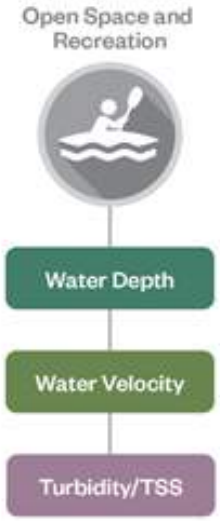
CONCLUSIONS

Based on the housing price analysis, the rate of change in housing prices for homes along the lower Esopus Creek waterfront was similar to those within 0.5-mile of lower Esopus Creek and along the Rondout Creek waterfront. Therefore, conditions within lower Esopus Creek did not have an observable effect on prices of single-family homes during the period of analysis between 2007 and 2017.

Based on the socioeconomic survey, higher streamflow has the potential to enhance use of lower Esopus Creek in the spring, summer, and fall. However, the increase in streamflow in the future with the Proposed Action as compared to the future without the Proposed Action due to the community release is subtle and diminishes moving downstream. Because the majority of the residents and businesses are located in downstream valley reaches, any benefit of increased flow would not be substantial.

Based on responses to a questionnaire obtained via a survey conducted to support the socioeconomic assessment, the community release would have the potential to increase the number of days questionnaire respondents would participate in recreational activities along lower Esopus Creek by providing sustained flow to lower Esopus Creek. Some survey respondents indicated that the *high flow, very cloudy water* and the *very low flow* conditions would have the potential to decrease the number of days they would participate in recreational activities (and potentially result in reduced spending). Likewise, some questionnaire responses received from businesses indicated that the *high flow, very cloudy water* condition may decrease revenue due to decreased sales and higher operating costs. However, the occurrence of these conditions would be infrequent, and similar between the future without and with the Proposed Action. Any potential reduction in the number of days respondents participate in recreational activities along lower Esopus Creek associated with infrequent, short duration, high streamflow, high turbidity conditions would be minor overall, and would result in minimal changes in spending and effects to socioeconomic conditions, if any. Therefore, the Proposed Action is not anticipated to cause a significant adverse impact on socioeconomic conditions within the lower Esopus Creek study area.

7.4 OPEN SPACE AND RECREATION



An open space and recreation assessment was conducted to evaluate whether the Proposed Action would result in benefits or impacts to open space and recreational resources along lower Esopus Creek.

7.4.1 BASELINE CONDITIONS

The study area includes the area within a quarter-mile of lower Esopus Creek along its length, beginning at Ashokan Reservoir and ending at the confluence of lower Esopus Creek and the Hudson River. Lower Esopus Creek is the predominant recreational resource in the study area. It provides a number of recreational opportunities such as fishing, swimming, and boating. Several municipalities offer open space and recreational resources along lower Esopus Creek, including hiking trails, boat access, beaches, playgrounds, picnic areas, ball fields, volleyball courts, and basketball courts. In addition, several privately-owned golf courses and marinas are located within the study area. These open spaces and recreational resources are summarized in **Table 7.4-1**, shown in **Figure 7.4-1** and described in further detail below.

Creek-dependent recreation such as swimming, boating, and fishing occur both on private and public property along lower Esopus Creek. These activities peak during certain times of year. For example, the swimming season in lower Esopus Creek is from July 1 to August 31, when public beaches such as Marbletown Beach (Town of Marbletown) and Saugerties Beach (Village of Saugerties) are open. Boating typically takes place from May through October, based on responses received from the survey conducted to support the socioeconomic assessment (see Section 7.3, "Socioeconomic Conditions"). Fishing occurs year-round, including ice fishing just upstream of Cantine Dam. However, peak fishing season is April through October, based on questionnaire responses received to support the socioeconomic assessment (Section 7.3, "Socioeconomic Conditions").

VALLEY REACH 1A: ASHOKAN DAY USE AREA

The Ashokan Day Use Area is a designated public use area, located partially within the study area in Valley Reach 1A. The Ashokan Day Use Area is approximately 55 acres, located adjacent to Ashokan Reservoir in the Town of Olive on DEP-owned land. The area offers access to land-based activities such as hiking, biking, walking, and jogging without the need for a DEP access permit. There is a 2.7-mile promenade which offers views of the Reservoir and the Catskill Mountains. The Ashokan Day Use Area does not provide access to lower Esopus Creek, and therefore does not provide creek-dependent recreational opportunities.

VALLEY REACH 2C

MARBLETOWN BEACH/ TONGORE PARK

Marbletown Beach is located in Tongore Park, located in the Town of Marbletown within Valley Reach 2C, and is also known as the Town of Marbletown Park. It is an approximately 6.4-acre park that is open to the public from April through October each year. It offers a picnic area and pavilion, playground, basketball and volleyball courts, ballfields, fishing, a cartop boat launch and swimming. There is also a small dock for launching kayaks and canoes. The public beach along lower Esopus Creek is typically open from July 1 to August 31.

Table 7.4-1. Open Space and Recreational Resources in the Study Area

Valley Reach	Recreation Area	Label Number (see Figure 7.4-1)	Town/City	Location	Activities/Facilities
1A	Ashokan Day Use Area	1	Town of Olive	BWS Rd	Hiking, Biking, Birding; No creek-dependent activities
2C	Marbletown Beach/Tongore Park	2	Town of Marbletown	Tongore Road	Swimming, Fishing, Playground, Basketball, Volleyball, Ballfields, Picnic Area, Pavilion, Cartop Boat Launch
	Fording Place Road	3	Town of Marbletown	Fording Place Road	Fishing
	Ontario and Western (O&W) Rail Trail	4	City of Kingston, Towns of Ulster, Hurley, Marbletown, Rochester, and Wawarsing, and Village of Ellenville	City of Kingston, Towns of Ulster, Hurley, Marbletown, Rochester, and Wawarsing, and Village of Ellenville	Hiking, Cycling, Horseback Riding, Cross-country Skiing, Snowshoeing; No creek-dependent activities
	Sandy Road Fishing and Boat Access	5	Town of Ulster	Sandy Road	Fishing, Picnic Area, and Cartop Boat Launch
	Kessman's Alapaha Golf Course and Driving Range	6	Town of Ulster	Saw Kill Road	Golf Course; No creek-dependent activities
	Hurley U.S. Route 209	7	Town of Ulster	Hurley U.S. Route 209	Fishing
	Green Acres Golf Club	8	Town of Ulster	Harwich Street	Golf Course; No creek-dependent activities
	Orlando Street Ball Park and Boat Access	9	Town of Ulster	Orlando Street	Fishing, Ballfields, Basketball Court, Cartop Boat Launch
3D	Jeanette Lane Mini Park	10	Town of Ulster	Jeanette Lane	Basketball Court, Ballfield; No creek-dependent activities
3E	Esopus Bend Nature Preserve	11	Village of Saugerties and Town of Saugerties	Kalina Drive	Hiking, Boat Landing, Birding
	Saugerties Beach	12	Village of Saugerties	Partition Street	Swimming, Fishing, Playground, Boat Launch

Table 7.4-1. Open Space and Recreational Resources in the Study Area

Valley Reach	Recreation Area	Label Number (see Figure 7.4-1)	Town/City	Location	Activities/Facilities
3F	Tina Chorvas Waterfront Park	13	Village of Saugerties	East Bridge Street	Fishing, Picnic Area, Boat Launch
	Ruth Reynolds Glunt Nature Preserve / Saugerties Lighthouse	14	Village of Saugerties	Lighthouse Drive	Hiking, Boat Access, Picnic Area, Lighthouse Museum, Lighthouse Bed and Breakfast
	Saugerties Marina	15	Village of Saugerties	Ferry Street	Boat Access and supporting boating activities (e.g., boat storage)

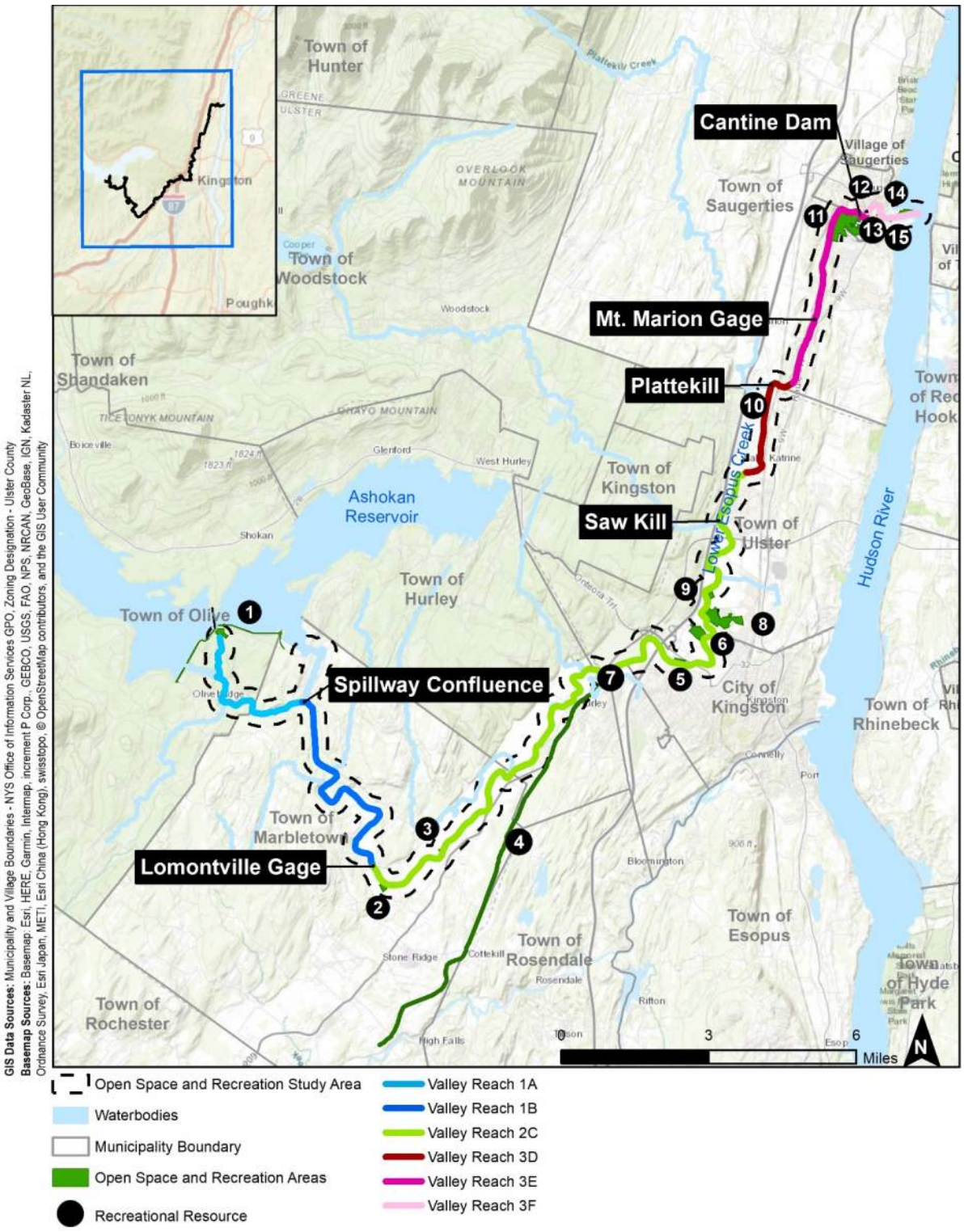


Figure 7.4-1
Lower Esopus Creek
Open Space and Recreational Resources

FORDING PLACE ROAD

Fording Place Road is a dirt trail located in the Town of Hurley that dead-ends into an unofficial access point to lower Esopus Creek that is used by anglers. This location is adjacent to Valley Reach 2C approximately 800 feet downstream of Marbletown Beach.

ONTARIO & WESTERN RAIL TRAIL

The Ontario and Western (O&W) Rail Trail is a multi-use trail that traverses Ulster County from the Village of Ellenville to the City of Kingston. The northern-most two miles of the trail are paved and are accessible from the trailhead parking lot just south of lower Esopus Creek in Valley Reach 2C near the Town of Hurley (**Figure 7.4-1**). The approximately 24-mile trail follows the historic route of the O&W Railroad and consists of three different segments, two of which are connected by roads. The trail is used year-round to support a variety of recreational activities, including hiking, jogging, cycling, horseback riding, snowshoeing, and cross-country skiing. The O&W Rail Trail does not provide access to lower Esopus Creek and does not provide creek-dependent recreational opportunities in lower Esopus Creek.

HURLEY U.S. ROUTE 209

Hurley U.S. Route 209 is an unofficial fishing access point of lower Esopus Creek. Parking is available at the O&W Rail Trail trailhead located off Hurley U.S. Route 209; a small gap in the parking lot guardrail provides access to lower Esopus Creek.

SANDY ROAD FISHING AND BOAT ACCESS

In 2016, NYSDEC and Ulster County opened the Sandy Road Fishing and Boat Access point in the Town of Ulster off of Sandy Road, along Valley Reach 2C. This includes a cartop boat launch, picnic area, and fishing platform and provides access to approximately 200 feet of lower Esopus Creek frontage.

KESSMAN'S ALAPAHA GOLF COURSE & GREEN ACRES GOLF CLUB

Kessman's Alapaha Golf Course and Driving Range and the Green Acres Golf Club are privately-owned golf courses located in the City of Kingston. Both facilities are open to the public and cover approximately 39.6 and 100 acres, respectively. The two golf courses are directly adjacent to lower Esopus Creek, along Valley Reach 2C. The golf courses do not provide access to lower Esopus Creek and do not provide creek-dependent recreational opportunities.

ORLANDO STREET BALL PARK AND BOAT ACCESS

Orlando Street Ball Park and Boat Access, located in the Town of Ulster, offers two ballfields and a basketball court. The approximately 10.8-acre park is located directly adjacent to lower Esopus Creek in Valley Reach 2C and provides a boat launch for recreational use of lower Esopus Creek, including fishing.

VALLEY REACH 3D

JEANETTE LANE MINI PARK

Jeanette Lane Mini Park is a small neighborhood park located in the Town of Ulster, along Valley Reach 3D. The park includes a ballfield and basketball court within its approximately 0.9 acres. This park does

not provide access to lower Esopus Creek and does not provide creek-dependent recreational opportunities.

VALLEY REACH 3E

ESOPUS BEND NATURE PRESERVE

Esopus Bend Nature Preserve, located in both the Town and Village of Saugerties, encompasses approximately 160 acres of natural landscape including meadows, wetlands, forest, and floodplain forest within Valley Reach 3E. The Preserve offers opportunities for hiking, birding, and guided nature walks. The Preserve can also be accessed from lower Esopus Creek via a kayak landing. There are five trails running along lower Esopus Creek. The Preserve is located within the Coastal Management Zone Area (CMZA) and the Village of Saugerties Local Waterfront Revitalization Program (LWRP) boundaries (see Section 7.2, "Public Policy, Land Use, and Zoning").

SAUGERTIES BEACH

Saugerties Beach is a public swimming beach, boat launch, and fishing area located in the Village of Saugerties in Valley Reach 3E. Other recreational features include a swimming dock and a playground area. Restoration of the beach was recently completed in 2017 under the NYRCR Program for Hudson Valley and Westchester (see Section 7.2, "Public Policy, Land Use, and Zoning"). The restoration replaced sand that was washed away during storms and installed two docks in lower Esopus Creek. The public beach along lower Esopus Creek is typically open from July 1 to September 1.

VALLEY REACH 3F

TINA CHORVAS WATERFRONT PARK

Tina Chorvas Waterfront Park, located in the Village of Saugerties, is a public recreation area that offers opportunities for fishing, boating, and picnicking within Valley Reach 3F. The park encompasses approximately 1.1 acres and has a parking lot with capacity for ten cars. A planned restoration of the park under the NYRCR Program will stabilize the shoreline, ensure continued public access to lower Esopus Creek, replace an existing bulkhead, and prevent further erosion. Tina Chorvas Waterfront Park is located within CMZA and LWRP boundaries.

RUTH REYNOLDS GLUNT NATURE PRESERVE/SAUGERTIES LIGHTHOUSE

Ruth Reynolds Glunt Nature Preserve, located in the Village of Saugerties in Valley Reach 3F, encompasses approximately 17 acres of natural landscape, including State-protected wetlands. There is a half-mile trail within the nature preserve that leads to the Saugerties Lighthouse. The lighthouse offers a museum, bed and breakfast, picnic areas along the beach, and a 40-foot dock for boat access. The Preserve is located within CMZA and LWRP boundaries.

SAUGERTIES MARINA

Saugerties Marina is a privately-owned marina within the Village of Saugerties. The marina provides motorboat and kayak rentals, local and long-distance boat transportation, transient docking, gas and diesel fuel, and a boating store. Because Saugerties Marina is located downstream of Cantine Dam, it provides access to Valley Reach 3F and the Hudson River. It includes over 45 boat slips (locations where boats can dock) which are up to 35 feet in length.

7.4.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP has consulted the municipalities within the study area and Ulster County, and has not been informed of any upcoming new projects within the study area that would affect conditions of lower Esopus Creek, or expand, create, or otherwise affect open space or recreational resources that provide access to lower Esopus Creek. In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on flows from the contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

7.4.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream and Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action. The number of days of streamflow with turbidity levels greater than 25 NTU would be similar between the future without and with the Proposed Action and would be within the range and variability of turbidity levels in lower Esopus Creek streamflow.

SWIMMING

Swimming is available at two locations along lower Esopus Creek: Marbletown Beach and Saugerties Beach. Marbletown Beach is located in Valley Reach 2C just downstream of the Lomontville gage (Valley Reach 1B), where releases would comprise approximately half of the total streamflow in wet, normal and dry years (e.g., approximately 53 percent of streamflow for releases up to 15 MGD (23 cfs), and approximately 84 percent of streamflow for releases between 15 and 600 MGD, 23 and 928 cfs). Saugerties Beach is located just upstream of Cantine Dam in Valley Reach 3E, where flows from Ashokan Reservoir would contribute a smaller portion of overall flow (e.g., approximately 20 percent of streamflow for releases up to 15 MGD (23 cfs), and approximately 54 percent of streamflow for flows between 15 and 600 MGD (23 and 928 cfs)) (see Section 6.2, "Operation of Ashokan Reservoir in Accordance with the IRP").

Cantine Dam attenuates streamflow, slows water velocity, and creates a pooling effect in lower Esopus Creek near Saugerties Beach, which would diminish the potential for flows from Ashokan Reservoir to affect swimming conditions at Saugerties Beach. Since flows from Ashokan Reservoir would make up a larger percentage of the streamflow at Marbletown Beach, and there is no pooling effect in the vicinity of this beach, evaluation of suitable streamflow-related swimming conditions in the future with the Proposed Action focused on this location. The suitability of water quality conditions in the future with the Proposed Action as compared to the future without the Proposed Action were evaluated for both beaches since turbidity within flows from Ashokan Reservoir are anticipated to be carried through the full length of lower Esopus Creek.

To evaluate the effect of the Proposed Action on the suitability of streamflow conditions (i.e., water velocity and water depth) for swimming at Marbletown Beach, OST modeling and estimated streamflow

were used to determine the average number of days during the swimming season (July and August) in which lower Esopus Creek at Marbletown Beach is anticipated to exceed a given streamflow magnitude in the future without and future with the Proposed Action (see **Table 7.4-2**).

Table 7.4-2. Days (On Average) Lower Esopus Creek Streamflow would be Above Specific Flows in July and August in the Future Without and With the Proposed Action

Lower Esopus Creek Streamflow (MGD [cfs])[1]	Days Above Streamflow in July and August (All Years)[2]		Days Above Streamflow in July and August (Wet Years)		Days Above Streamflow in July and August (Normal Years)		Days Above Streamflow in July and August (Dry Years)	
	IRP	No IRP	IRP	No IRP	IRP	No IRP	IRP	No IRP
15 [23]	61	12	62	18	62	11	59	10
25 [39]	20	8	26	13	19	7	14	7
50 [77]	9	5	13	8	8	4	5	3
100 [155]	7	3	10	5	7	2	3	2
150 [232]	6	2	9	4	5	2	2	1
200 [309]	5	2	7	3	4	1	2	1
300 [464]	2	1	5	3	1	1	1	1
400 [619]	1	1	3	2	1	1	1	0
500 [774]	1	1	2	2	0	0	0	0
600 [928]	1	1	2	2	0	0	0	0
700 [1,083]	1	1	2	1	0	0	0	0
800 [1,238]	1	0	2	1	0	0	0	0
1,000 [1,547]	0	0	1	1	0	0	0	0

Notes:
[1] Streamflow was evaluated for Marbletown Beach by scaling modeled flow at Mount Marion based on the relative size of the drainage areas at both locations.
[2] There are 62 days in the swimming season at Marbletown Beach

As shown in **Table 7.4-2**, in the future with the Proposed Action there would be more days with streamflow in the range of 15 to 150 MGD (23 to 232 cfs), than in the future without the Proposed Action. In the summer, this additional flow would be attributed to the community release. Therefore, the sustained flow from the community release has the potential to increase recreational swimming opportunities at this location. Additionally, the number of days streamflow is estimated to be between 200 and 1,000 MGD (309 and 1,547 cfs) at Marbletown Beach would be comparable between the future without and with the Proposed Action.

Turbidity at Marbletown Beach and Saugerties Beach would be comparable between the future without and with the Proposed Action. The majority (71 percent) of flows from Ashokan Reservoir would be comprised of the community release; the median turbidity levels of the community release would be low (1.8 NTU). Over the time period since implementation of the IRP, all observed release turbidity levels were below 5 NTU approximately 68 percent of the time (community and spill mitigation releases).[37] Based on review of historical Ashokan Reservoir water quality data since 2012, Reservoir releases are not

[37] On occasion, Marbletown Beach has closed due to high bacteria levels, unrelated to flows from Ashokan Reservoir. The beach was closed for the entire 2018 recreation season because of high bacteria levels.

anticipated to have an effect on bacteriological water quality within lower Esopus Creek because coliform levels within the Reservoir fall below NYSDOH standards (which set a maximum indicator level for swimming-related water quality acceptability based on coliform levels, among indicator organisms) and coliform water quality data for releases and spills are similar.

FISHING

As described in Section 5.3.4, "Open Space and Recreation" methodology, potential effects of the Proposed Action on fishing were evaluated, in part, based on responses to the socioeconomic conditions survey (see Section 7.3, "Socioeconomic Conditions"). Of the questionnaire responses received, 103 of the respondents indicated that they fish or spend money on fishing when participating in activities along lower Esopus Creek. The majority (97 of the 103 respondents) provided information on the number of days they typically participate in fishing during each season and how their days participating in fishing activities may change for the various streamflow and water quality conditions presented in the questionnaire (**Table 7.4-3**). Based on the values of the median for each season, the *moderate flow* and *high flow* conditions would have little effect on fishing as long as the water remains *clear* (i.e., the streamflow has low levels of turbidity). These respondents reported that there would be no difference or a slight increase in their fishing activity for the *high flow, clear water* condition (a median change of 1 day), but indicated that *high flow, very cloudy* (i.e., turbid) water conditions would decrease their likelihood of fishing in lower Esopus Creek (i.e., a median reduction in the days participating in fishing of zero to five days, depending on the season). However, the frequency of occurrence of *high flow, very cloudy* conditions would be similar (i.e., relatively infrequent and of a short duration) between the future without and with the Proposed Action (see Section 7.1, "Water Resources and Water Quality").

For moderate flows, questionnaire responses received indicated that respondents who fish in lower Esopus Creek showed some tendencies to increase participation in fishing provided the water was *clear*. *Cloudy* water would generally have no impact on days respondents participate in fishing (median values of zero for all seasons) with some inclinations to reduce the number of days participating in fishing as shown by a mean four days in the summer and 1.6 days in the fall. As discussed in Section 7.1, "Water Resources and Water Quality," turbidity levels of flows from Ashokan Reservoir in the future with the Proposed Action are anticipated to be similar to those that occur in the future without the Proposed Action. Turbidity levels of these flows would fall within the range and variability of turbidity levels that occur in lower Esopus Creek streamflow.

Additionally, median calculations showed that survey respondents who fish would decrease their participation in fishing along lower Esopus Creek by three days in the summer and one day in the spring during *very low flow* conditions. For these respondents, the mean change in days of participation in fishing ranged from a reduction of 12 days in the summer to 4.8 days in the fall, compared to *moderate flow, clear water* conditions. As with recreational swimming opportunities, the Proposed Action would provide a potential benefit to recreational fishing opportunities through the community release, which would provide sustained flow to lower Esopus Creek year-round. However, this potential benefit would diminish moving downstream where most of the fishing areas are located.

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Table 7.4-3. Expected Change in Days Respondents Would Participate in Fishing due to Lower Esopus Creek Conditions (n=97)

Lower Esopus Creek Conditions	Spring			Summer			Fall			Winter		
	Mean	Median	IQR	Mean	Median	IQR	Mean	Median	IQR	Mean	Median	IQR
Scenario 1 – Moderate Flow, Clear Water	1.8	0.2	(0 to 2.5)	5.9	1.1	(0 to 6.0)	2.1	0	(0 to 2.0)	-0.01	0	(0 to 0)
Scenario 2 – Moderate Flow, Cloudy Water	-2.3	0	(-1.0 to 0)	-4.5	0	(-4.0 to 0)	-1.6	0	(-1.0 to 0)	0	0	(0 to 0)
Scenario 3 – High Flow, Very Cloudy Water	-7.5	-2.0	(-10.0 to 0)	-14.0	-5.0	(-20.0 to 0)	-6.1	0	(-5.0 to 0)	-0.56	0	(0 to 0)
Scenario 4 – High Flow, Clear Water	0.9	0	(0 to 1.0)	3.4	0	(0 to 2.0)	1.9	0	(0 to 1.0)	0.2	0	(0 to 0)
Scenario 5 – Very Low Flow	-6.0	-1.0	(-7.5 to 0)	-12.0	-3.0	(-13.0 to 0)	-4.8	-0.2	(-4.0 to 0)	-0.5	0	(0 to 0)

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BOATING

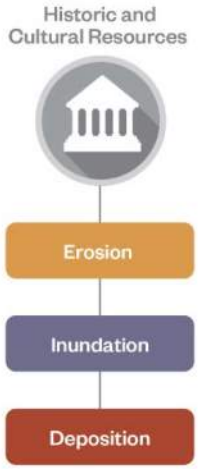
Similar to the fishing assessment presented above, questionnaire responses received were used to inform the boating assessment (see Section 5.3.4, "Open Space and Recreation" impact assessment). Of the questionnaire responses received, 122 of the respondents indicated they paddle on lower Esopus Creek, and 62 noted they utilize lower Esopus Creek for motorized boating (see Section 7.3, "Socioeconomic Conditions"). Based on these responses, it is anticipated recreational use of lower Esopus Creek would only decrease during *high flow*, *very cloudy* conditions, or *very low flow* conditions. Based on the survey responses, for *high flow* conditions that are *cloudy* or *clear*, participation in boating along lower Esopus Creek would increase. As with recreational swimming and fishing, the Proposed Action would provide a potential benefit to recreational boating by providing sustained flow to lower Esopus Creek year-round through the community release. The potential benefit of this sustained flow would diminish moving downstream. As discussed for fishing, turbidity levels of flows from Ashokan Reservoir in the future with the Proposed Action are anticipated to be similar to those that occur in the future without the Proposed Action. Turbidity levels of these flows would fall within the range and variability of turbidity levels that occur in lower Esopus Creek streamflow.

CONCLUSIONS

Overall, the Proposed Action has the potential to improve recreational opportunities associated with swimming, fishing, and boating as compared to the future without the Proposed Action by providing sustained flow to lower Esopus Creek year-round through the community release. Since a majority of the recreational activities occur in the downstream portions of lower Esopus Creek (i.e., Valley Reaches 3D, 3E) the benefit would be small. Turbidity levels of flows from Ashokan Reservoir in the future with the Proposed Action are anticipated to be similar to those that occur in the future without the Proposed Action in locations downstream of the spillway confluence where public recreational opportunities are located. Therefore, there are no anticipated significant adverse impacts to lower Esopus Creek open space and recreational resources as a result of the Proposed Action.

7.5 HISTORIC AND CULTURAL RESOURCES

Historic and cultural resources encompass buildings, structures, sites, districts, and objects of historical, aesthetic, cultural, and archaeological importance. This section evaluates historic and archaeological resources in the lower Esopus Creek study area and evaluates the potential for impacts to these resources as a result of the Proposed Action.



7.5.1 BASELINE CONDITIONS

The historic and cultural resources study area includes the area within a quarter-mile area along the length of lower Esopus Creek beginning at Ashokan Reservoir and ending in the Village of Saugerties at the confluence of lower Esopus Creek and the Hudson River.

ARCHITECTURAL RESOURCES

NYSOPRHP has identified records for 60 properties listed on the National/State Register of Historic Places (N/SR) or eligible for listing on the N/SR within or partially within the study area and three historic districts (see **Table 7.5-1** and **Figure 7.5-1** through **Figure 7.5-6**).

Table 7.5-1. Historic Resources Within the Study Area

Valley Reach	Name	Label Number (see Figure 7.5-1 through Figure 7.5-6)	National/ State Register Status	Location
1A	Ben Nesin Lab	1	Eligible	Town of Olive
	Shokan Old Electric Shop	2	Eligible	Town of Olive
	Bridge over the Relic Channel Esopus Creek	3	Eligible	Town of Olive
	Glass Shop/Blacksmith Shop	4	Listed	Town of Olive
	Print Shop	5	Listed	Town of Olive
	Tin/Pewter Shop	6	Listed	Town of Olive
1A	Winchell-Moehring House	7	Listed	Town of Olive
	Moehring Barn	8	Listed	Town of Olive
	Ashokan-Turnwood Covered Bridge	9	Listed	Town of Olive
NA (spillway channel)	Stone Church Bridge	10	Eligible	Town of Marbletown

Table 7.5-1. Historic Resources Within the Study Area (Continued)

Valley Reach	Name	Label Number (see Figure 7.5-1 through Figure 7.5-6)	National/ State Register Status	Location
2C	Reformed Church of Hurley	11	Listed	Town of Hurley
	Crispel Reformed Dutch Church Parsonage	12	Listed	Town of Hurley
	Dr. Ten Eyck House	13	Listed	Town of Hurley
	Bevier House	14	Listed	Town of Hurley
	Late 19th Century Frame House	15	Listed	Town of Hurley
	Frame Bungalow	16	Listed	Town of Hurley
	Frame Colonial Revival circa 1920-35	17	Listed	Town of Hurley
	Dumond House	18	Listed	Town of Hurley
	Elmendorf House	19	Listed	Town of Hurley
	Polly Crispel Cottage	20	Listed	Town of Hurley
	Elmendorf House – Half Moon Tavern	21	Listed	Town of Hurley
	Old Hurley Cemetery	22	Listed	Town of Hurley
	Pieter Cornelissen Louw House (the Ruin)	23	Listed	City of Kingston
	93 North Front Street	24	Listed	City of Kingston
	89 North Front Street	25	Listed	City of Kingston
	79 North Front Street	26	Listed	City of Kingston
	59 North Front Street	27	Listed	City of Kingston
	57 North Front Street	28	Listed	City of Kingston
	53-55 North Front Street	29	Listed	City of Kingston

Table 7.5-1. Historic Resources Within the Study Area (Continued)

Valley Reach	Name	Label Number (see Figure 7.5-1 through Figure 7.5-6)	National/ State Register Status	Location
2C	49-51 North Front Street	30	Listed	City of Kingston
	47 North Front Street	31	Listed	City of Kingston
	43-45 North Front Street	32	Listed	City of Kingston
	41 North Front Street	33	Listed	City of Kingston
	39 North Front Street	34	Listed	City of Kingston
	37 North Front Street	35	Listed	City of Kingston
	35 North Front Street	36	Listed	City of Kingston
	33 North Front Street	37	Listed	City of Kingston
	31 North Front Street	38	Listed	City of Kingston
	52-58 North Front Street	39	Listed	City of Kingston
	50 North Front Street	40	Listed	City of Kingston
	46-48 North Front Street	41	Listed	City of Kingston
	44 North Front Street	42	Listed	City of Kingston
	42 North Front Street	43	Listed	City of Kingston
	38 North Front Street	44	Listed	City of Kingston
	34-36 North Front Street	45	Listed	City of Kingston
	335 Wall Street	46	Listed	City of Kingston
	333 Wall Street	47	Listed	City of Kingston
	334 Wall Street	48	Listed	City of Kingston
	332 Wall Street	49	Listed	City of Kingston
	Ertel Building	50	Listed	City of Kingston
	Herzog Building	51	Listed	City of Kingston
	Tremper-Livingston House	52	Listed	City of Kingston
3E	Trinity Church Parish House	53	Listed	Village of Saugerties
	Trinity Church	54	Listed	Village of Saugerties
	Trinity Church Rectory	55	Listed	Village of Saugerties

Table 7.5-1. Historic Resources Within the Study Area (Continued)

Valley Reach	Name	Label Number (see Figure 7.5-1 through Figure 7.5-6)	National/ State Register Status	Location
3F	Loerzel Building	56	Listed	Village of Saugerties
	Former Sheffield Mill/ The Mill at Saugerties/ 55 East Bridge Street	57	Eligible	Village of Saugerties
	Warehouse 1, Saugerties Steamboat Co.	58	Listed	Village of Saugerties
	Warehouse 2, Saugerties Steamboat Co.	59	Listed	Village of Saugerties
	Saugerties Lighthouse	60	Listed	Village of Saugerties
Historic Districts				
1A	Ashokan Field Campus Historic District	NA	Listed	Town of Olive
2C	Hurley Historic District	NA	Listed	Town of Hurley
	Kingston Stockade Historic District	NA	Listed	City of Kingston

Note:
NA – Not Applicable

Source: NYSOPRHP Cultural Resource Information System (CRIS), https://cris.parks.ny.gov/, accessed May 21, 2019.

Fifty-five of the properties are N/SR-listed historic buildings according to the NYSOPRHP Cultural Resource Information System (CRIS) website, and five properties are identified as eligible for listing. Seven of the listed properties, the Saugerties Lighthouse (#49), the Glass Shop/Blacksmith Shop (#4), the Print Shop (#5), the Tin/Pewter Shop (#6), the Winchell-Moehring House (#7), the Moehring Barn (#8), and the Ashokan-Turnwood Covered Bridge, also known as Barrington Lodge Bridge (#9), are also listed on the National Register of Historic Places. Nearly half of the listed properties are located in Valley Reach 2C in the City of Kingston, within the Kingston Stockade Historic District.

In addition to properties, NYSOPRHP also notes historic building districts. There are several in the lower Esopus Creek study area: Hurley Historic District, Ashokan Field Campus Historic District, and Kingston Stockade Historic District. The Ashokan Field Campus Historic District was recently listed on the New York State and National Registers of Historic Places. While the Kingston Stockade Historic District is not adjacent to lower Esopus Creek, it still falls within the study area. Both the Ashokan Field Campus Historic District and the Hurley Historic District have boundaries that extend to the edge of lower Esopus Creek. The Ashokan Field Campus District, the Hurley Historic District and the Kingston Stockade Historic District are also listed on the National Register of Historic Places.

ARCHAEOLOGICAL RESOURCES

In 1999, a Phase 1 Cultural Resource survey was conducted at the Ashokan Field Campus, located within the study area, as part of a project that included the demolition and restoration of portions of the Ashokan Field Campus site. This survey identified no cultural material or archaeological sites. In addition, a number of other archaeological surveys have been undertaken along the length of lower Esopus Creek within the study area for other projects.

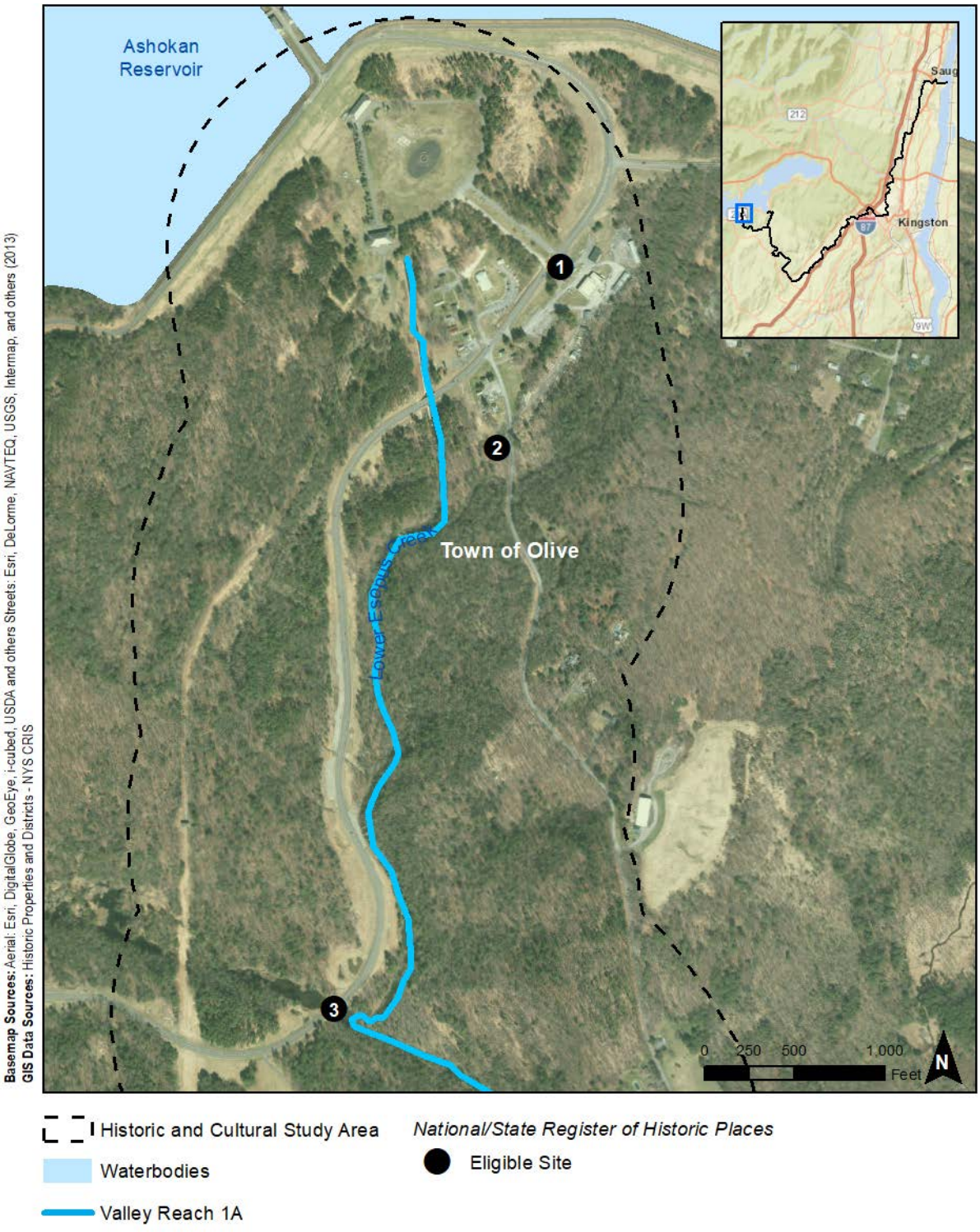


Figure 7.5-1
Lower Esopus Creek
Properties Listed on National/State Register of Historic Places

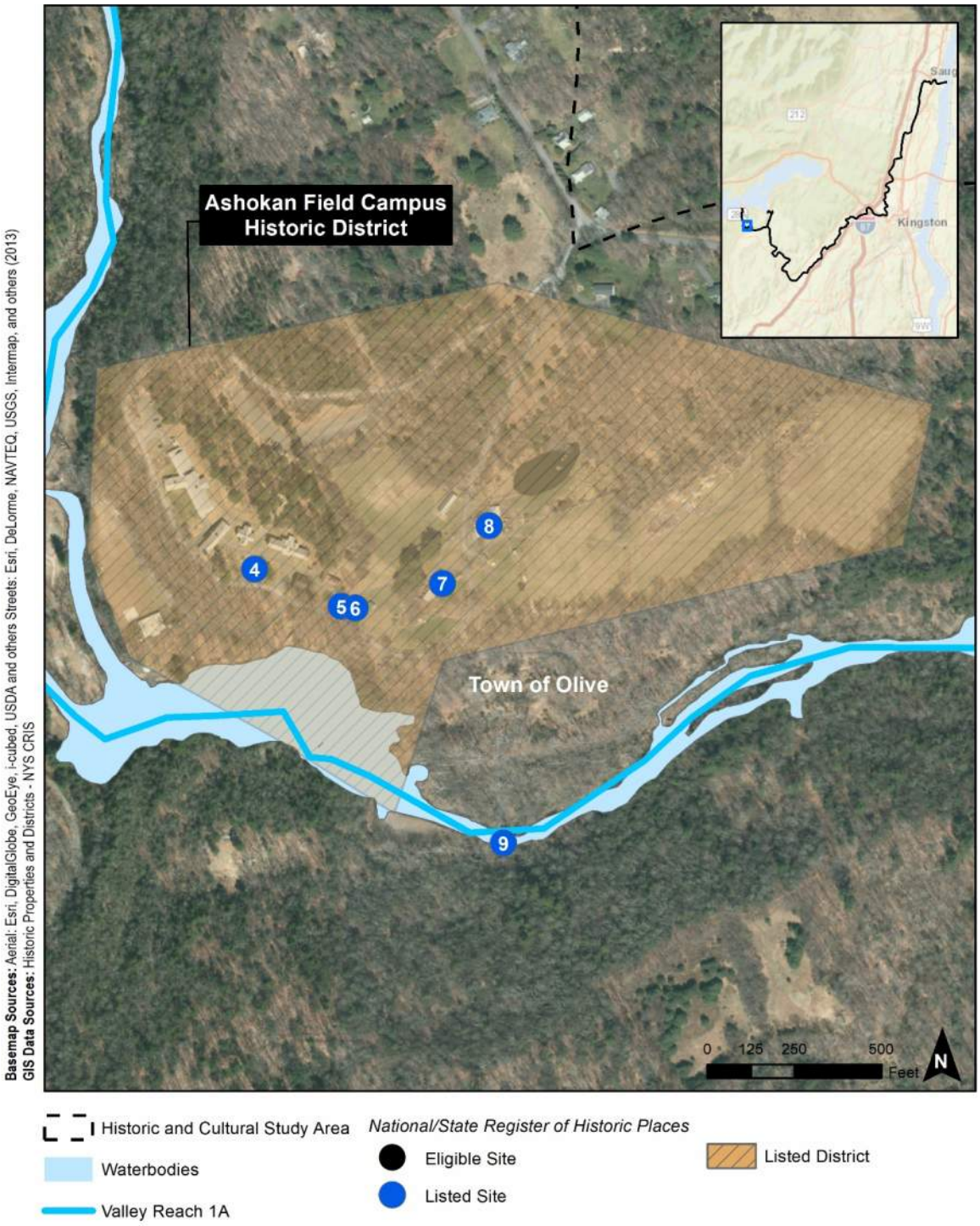


Figure 7.5-2
Lower Esopus Creek
Properties Listed on National/State Register of Historic Places

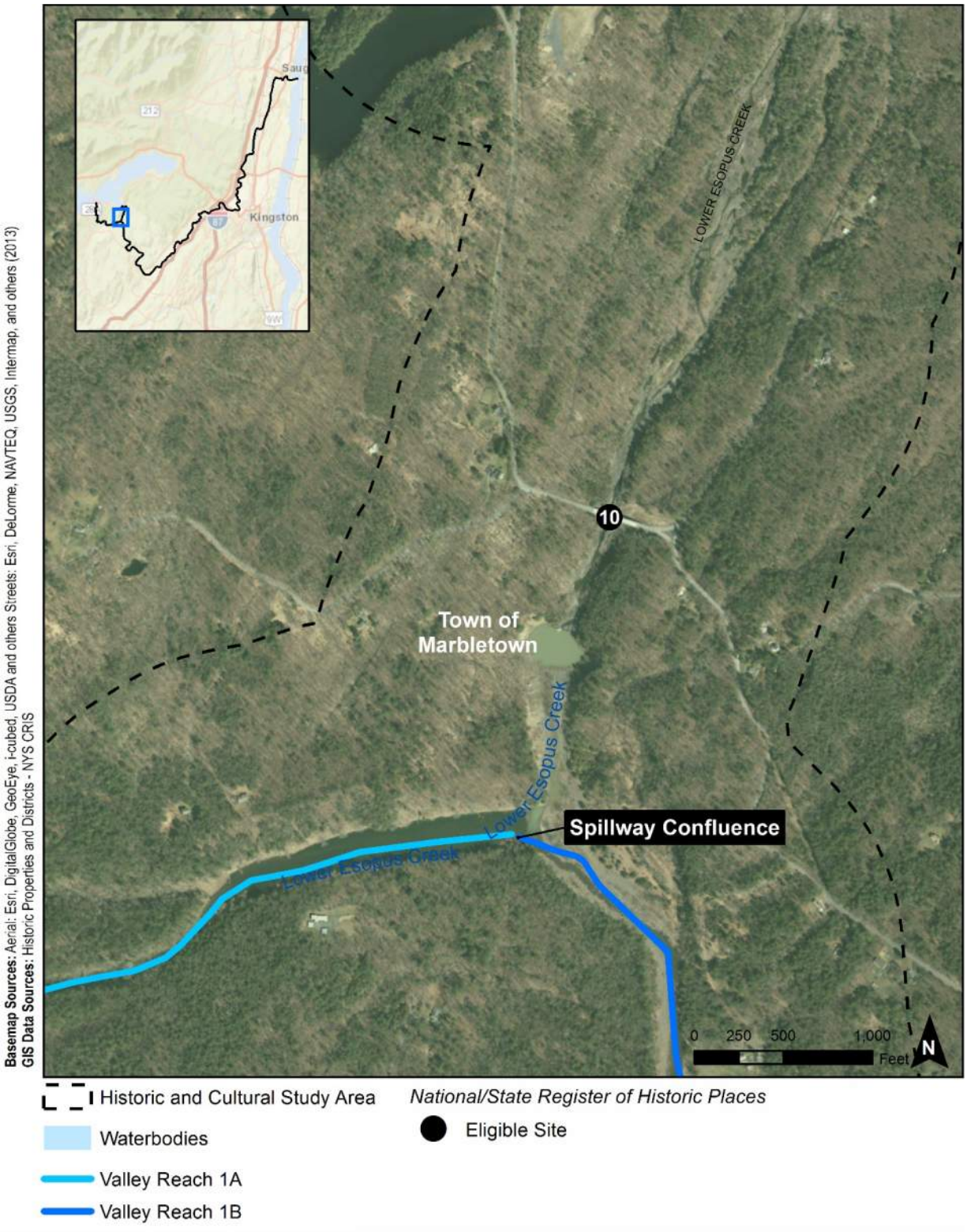


Figure 7.5-3
Lower Esopus Creek
Properties Listed on National/State Register of Historic Places

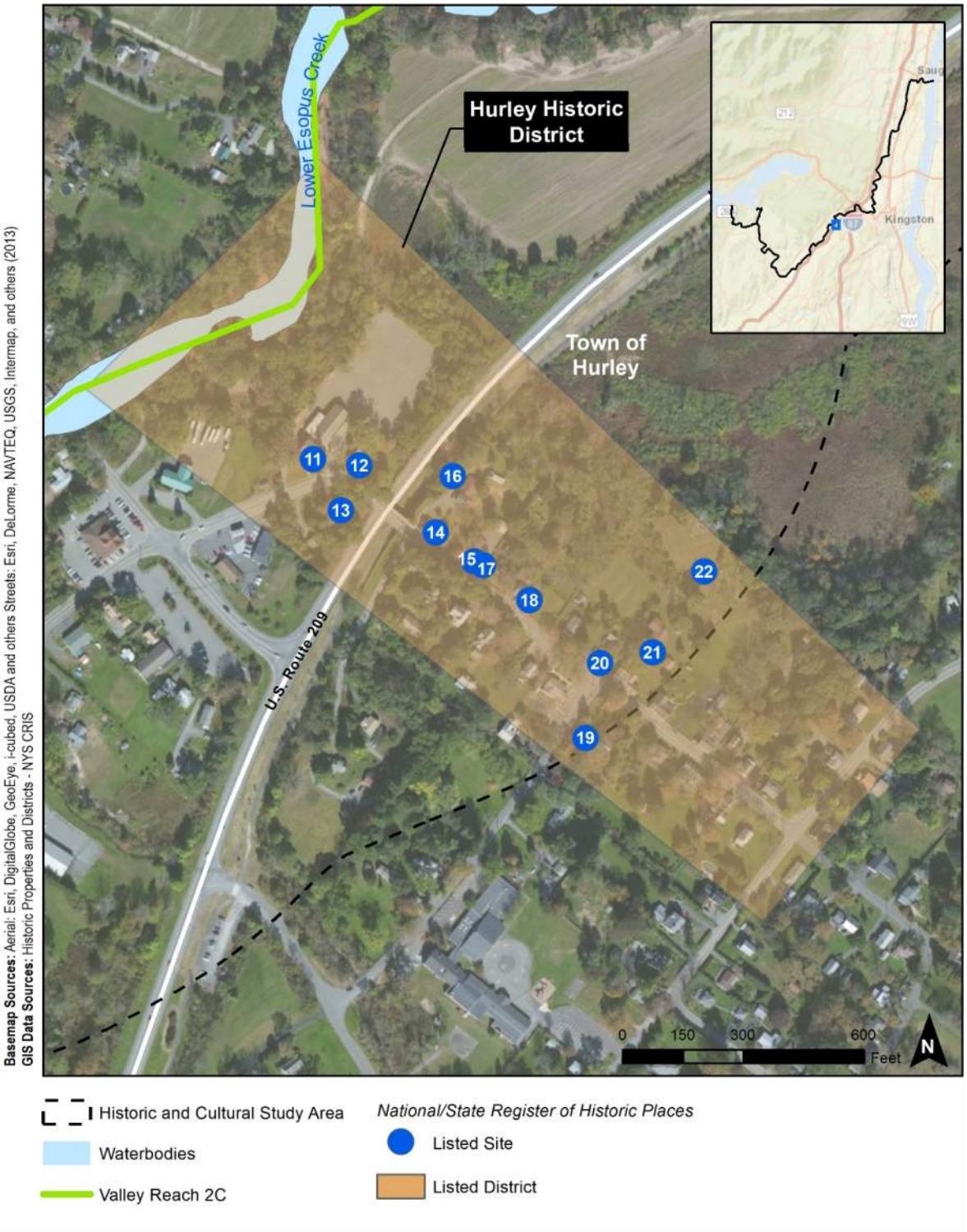


Figure 7.5-4
Lower Esopus Creek
Properties Listed on National/State Register of Historic Places

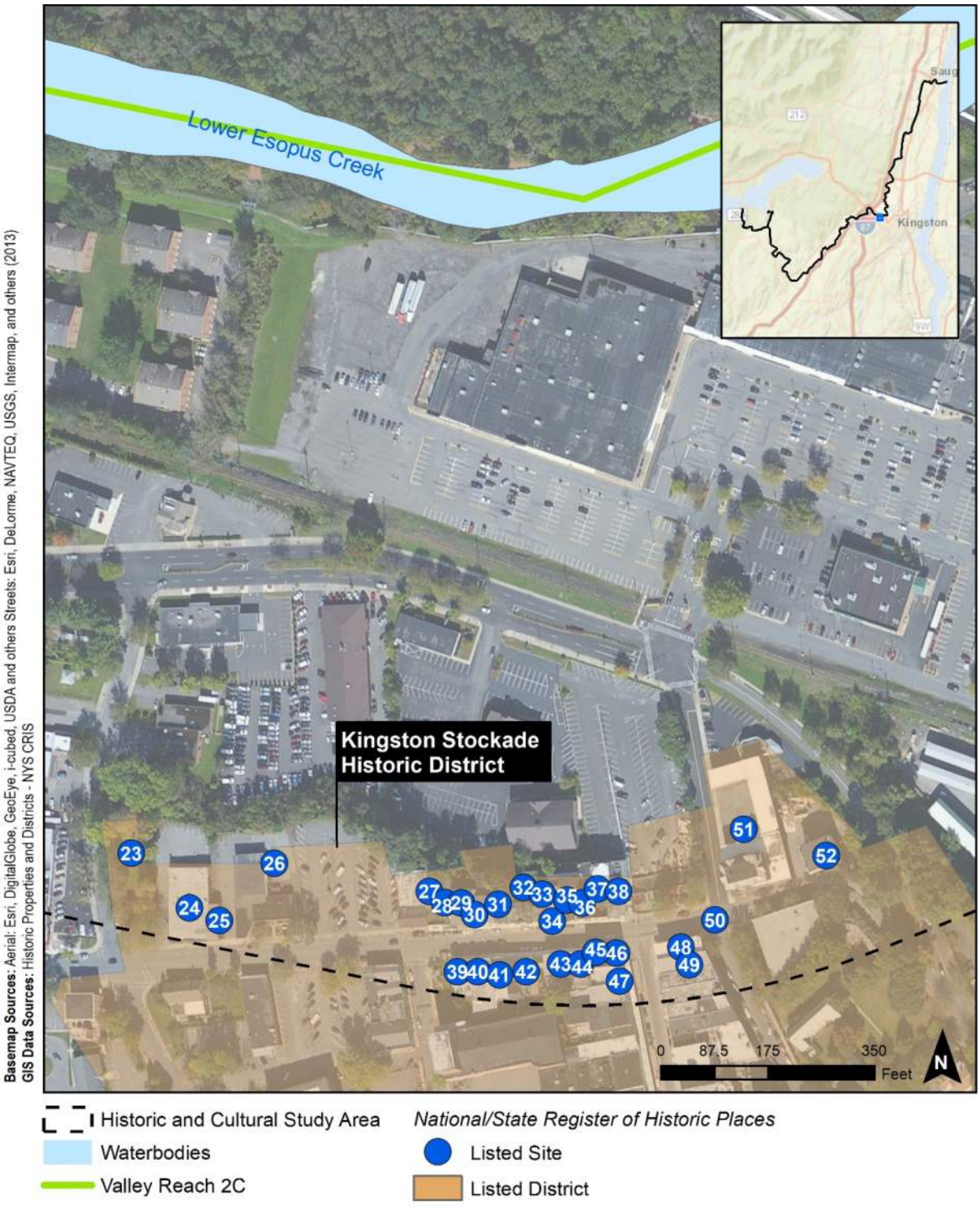


Figure 7.5-5
Lower Esopus Creek
Properties Listed on National/State Register of Historic Places

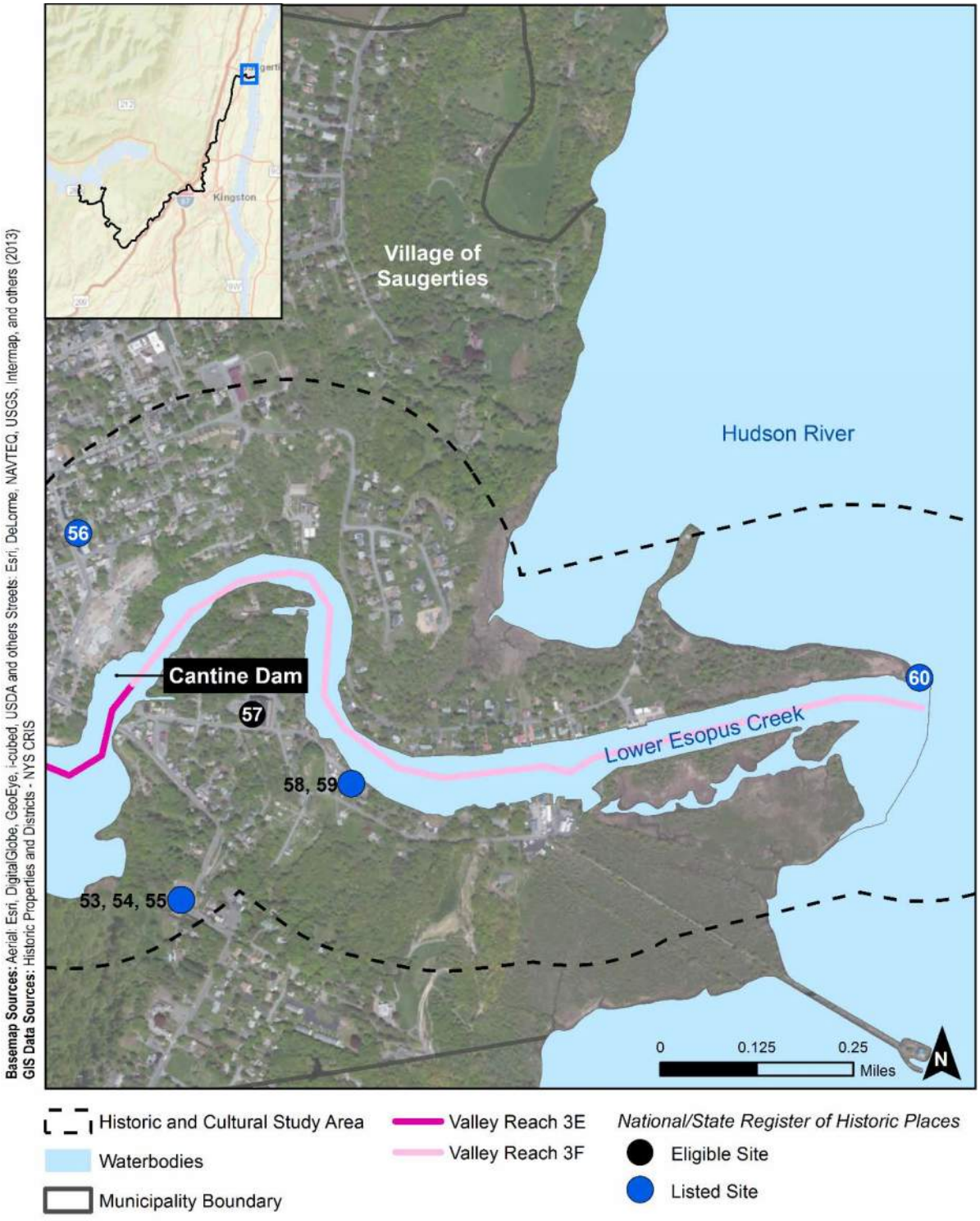


Figure 7.5-6
Lower Esopus Creek
Properties Listed on National/State Register of Historic Places

7.5.2 FUTURE WITHOUT THE PROPOSED ACTION

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from the contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

7.5.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action.

ARCHITECTURAL RESOURCES

Fifty-six of the 60 historic architectural resources identified in the study area are located more than 200 feet away from lower Esopus Creek. The Ashokan-Turnwood Covered Bridge, located in Valley Reach 1A, falls within the inundation boundary as defined by the HEC-RAS modeling for the future with the Proposed Action, as shown in **Figure 7.5-7**. Three historic structures – Warehouses 1 and 2 of the Saugerties Steamboat Co. and the Saugerties Lighthouse – are located downstream of Cantine Dam in Valley Reach 3F, which is tidally influenced and would not be affected by differences between the future without and with the Proposed Action.

As discussed in Section 7.1, "Water Resources and Water Quality," HEC-RAS modeling was conducted to determine potential levels of inundation along lower Esopus Creek upstream of Cantine Dam. As stated in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," HEC-RAS modeling indicated that streamflow in the future with the Proposed Action would remain in the channel up to approximately 4,000 to 7,000 MGD (6,189 to 10,831 cfs). Therefore, streamflow in the range of the releases in the future with the Proposed Action would not result in any flooding of roads, buildings, or properties (including the noted 56 architectural resources) located outside the channel.

While the Covered Bridge is located within the inundation boundary associated with releases up to 600 MGD (928 cfs), it has regularly experienced water levels associated with 600 MGD releases. A field visit conducted in fall 2018 showed that water levels associated with this release level do not reach the bridge deck (**Figure 7.5-8**).

In addition, while the Kingston Stockade Historic District is within the study area, the district is not located adjacent to lower Esopus Creek and would not be affected by potential differences in streamflow in lower Esopus Creek between the future without and with the Proposed Action. Finally, while the boundaries of the Ashokan Field Campus District and the Hurley Historic District extend to the edge of lower Esopus Creek, streamflow in the range of the releases in the future with the Proposed Action would not result in flooding of any structures within these districts. NYSOPRHP was consulted and their determination letter dated May 22, 2019 indicated that the Proposed Action would have no impact on historic resources located within the study area. Therefore, the Proposed Action is not anticipated to affect architectural resources.

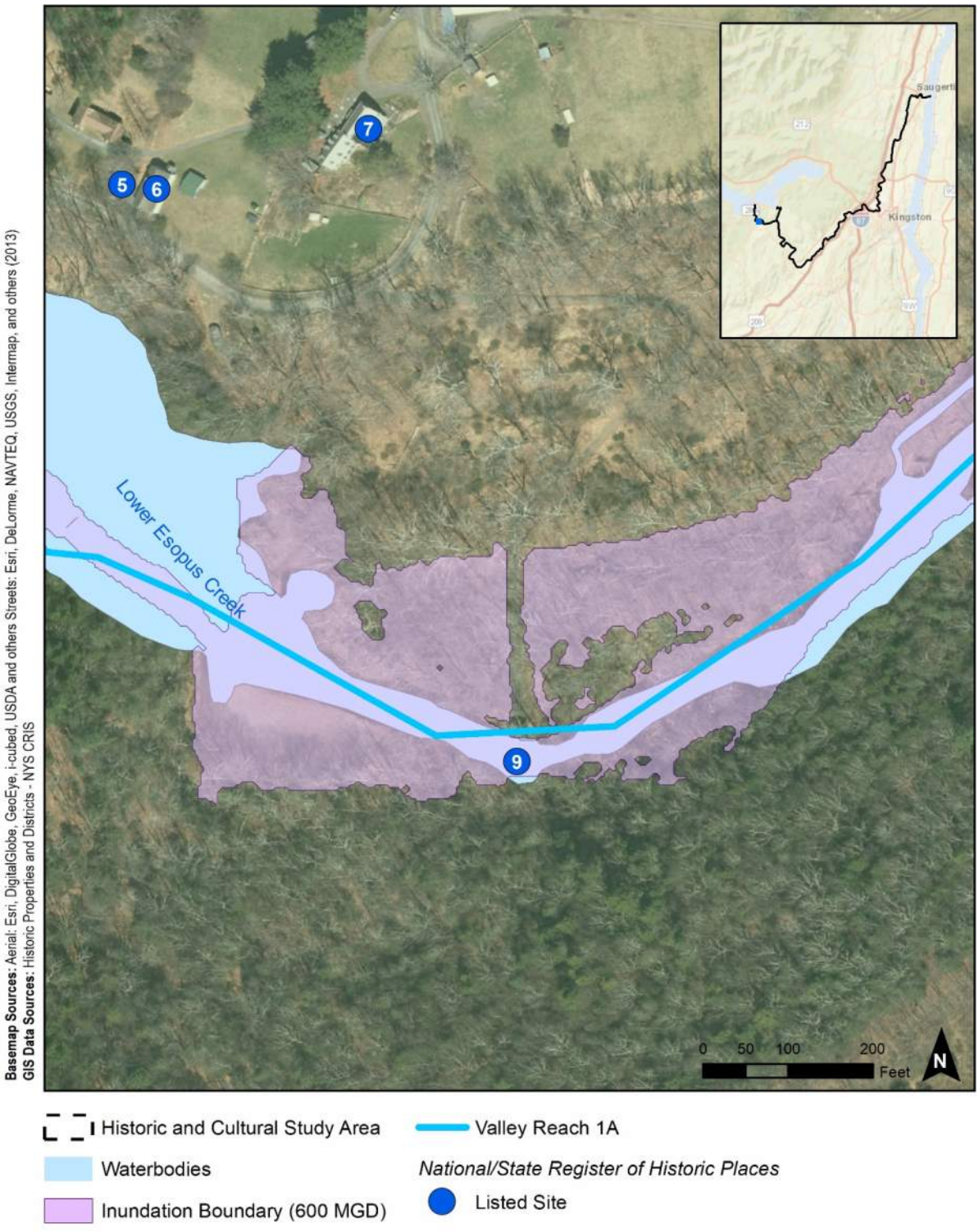


Figure 7.5-7
Lower Esopus Creek
Properties Listed in National/State Register of Historic Places

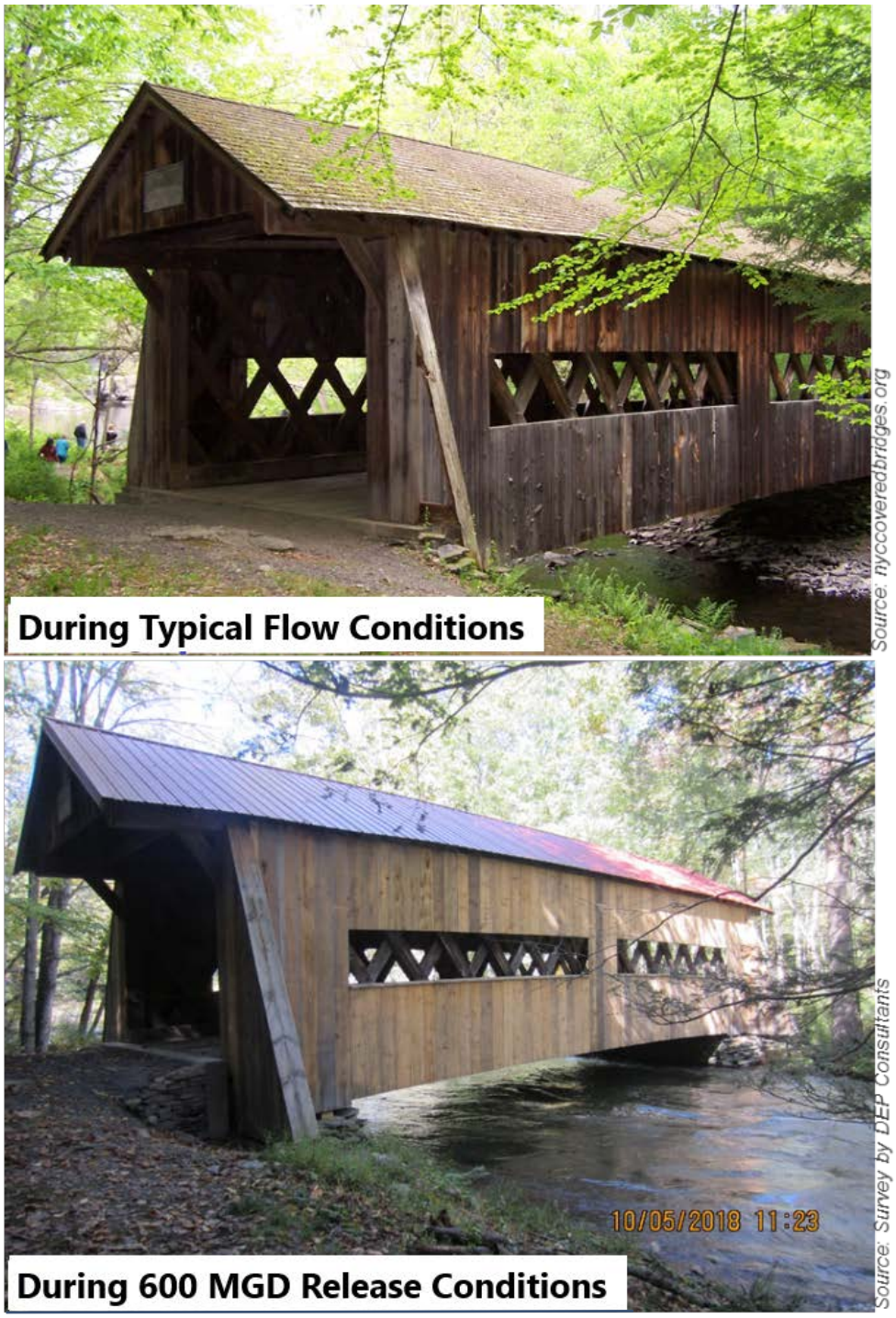


Figure 7.5-8
Lower Esopus Creek
The Ashokan-Turnwood Covered Bridge during Typical (Background) Streamflow and 600 MGD (928 cfs) Release

ARCHAEOLOGICAL RESOURCES

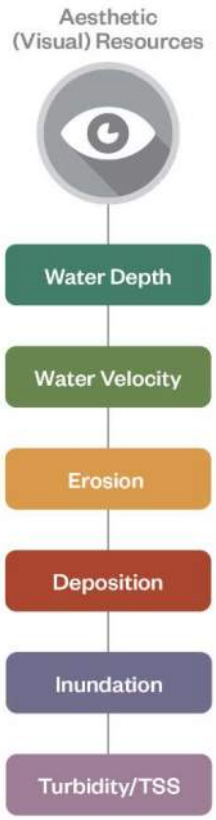
As discussed in Section 5.3.6, "Historic and Cultural Resources" methodology, assessment of archaeological resources considered locations where identified resources would be co-located with areas where there would be potential differences in inundation or erosion and deposition between the future without and with the Proposed Action. As noted in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," erosion is anticipated to be highest in Valley Reach 2C but would be comparable between the future without and with the Proposed Action. In addition, no cultural material or archaeological sites have been identified within the study area. Therefore, the Proposed Action is not anticipated to affect archaeological resources.

CONCLUSIONS

Historic and cultural resources would not be affected by the Proposed Action because all but one resource (the Ashokan-Turnwood Covered Bridge) would either be outside of the inundation boundary in the future with the Proposed Action, or are located in Valley Reach 3F which is tidally influenced and would not be affected by the Proposed Action. The Ashokan-Turnwood Covered Bridge, which is within the modeled inundation boundary, has regularly experienced flows up to 600 MGD (928 cfs) and it was field-verified that water levels associated with this release level do not reach the bridge deck. NYSOPRHP was consulted and their determination indicated that the Proposed Action would have no impact on archaeological and/or historic resources located within the study area, including the Covered Bridge, the Kingston Stockade District, the Ashokan Field Campus Historic District, and the Hurley Historic District. Therefore, there are no anticipated significant adverse impacts to historic or archaeological resources as a result of the Proposed Action.

7.6 AESTHETIC (VISUAL) RESOURCES

This section presents the assessment of the potential for the Proposed Action to result in changes to views to or from aesthetic (visual) resources within the lower Esopus Creek study area. It also assesses publicly accessible view corridors with aesthetic value within the lower Esopus Creek study area that could be altered due to the Proposed Action.



7.6.1 BASELINE CONDITIONS

The visual resources study area consists of the area within 400 feet of either side of lower Esopus Creek, including lower Esopus Creek itself (see **Figure 7.6-1** and **Figure 7.6-2**). This section includes a characterization of baseline views towards lower Esopus Creek from the identified resources, as well as a description of the views from lower Esopus Creek as experienced by individuals participating in recreational activities.

The discussion of aesthetic resources is grouped based on relative location along lower Esopus Creek, including upstream aesthetic resources (resources located along Valley Reach 1A, upstream of the spillway confluence), Valley Reach 2C resources, and downstream resources (resources located along Valley Reaches 3D, 3E, and 3F). There are no visual resources located along Valley Reach 1B.

The visual resources within the study area are identified in **Table 7.6-1**. There were 30 visual resources identified within the study area due to their recreational usage, scenic qualities/status, eligibility/listing on the National/State Register of Historic Places, or their National Heritage status.

The overall visual character of the study area varies along lower Esopus Creek. The upstream portion of the study area (i.e., Valley Reaches 1A and 1B) is located in forested, undeveloped, rural areas with limited access points or views to lower Esopus Creek. Downstream in Valley Reach 2C, there are more access points and views to lower Esopus Creek as the surrounding land use becomes more developed with farmlands, fields, residential, and commercial areas. Further downstream at Valley Reaches 3D and 3E, lower Esopus Creek flows through additional suburban residential and undeveloped areas. The farthest downstream portion of the study area (i.e., Valley Reach 3F) includes the Village of Saugerties, where lower Esopus Creek flows through residential and commercial areas before reaching the Hudson River.

UPSTREAM AESTHETIC RESOURCES

The aesthetic resources in the study area located upstream of the spillway confluence in Valley Reach 1A include a State Park and scenic areas (Catskill Park, Catskill Mountains Scenic Byway), local recreational resources (Ashokan Reservoir, DEP Ashokan Day Use Area), several listed resources on the National/State Register of Historic Places (Ashokan Field Campus Historic District and its associated buildings, and Ashokan-Turnwood Covered Bridge), and two resources within the study area that are eligible for listing on the National/State Register of Historic Places (Bridge over the Relic Channel Esopus Creek and Stone Church Bridge).

Table 7.6-1. Visual Resources Within the Study Area

Valley Reach	Label Number	Resource	Type	Approximate Distance from Resource to Lower Esopus Creek
1A	1	Catskill Park	State Park (Recreational/Scenic)	0 feet (Catskill Park is adjacent to lower Esopus Creek)
	2	Ashokan Reservoir	Local Resource (Recreational)	0 feet (Ashokan Reservoir is connected to lower Esopus Creek)
	3	Catskill Mountains Scenic Byway	(Recreational/Scenic)	125 feet
	4	DEP Ashokan Day Use Area	Local Resource (Recreational)	175 feet
	5	Bridge over the Relic Channel of Esopus Creek	National/State Register of Historic Places (Eligible)	125 feet
	6	Ashokan Field Campus Historic District	National/State Register of Historic Places (Listed)	0 feet (the Field Campus is adjacent to lower Esopus Creek)
	7	Print Shop	National/State Register of Historic Places (Listed)	150 feet
	8	Glass Shop/Blacksmith Shop	National/State Register of Historic Places (Listed)	260 feet
	9	Tin/Pewter Shop	National/State Register of Historic Places (Listed)	160 feet
	10	Ashokan-Turnwood Covered Bridge (Barrington Lodge Bridge)	National/State Register of Historic Places (Listed)	0 feet (Bridge crosses over lower Esopus Creek)
	11	Stone Church Bridge	National/State Register of Historic Places (Eligible)	0 feet (Bridge crosses over lower Esopus Creek)
2C	12	Tongore/Marbletown Park	Local Resource (Recreational)	0 feet
	13	Crispel Reformed Dutch Church Parsonage	National/State Register of Historic Places (Listed)	375 feet
	14	Reformed Church of Hurley	National/State Register of Historic Places (Listed)	250 feet
	15	Hurley Historic District	National/State Register of Historic Places (Listed)	0 feet (The district is located adjacent to lower Esopus Creek)
	16	O&W Rail Trail (Planned Portion)	Local Resource (Recreational)	400 feet
	17	Lower Esopus Creek Fishing Access and Boat Launch	Local Resource (Recreational)	0 feet (The fishing access is located adjacent to lower Esopus Creek)
All	18	Lower Esopus Creek	Local Resource (Recreational)	NA

Table 7.6-1. Visual Resources Within the Study Area

Valley Reach	Label Number	Resource	Type	Approximate Distance from Resource to Lower Esopus Creek
3E	19	Esopus Bend Nature Preserve	Local Resource (Recreational)	0 feet (A portion of the Esopus Bend Nature Preserve is located adjacent to lower Esopus Creek)
	20	Village of Saugerties Beach and Esopus Creek Access	Local Resource (Recreational)	0 feet (The beach is located adjacent to lower Esopus Creek)
3F	21	Former Sheffield Mill	National/State Register of Historic Places (Eligible)	350 feet
	22	Tina Chorvas Waterfront Park	Local Resource (Recreational)	0 feet (The park is located adjacent to lower Esopus Creek)
	23	Warehouse 1, Saugerties & NY Steamboat Co.	National/State Register of Historic Places (Listed)	17 feet
	24	Warehouse 2, Saugerties & NY Steamboat Co.	National/State Register of Historic Places (Listed)	15 feet
	25	Saugerties Lighthouse	National/State Register of Historic Places (Listed)	0 feet (The lighthouse is at the confluence of lower Esopus Creek and the Hudson River)
3F	26	Ruth Reynolds Glunt Nature Preserve/Saugerties Lighthouse	Local Resource (Recreational)	0 feet (The lighthouse is at the confluence of lower Esopus Creek and the Hudson River)
	27	Hudson River	Hudson River Resource (American Heritage River)	0 feet (lower Esopus Creek converges with Hudson River)
	28	Ulster North Scenic Areas of Statewide Significance	Scenic Areas of Statewide Significance	NA
All	29	Hudson River Valley National Heritage Area	Hudson River Resource (National Heritage Area)	NA
NA	30	Hudson River Art Trail	Hudson River Resource (Scenic)	2.2 miles

Notes:

CEQR guidance establishes a 400-foot study area for assessing views by a pedestrian at publicly accessible visual resources. View corridors outside the 400-foot study area were also considered in the assessment (see Section 5.3.7, "Aesthetic (Visual) Resources" impact assessment methodology).

NA – Not applicable

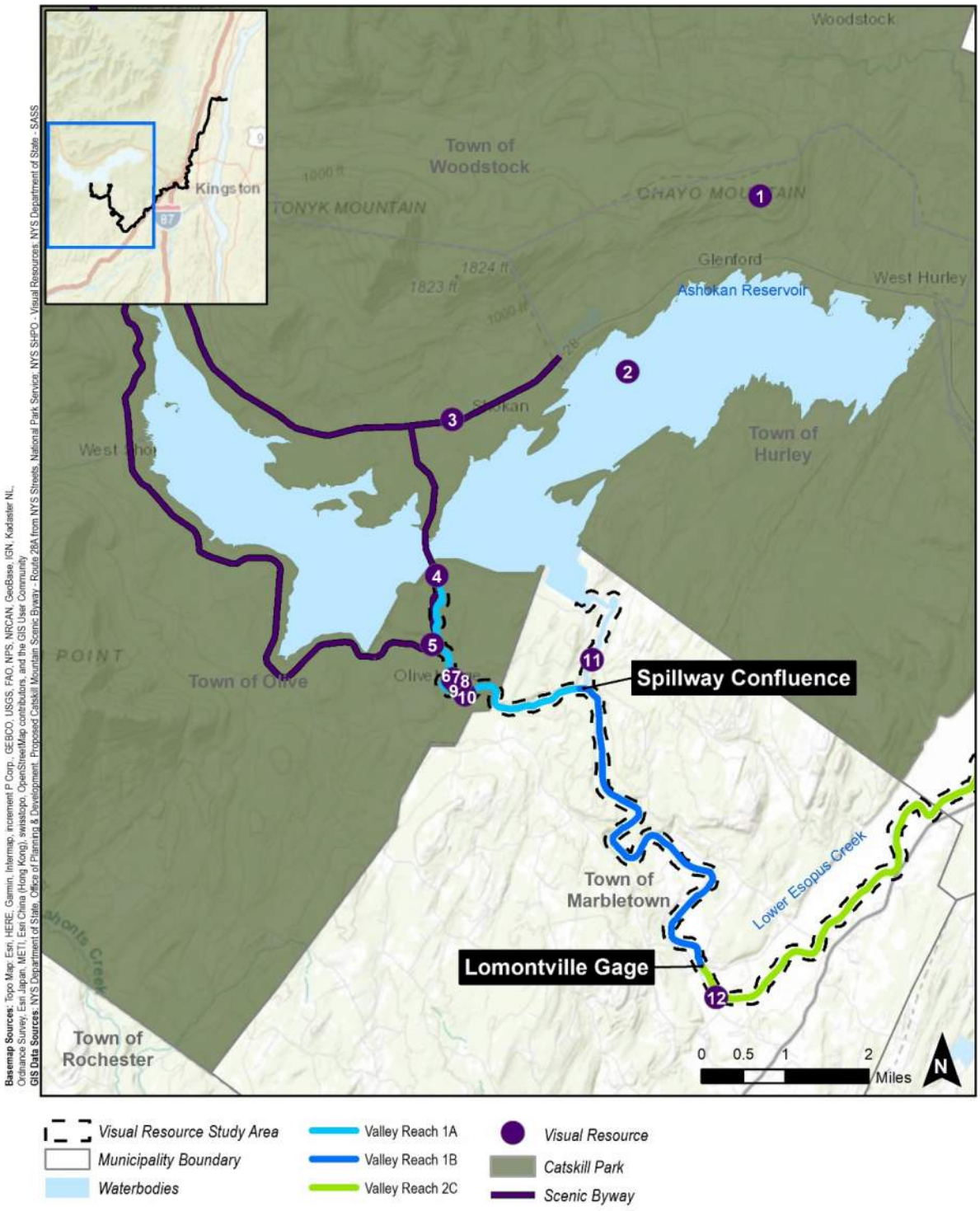


Figure 7.6-1
Lower Esopus Creek (Western Portion)
Visual Resources

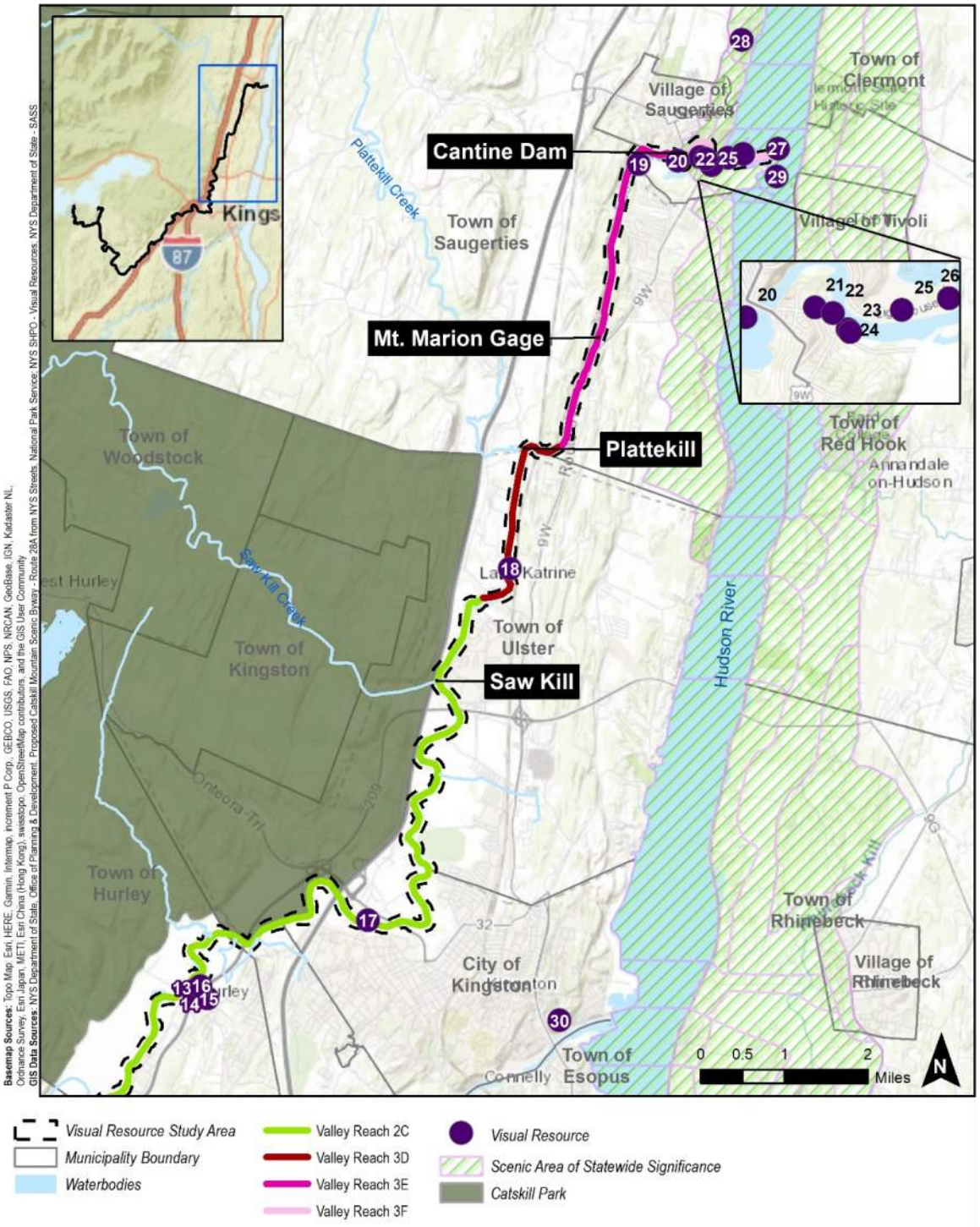


Figure 7.6-2
Lower Esopus Creek (Eastern Portion)
Visual Resources

State Parks and Scenic Areas

The largest of the aesthetic and visual resources along lower Esopus Creek is Catskill Park, which is comprised of approximately 700,000 acres and spans Ulster, Greene, Delaware, and Sullivan counties. Catskill Park includes mountainous areas of public and private lands. In total, approximately 310 acres (and approximately one mile in length) fall within the westernmost portion of the study area. Roughly 287,500 acres of the park are preserved as State forest; however, this acreage does not fall within the study area. Furthermore, the study area does not overlap with any section of the park that is dedicated to tourism or recreational uses, and there are no identified trails or waterway access locations within the portion of Catskill Park within with the study area.

The 52-mile Catskill Mountains Scenic Byway primarily follows New York State Route 28, with short extensions along New York State Routes 42 and 214 through the Central Catskills. Less than a mile (approximately 4,500 feet) of the byway passes through the western portion of the study area. There are no scenic overlooks along this section of roadway and views from passing vehicles to the study area are limited due to the surrounding dense deciduous and evergreen vegetation.

Local Resources

There are many local visual resources within the study area associated with recreational use of lower Esopus Creek. Lower Esopus Creek is not visible from Ashokan Reservoir or the Ashokan Day Use Area due to the presence of dense vegetation between the resource and lower Esopus Creek.

National/State Register of Historical Places

Upstream of the spillway confluence, there are multiple resources within the study area that are either currently under consideration for listing or are listed on the National/State Register of Historic Places. Those with direct views of lower Esopus Creek include the Ashokan Field Campus and its associated buildings (Print Shop, Glass Shop/Blacksmith Shop, Tin/Pewter Shop), and the Ashokan-Turnwood Covered Bridge. Views of lower Esopus Creek from Ashokan Field Campus during typical streamflow and 600 MGD (928 cfs) release conditions are shown on **Photographs 1 and 2**. At this location, lower Esopus Creek is wide and shallow. Views from the Ashokan-Turnwood Bridge under typical streamflow and 600 MGD (928 cfs) release conditions are of lower Esopus Creek, surrounding wetland vegetation and wooded areas. Views from the bridge are presented in **Photograph 3**. The Stone Church Bridge is located along the Ashokan Reservoir Spillway Channel. The view from the bridge and spillway channel is shown on **Photograph 4**. The bridge over the relic channel of lower Esopus Creek on NY-28A is located between Olivebridge Dam and Valley Reach 1A and does not have direct views of lower Esopus Creek.

Photographs 1 and 2. View of Lower Esopus Creek from Ashokan Field Campus (Typical Streamflow - Left) and During a Release (Right – 570 MGD, 882 cfs)

Photograph 3. View of Lower Esopus Creek from the Ashokan-Turnwood Covered Bridge (Background Streamflow)

Photograph 4. View of Lower Esopus Creek from the Stone Church Bridge

VALLEY REACH 2C AESTHETIC RESOURCES

The aesthetic resources in the study area located in Valley Reach 2C include several local recreational resources and several resources listed on the National/State Register of Historic Places.

Local Resources

There are many local visual resources within the study area associated with recreational use of lower Esopus Creek. Lower Esopus Creek is not visible from the planned O&W Rail Trail (a partially constructed trail that follows the former O&W Railroad in Southern New York) due to the presence of dense vegetation between the resource and lower Esopus Creek.

The remaining Valley Reach 2C local resources noted in **Table 7.6-1** may have direct views of lower Esopus Creek. Per Section 7.4, "Open Space and Recreation," Marbletown Beach/Tongore Park and Lower Esopus Creek Fishing Access and Boat Launch provide recreational opportunities. Recreational users of/near lower Esopus Creek enjoy its scenic qualities within the context of its overall surroundings. As such, the visual quality of the local recreational resources noted in this section include lower Esopus Creek, as well as its surrounding landscape (e.g., local and long-range views of vegetation and mountains). Streamflow characteristics (i.e., water depth and water clarity/turbidity levels) within lower Esopus Creek are a part of its scenic quality, and affects recreational users' experience. **Photographs 5 and 6** show the view of lower Esopus Creek from local resources located along Valley Reach 2C.

Photographs 5 and 6. View of Lower Esopus Creek from Tongore/Marbletown Park (Left), Lower Esopus Creek Fishing Access and Boat Launch (Right).

National/State Register of Historic Places

There are several resources along Valley Reach 2C that are currently listed on either the National or State Register of Historic Places. Among these is the Hurley Historic District, which includes a concentration of historic buildings such as the Reformed Church of Hurley. The boundary of the Hurley Historic District extends to the edge of lower Esopus Creek.

DOWNSTREAM AESTHETIC RESOURCES

The aesthetic resources in the study area located downstream (i.e., Valley Reaches 3D, 3E, and 3F) include a scenic area of statewide significance (Ulster North), several local recreational resources,

multiple resources within the study area that are either listed or eligible for listing on the National/State Register of Historic Places, and several Hudson River scenic resources.

Scenic Areas

The Ulster North Scenic Areas of Statewide Significance, which encompasses a ten-mile stretch of the Hudson River, includes views of lower Esopus Creek. The scenic portion of the Hudson River is located in the study area, including its confluence with lower Esopus Creek. Ulster North Scenic Areas of Statewide Significance are divided into ten subunits based on the qualities of the various portions of the scenic area. A portion of the Saugerties Bluff subunit (UN-4) extends to the study area, and the Esopus Creek subunit (UN-5) includes a portion of lower Esopus Creek. Publicly accessible views from the scenic area are available from local roads, lower Esopus Creek itself, the Saugerties Lighthouse, and the Hudson River. There is no publicly-owned land on the waterfront within this scenic area. A view of the UN-5 subunit, from the Saugerties Lighthouse, is shown on **Photograph 7**.

Photograph 7. View of Lower Esopus Creek from the Saugerties Lighthouse

Local Resources

There are many local visual resources within the study area associated with recreational use of lower Esopus Creek. All of the downstream local resources noted in **Table 7.6-1** may have direct views of lower Esopus Creek. Per Section 7.4, "Open Space and Recreation," Esopus Bend Nature Preserve, Village of Saugerties Beach and Esopus Creek Access, Tina Chorvas Waterfront Park, the Ruth Reynolds Glunt Nature Preserve, and lower Esopus Creek provide recreational opportunities. **Photographs 8** through **11** show the view of lower Esopus Creek from local resources located in the study area. Recreational users of/near lower Esopus Creek enjoy the scenic qualities of lower Esopus Creek within the context of its overall surroundings.

National/State Register of Historic Places (Eligible)

Downstream of Cantine Dam, eligible historic resources with direct views of lower Esopus Creek include: the Saugerties Steamboat Company Warehouse 1 and Warehouse 2, which are historically significant steamboat dock storehouses located on the banks of lower Esopus Creek; and the Saugerties Lighthouse, which was originally constructed in 1834 and is the oldest lighthouse on the Hudson River.

Views of lower Esopus Creek from Saugerties Steamboat Company Warehouse 1 and Warehouse 2 are shown on **Photograph 12** and **Photograph 13**. The Saugerties Lighthouse is located at the confluence of lower Esopus Creek and the Hudson River. A view of lower Esopus Creek from the Saugerties Lighthouse is shown as part of the Ulster North Scenic Area of Statewide Significance discussion in **Photograph 7**.

The Former Sheffield Mill in the Village of Saugerties does not have direct views of lower Esopus Creek due to its distance from it and the presence of vegetation and/or buildings that obstruct any views to it.

Photographs 8 through 11. View of Lower Esopus Creek from Esopus Bend Nature Preserve (Top Left), Village of Saugerties Beach (Top Right), Tina Chorvas Waterfront Park (Bottom Left), Ruth Reynolds Glunt Nature Preserve (Bottom Right)

Photograph 12. View towards Lower Esopus Creek from Warehouse No. 1 During High Streamflow Conditions and High Tide

Photograph 13. View towards Lower Esopus Creek and Warehouse No. 1 and No. 2

Hudson River Resources

There are three Hudson River-related visual resources identified within or in the vicinity of the study area. The Hudson River School Art Trail is of scenic importance in the region. It includes sites with natural views that inspire artists. The closest the trail gets to lower Esopus Creek is Hasbrouck Park in Kingston. However, this park is located over two miles southeast of lower Esopus Creek, and due to the distance and topography, lower Esopus Creek is not visible from this location. As a result, the important vistas at this location are the eastward vistas from the park towards the Hudson River.

The mouth of lower Esopus Creek is located at its confluence with the Hudson River, which is an American Heritage River. Views from the Hudson River to the study area extend from this location, upstream approximately 3,400 feet along lower Esopus Creek, due to the meander in lower Esopus Creek that occurs at this distance from the river.

Finally, the entire study area is within the Hudson River Valley National Heritage Area. The Hudson River Valley National Heritage Area, spanning north from the New York City line to Troy, collaborates with residents, government agencies, non-profit groups, and private partners to interpret, preserve, and celebrate the nationally significant cultural and natural resources of the Hudson River Valley. The Heritage Area includes numerous historic resources, including the Saugerties Lighthouse (also a historic resource, discussed above). Views from the lighthouse are similar to those within the Hudson River National Heritage Area.

7.6.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP has consulted the municipalities within the study area and Ulster County and has not been informed of upcoming new projects that would affect aesthetic resources within the study area.

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from the contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

7.6.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, “Water Resources and Water Quality”). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, “Operation of Ashokan Reservoir in Accordance With the IRP,” the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action. Turbidity levels in flows from Ashokan Reservoir would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow.

EFFECTS ON VALLEY REACHES 1A AND 1B VISUAL RESOURCES

As discussed in Section 7.1.4, “Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality,” water velocity, water depth and inundation along lower Esopus Creek varies with flow rate and local topography. Without releases from Ashokan Reservoir, the section of lower Esopus

Creek upstream of the spillway confluence would only receive runoff from a small contributing sub-watershed. In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases in the future with the Proposed Action would also increase the extent of inundation in Valley Reaches 1A and 1B. However, streamflow would remain within the stream channel of lower Esopus Creek (Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime ad Water Quality"). In the future with the Proposed Action, viewers would continue to enjoy a similar visual experience of lower Esopus Creek and its surroundings as in the future without the Proposed Action.

As discussed in Section 7.1.3, "Summary of Effects of the Proposed Action on Flow Regime and Water Quality," due to coarse material and bedrock outcrops that are resistant to bank erosion in Valley Reach 1A, rates of erosion (and subsequent deposition) in this reach are anticipated to be comparable between the future without and with the Proposed Action. Downstream of the spillway confluence, starting in Valley Reach 1B, streamflow in the future without and with the Proposed Action is anticipated to be comparable. Therefore, rates of erosion and deposition in this reach are also anticipated to be comparable. The number of days of streamflow with turbidity levels greater than 25 NTU would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow. There is a potential for release turbidity levels to exceed the 30 NTU trigger in the IRP for short periods (up to 12 consecutive days during an episodic turbidity event) in Valley Reach 1A in the future with the Proposed Action which would not occur in the future without the Proposed Action. It is not anticipated there would be a significant adverse visual impact in Valley Reach 1A due to the short duration of the condition.

EFFECTS ON VALLEY REACH 2C VISUAL RESOURCES

As discussed in 7.1.2 "Summary of Effects of the Proposed Action on Flow Regime and Water Quality," median water depth in Valley Reach 2C is anticipated to be less than one-half foot higher between the future with and without the Proposed Action. Water velocities in the future with the Proposed Action would be comparable to those in the future without the Proposed Action in Valley Reach 2C. This is due to the diminishing percent contribution of flows from Ashokan Reservoir moving downstream, and the presence of a well-developed floodplain. Streamflow in the range of the maximum release magnitude in the future with the Proposed Action would remain within the stream channel and would only inundate the inner berm. Views of and from Valley Reach 2C related to erosion and deposition are not anticipated to change as a result of the Proposed Action. As discussed in Section 7.1.1, "Flow Regime and Water Quality in Lower Esopus Creek," turbidity levels would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow.

EFFECTS ON VALLEY REACHES 3D, 3E, 3F VISUAL RESOURCES

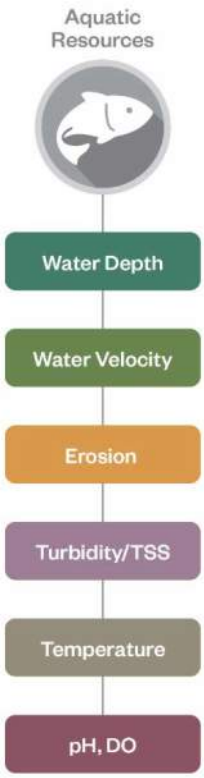
The Proposed Action would not result in any changes to water depth, velocity, inundation, erosion or deposition in Valley Reaches 3D, 3E, and 3F. As with the upstream reaches, it is anticipated turbidity levels would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow. Therefore, views of lower Esopus Creek in these valley reaches would be similar between the future without and with the Proposed Action.

CONCLUSIONS

In the future with the Proposed Action, releases would increase the velocity and depth of the water in Valley Reach 1A of lower Esopus Creek as compared to the future without the Proposed Action. The extent of inundation would increase, most noticeably in narrow portions of lower Esopus Creek, but remain within the channel. Turbidity levels of releases would be below 5 NTU approximately 70 percent of the time based on OST modeling. In valley reaches downstream of the spillway confluence, velocity would be comparable to those in the future without the Proposed Action. While water depth and the extent of inundation would increase, it would remain within the channel. Turbidity levels would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow. Differences in water depth, velocity, and inundation between the future without and with the Proposed Action are not anticipated to impact views of lower Esopus Creek from aesthetic resources, as viewers would continue to enjoy a similar visual experience of lower Esopus Creek and its surroundings. Therefore, there are no significant adverse impacts anticipated to visual resources as a result of the Proposed Action.

7.7 AQUATIC RESOURCES

This section presents an assessment of the potential for the Proposed Action to result in impacts to benthic and fish communities within the lower Esopus Creek study area. It also includes an assessment of the potential effect of the Proposed Action on submerged aquatic vegetation (SAV).



7.7.1 BASELINE CONDITIONS

DEP conducted fish and macroinvertebrate community surveys along lower Esopus Creek in 2009, 2012, 2013, 2014, and 2017 (**Figure 7.7-1**). In 2009, initial sampling of fish and macroinvertebrates was performed at the following six sampling stations: Stations 1 through 5 in Valley Reach 1A, and Station 6 in Valley Reach 1B (**Figure 7.7-2**). In 2012, DEP added four additional sampling stations located in Valley Reaches 2C, 3D, and 3E (Stations 7 through 10) (**Table 7.7-1)**. In 2013, DEP added an additional sampling station in Valley Reach 1B (Station 5A). Valley Reach 3F, which is located downstream of Cantine Dam, was not sampled since this is the tidally-influenced portion of lower Esopus Creek and is not anticipated to be affected by the Proposed Action.

Table 7.7-1. Spatial and Temporal Distribution of Fish and Macroinvertebrate Sampling Stations

Sampling Years	Sampling Stations by Valley Reach										
	Reach 1A					Reach 1B		Reach 2C		Reach 3D	Reach 3E
	1	2	3	4[2]	5	5A	6	7	8	9	10
2009	X	X	X	X	X		X				
2012	X	X	X		X		X	X	X	X	X
2013	X	X	X	X[3]	X	X	X	X	X	X	X
2014	X	X	X		X	X	X	X	X	X	X
2017	X	X	X		X	X	X	X	X	X	X

Notes:
[1] X indicates when/where fish and/or macroinvertebrate samples were collected.
[2] Station 4 was dry on most sampling dates.
[3] Only a macroinvertebrate sample (no fish sample) was collected at Station 4 in 2013.

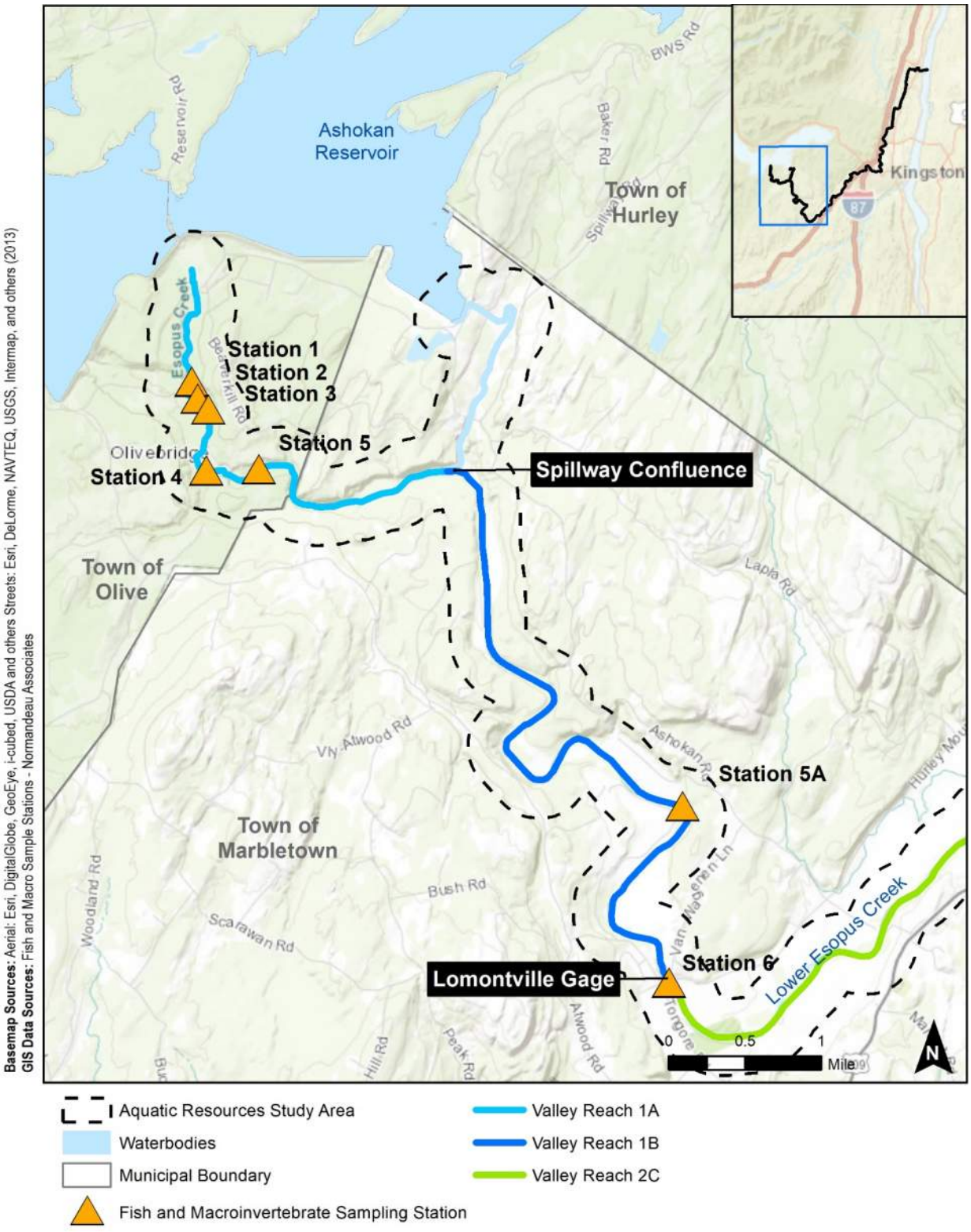


Figure 7.7-1
Lower Esopus Creek Study Area
Fish and Macroinvertebrate Sampling Stations

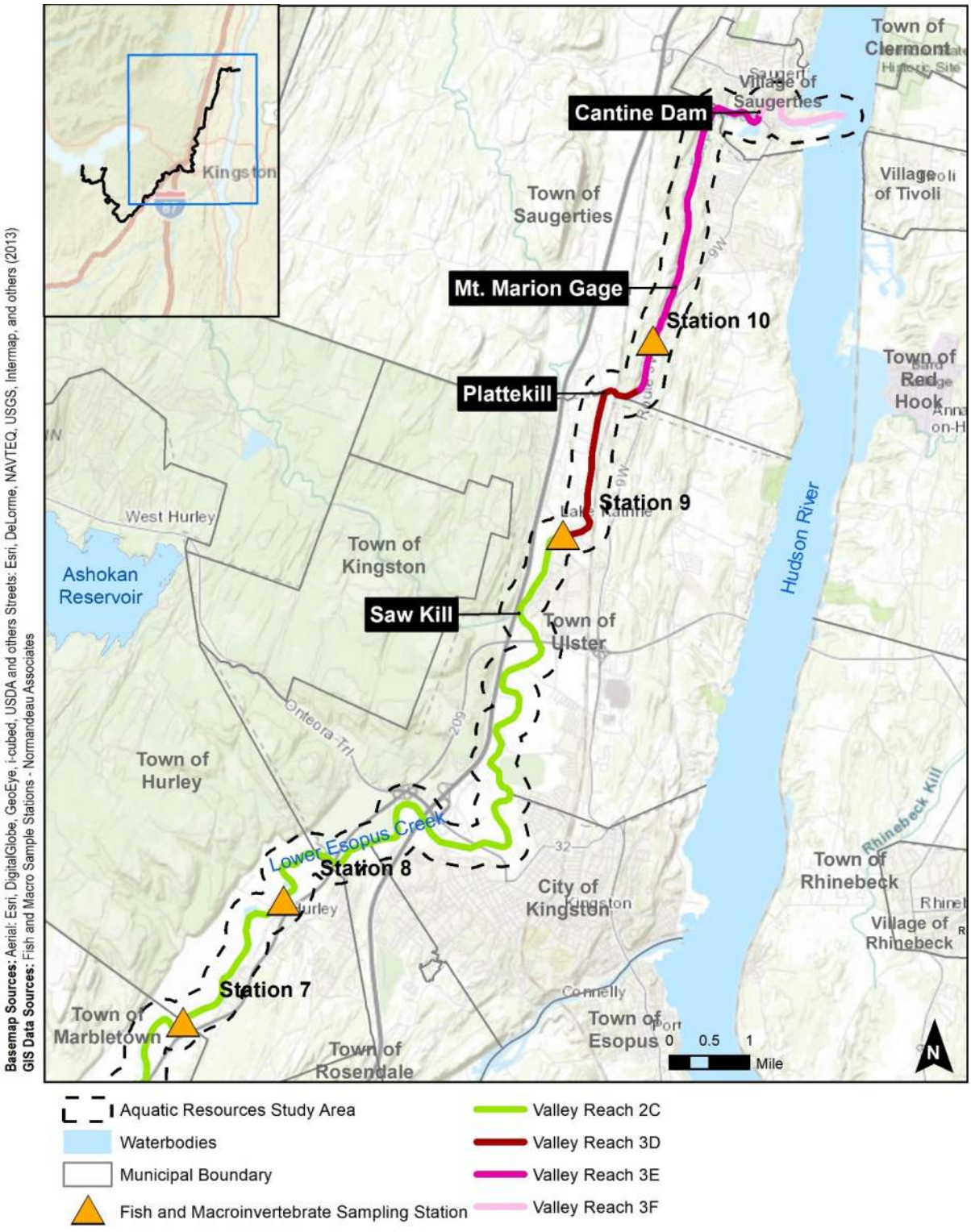


Figure 7.7-2
Lower Esopus Creek Study Area
Fish and Macroinvertebrate Sampling Stations

Benthic Macroinvertebrates

Benthic macroinvertebrate sampling was conducted in accordance with NYSDEC's Standard Operating Procedure: Biological Monitoring of Surface Water in New York State published in 2016. The majority of the species collected during the monitoring period were insects, including mayflies (*Ephemeroptera*), stoneflies (*Plecoptera*), aquatic beetles (*Coleoptera*), non-biting midges (*Chironomidae*), and caddisflies (*Trichoptera*). Many taxa that were collected are considered relatively intolerant of poor water quality or habitat disturbance. Annelids (*Oligochaeta*) were abundant in many samples, most notably in 2009 and 2014. Crustacean taxa that were present in lower Esopus Creek include amphipods (*Gammaridae, Crangonyctidae*) and crayfish (*Cambaridae*). Relatively few mollusks were collected; however, fingernail clams (*Sphaeriidae*) and freshwater snails (*Planorbidae*) were consistently present in the samples.

A range of biotic indices, including Species Richness, Ephemeroptera/Plecoptera/Trichoptera (EPT) Richness, Hilsenhoff's Index, Percent Model Affinity, and Nutrient Biotic Index (for phosphorus) were calculated for each station over the years surveyed (**Table 7.7-2**). These indices' values were averaged to provide a condition index score which corresponds to a degradation state ranging from "non-impacted" to "severely impacted." The majority of stations in Valley Reach 1A were deemed to be non-impacted or slightly impacted during all years as compared to the stations in the lower reaches which were predominantly categorized as slightly impacted. Station 9 (Valley Reach 3D) was deemed moderately impacted during all sampling years. No stations were deemed to be "severely impacted." Generally, the number of stations that were categorized as non-impacted increased over the monitoring period, suggesting an overall improvement in the condition of the stream macroinvertebrate community based on the condition index assessment.

Table 7.7-2. Richness and Biological Impact Assessment Scores, Stream Macroinvertebrate Sampling, 2009 to 2017

		Sampling Stations										
Year	Parameter	Reach 1A					Reach 1B		Reach 2C		Reach 3D	Reach 3E
		1	2	3	4	5	5a	6	7	8	9	10 [E]
2009	Richness	18	22	15	27	21	NA	18	NA	NA	NA	NA
	Condition Index	SLIGHTLY	NON	SLIGHTLY	SLIGHTLY	SLIGHTLY	NA	SLIGHTLY	NA	NA	NA	NA
2012	Richness	23	27	26	NA	31	NA	24	24	16	13	27
	Condition Index	SLIGHTLY	SLIGHTLY	NON	NA	SLIGHTLY	NA	SLIGHTLY	SLIGHTLY	SLIGHTLY	MOD	SLIGHTLY
2013	Richness	26	20	19	34	28	23	19	19	20	14	28
	Condition Index	NON	NON	NON	NON	NON	NON	SLIGHTLY	SLIGHTLY	SLIGHTLY	MOD	SLIGHTLY
2014	Richness	22	13	20	NA	22	23	21	17	18	15	24
	Condition Index	SLIGHTLY	SLIGHTLY	NON	NA	NON	SLIGHTLY	SLIGHTLY	SLIGHTLY	SLIGHTLY	MOD	SLIGHTLY
2017	Richness	22	24	25	NA	31	29	26	18	26	11	16
	Condition Index	SLIGHTLY	NON	NON	NA	NON	NON	NON	SLIGHTLY	NON	MOD	SLIGHTLY

Notes:

Assessment scoring definitions based on NYSDEC (2016):

- **Non-impacted:** Indices reflect very good water quality. The macroinvertebrate community is diverse, and virtually unaffected by human disturbance. Water quality should not be limiting to fish survival or propagation.
- **Slightly impacted:** Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation, especially sensitive cold-water fish taxa.
- **Moderately impacted:** Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Water quality often is limiting to fish propagation, but usually not to fish survival.
- **Severely impacted:** Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

NA – Not applicable

In addition to the DEP sampling, NYSDEC conducted a biological assessment at three lower Esopus Creek locations within Valley Reach 1A and Valley Reach 1B in March 2011 (Smith et al., 2015). The assessment was conducted to identify any impacts to aquatic life that may have resulted from turbid water releases after an extended period of heavy rainfall during the fall of 2010. Results from the assessment indicated that water quality conditions in this portion of lower Esopus Creek ranged from non- to slightly-impacted, indicating aquatic life was fully supported.

Fish Assemblages

To support the aquatic resources assessment, a detailed literature review of available information on the fish assemblages of lower Esopus Creek was conducted. The Lower Esopus Watershed Project (LEWP) generally describes the lower Esopus Creek study area fish community as dominated by bass and panfish (e.g., perch, sunfish)[38]. Trout are described as being relatively common upstream of the spillway confluence (Valley Reach 1A), where cold-water conditions and shading provide suitable habitat. Brown and rainbow trout are described as possibly occurring throughout lower Esopus Creek and its tributaries, but, as they must locate cold water to survive, their distribution is primarily limited to upstream of the spillway confluence. American eel (*Anguilla rostrata*) are also described as common in lower Esopus Creek, and elvers (juvenile eels) are able to traverse the Cantine Dam and swim into lower Esopus Creek's tributaries and upstream to Ashokan Reservoir, which is described as their upstream-most distribution limit in lower Esopus Creek.

From approximately 1980 to 2000; tiger muskellunge (*Esox lucius x E. masquinongy*) were stocked by NYSDEC above the Cantine Dam in the Town of Saugerties. They failed to establish a viable recreational fishery; most were, in fact, caught by anglers below the dam in the tidal portion of lower Esopus Creek rather than in the Cantine pool. Similarly, NYSDEC stocked walleye (*Sander vitreus*) during the late 1990s, but this species also failed to establish a viable recreational fishery. The Federated Sportsman's Clubs of Ulster County has also periodically stocked walleye at various locations within lower Esopus Creek (LEWP 2011).

NYSDEC (Bureau of Fisheries) conducted electrofishing surveys in 2014, 2015, and 2016 at deep water locations in the Town of Saugerties, Town of Kingston, and Town of Marbletown. Survey results describe a typical riverine warmwater fish community for this region (Valley Reach 2C through Valley Reach 3D), with the collected fish generally exhibiting fast growth rates and relatively low densities. Representative species included yellow perch, sunfish and bass. The highest catch rates were generally co-located with habitat characterized by large woody debris, especially in the two uppermost locations, per the NYSDEC Bureau of Fisheries Biological Survey Unit Abstract from 2016 and 2017. Electrofishing surveys conducted by DEP in the fall between 2009 and 2019 did not identify any State or federally-listed endangered or threatened fish species present within lower Esopus Creek. Additionally, the only non-native fish species collected during the monitoring period that is considered to be invasive is the Oriental weatherfish (*Misgurnus anguillicaudatus*). Collection data aligned with the NYSDEC and LEWP's description of lower Esopus Creek as primarily a warmwater fishery, with the exception of the most upstream portions (Valley Reach 1A) that support cold-water species (**Figure 7.7-3**).

Species found in Valley Reach 1A over the monitoring period were typically categorized as cold-water fish. Species include: white sucker (*Catostomus commersoni*), blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), cutlips minnow (*Exoglossum maxillingua*), bluntnose minnow (*Pimepheles notatus*) and juvenile brown (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). These were the most abundant species collected at Stations 1, 2, and 3. However, juvenile brown and rainbow trout were approximately half as numerous at Station 3 as compared to Stations 1 and 2 overall. At

[38] Lower Esopus Creek Project. *A Journey through Lower Esopus Creek.* 2011.

Station 4 (which was only sampled in 2009), white sucker, blacknose dace, longnose dace (*R. cataractae*) and bluntnose minnow were the most abundant. A single brown trout juvenile was collected at this location. Collections at Stations 5 and 5A were dominated by white sucker, blacknose dace, longnose dace, creek chub, cutlips minnow, smallmouth bass (*Micropterus dolomieui*), margined madtom (*Noturus insignis*), tessellated darter (*Etheostoma olmstedi*) and American eel. Relatively few trout were collected below the spillway confluence throughout all survey years. The markedly fewer trout, as well as the increased presence of smallmouth bass, indicate the fishery begins to transition away from a cold-water fishery around the spillway confluence.

Species found in Valley Reaches 1B, 2C, 3D, and 3E were typically categorized as warmwater fish. Sampling at Station 6, in Valley Reach 1B, was dominated by redbreast sunfish, smallmouth and largemouth bass (*Micropterus salmoides*), cutlips minnow, margined madtom and tessellated darter. Valley Reach 2C was dominated by fallfish (*Semotilus corporalis*), spotfin shiner (*Cyprinella spiloptera*), smallmouth bass, redbreast sunfish (*Lepomis auritis*) and tessellated darter. Valley Reach 3D was dominated by American eel, bluegill (*L. macrochirus*), redbreast sunfish, smallmouth bass and tessellated darter. As described above, trout habitat is limited in valley reaches downstream of the spillway confluence by elevated summer water temperatures; the only trout collected downstream of the spillway confluence during all sampling years were two trout at Station 9 during the 2014 survey, and two trout at Station 5A during the 2017 electrofishing survey.

The Cantine Dam represents a barrier to all upstream fish migration – except for American eel – and delineates the boundary between the tidal and non-tidal portion of lower Esopus Creek. Representative fish species that may be found in the tidal portion (Valley Reach 3F) include: anadromous and estuarine fish such as striped bass (*Morone saxatilis*), white perch (*Morone americana*), American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*), and blueback herring (*Alosa aestivalis*), along with many of the resident freshwater species that were found in the non-tidal portion of lower Esopus Creek. Large concentrations of largemouth bass are known to overwinter in Valley Reach 3F from October to April. During late spring, river herring (alewife and blueback herring) are collected and sold as bait to anglers. American eel are also common in this valley reach, and elvers (juvenile eels) traverse the Cantine Dam and disperse throughout the non-tidal portion of the lower Esopus Creek and its tributaries (LEWP 2011).

Because the species composition of lower Esopus Creek transitions from a cold-water fishery upstream of the spillway confluence to a warmwater fishery downstream of the spillway confluence, and due to similar variations in streamflow characteristics within portions of lower Esopus Creek, the valley reaches were grouped as upstream (Valley Reach 1A) and downstream (Valley Reaches 1B, 2C, 3D, and 3F) for the assessment of the aquatic resources technical area in this EIS. **Table 7.7-3** and **Table 7.7-4** presents a summary of the presence and absence of fish species identified through electrofishing surveys throughout lower Esopus Creek.

Table 7.7-3. Presence/Absence of Fish Species Collected During Electrofishing Surveys

Sampling Station	Valley Reach	Year	American Eel	White Sucker	Rock Bass	Redbreast Sunfish	Green Sunfish	Pumpkinseed	Bluegill	Smallmouth Bass	Largemouth Bass	Black Crappie	Slimy Sculpin	Satinfin Shiner	Spotfin Shiner	Cutlips Minnow	Common Shiner	Golden Shiner	Comely Shiner	Spottail Shiner	Bluntnose Minnow	E. Blacknose Dace	Longnose Dace	Creek Chub	Fallfish	Banded Killfish	Chain Pickerel	Yellow Bullhead	Brown Bullhead	Margined Madtom	Tessellated Darter	Yellow Perch	Log Perch	Rainbow Trout	Brown Trout	Oriental Weatherfish
1	1A	2009	2	6	2	-	-	3	-	-	14	-	-	2	-	62	-	-	-	-	5	124	-	3	-	-	4	4	-	-	7	-	-	-	40	-
		2012	-	38	-	-	-	3	1	-	-	-	-	-	-	25	-	-	-	-	35	56	-	-	1	-	-	5	-	-	2	-	-	31	1	-
		2013	-	89	-	-	-	-	-	-	1	-	2	-	1	17	-	-	-	-	-	66	3	37	-	-	-	7	-	-	5	-	-	40	-	-
		2014	-	179	-	-	-	-	-	1	9	-	-	-	-	7	-	-	-	-	25	121	-	214	-	-	-	1	-	-	8	-	-	6	21	-
		2017	1	14	-	-	-	-	-	-	1	-	-	-	-	20	-	-	-	-	-	65	-	6	-	-	-	1	-	1	21	-	-	47	33	-
2	1A	2009	-	1	-	-	-	-	1	-	3	-	-	1	-	67	-	-	-	-	9	93	-	3	-	-	-	4	-	-	4	-	-	-	39	-
		2012	-	2	-	-	-	-	-	-	-	-	-	-	-	24	-	-	-	-	9	34	2	1	-	-	-	10	-	-	11	-	-	19	-	-
		2013	-	98	-	-	-	-	-	-	1	-	-	-	-	24	-	-	-	-	8	117	1	31	-	-	-	1	-	1	10	-	-	15	-	-
		2014	-	46	-	-	-	-	-	-	2	-	-	-	-	13	-	2	-	-	4	92	-	100	-	-	-	-	-	-	5	-	-	1	1	-
		2017	-	7	-	-	-	-	-	-	2	-	-	-	-	30	-	-	-	-	-	61	4	18	-	-	-	3	-	-	2	-	-	25	16	-
3	1A	2009	-	9	1	-	-	-	-	-	6	-	-	-	-	185	-	-	-	-	69	108	-	20	-	-	1	10	-	1	15	-	-	-	37	-
		2012	-	92	2	-	-	1	-	-	1	-	-	-	-	117	1	-	-	1	94	54	1	9	2	-	-	11	-	2	15	-	-	27	-	-
		2013	1	93	-	-	-	5	-	-	1	-	-	-	-	52	-	2	-	-	50	57	-	74	-	-	-	6	-	1	9	-	-	11	-	-
		2014	-	110	-	-	-	1	-	1	1	-	-	-	-	29	-	1	-	-	33	136	-	89	-	-	-	2	-	-	16	-	-	-	-	-
		2017	-	15	-	-	-	-	-	-	4	-	1	-	-	102	-	-	-	-	31	247	3	46	-	-	-	-	-	1	5	-	-	8	36	-
4	1A	2009	-	204	-	-	-	2	-	-	-	-	-	4	-	-	-	-	-	-	89	172	-	71	-	-	-	24	-	-	19	-	-	-	1	-
5	1A	2009	30	6	-	6	-	1	-	1	-	-	-	1	-	132	-	-	-	-	1	19	2	2	-	-	-	13	-	-	2	-	7	-	1	-
		2012	48	22	1	-	-	1	-	-	-	-	-	-	-	94	1	-	-	-	2	116	4	2	11	-	-	1	-	1	9	-	1	5	12	-
		2013	82	18	-	3	-	1	-	5	-	-	-	-	-	193	-	-	-	-	13	141	15	101	1	-	-	4	-	2	18	-	11	2	11	-
		2014	7	50	-	-	-	4	-	5	2	-	-	-	-	115	-	-	1	-	12	94	16	91	51	-	-	-	-	2	9	-	1	1	7	-
		2017	24	36	-	-	-	-	-	-	-	-	-	-	-	167	-	-	-	-	-	150	25	22	-	-	-	-	-	1	4	-	-	21	19	-
5A	1B	2013	2	-	1	21	-	1	-	37	-	-	-	-	5	25	-	-	-	-	-	6	28	-	-	-	-	5	-	30	31	-	-	-	-	-
		2014	2	17	5	10	-	-	-	68	4	-	-	-	2	57	-	-	-	-	4	3	10	-	7	-	-	4	-	21	21	2	-	-	-	-
		2017	1	2	1	18	-	3	-	52	1	-	-	-	-	50	-	-	-	-	1	1	11	-	17	3	-	2	-	30	9	-	-	1	1	-

Table 7.7-4. Presence/Absence of Fish Species Collected During Electrofishing Surveys

Sampling Station	Valley Reach	Year	American Eel	White Sucker	Rock Bass	Redbreast Sunfish	Green Sunfish	Pumpkinseed	Bluegill	Smallmouth Bass	Largemouth Bass	Black Crappie	Slimy Sculpin	Satinfin Shiner	Spotfin Shiner	Cutlips Minnow	Common Shiner	Golden Shiner	Comely Shiner	Spottail Shiner	Bluntnose Minnow	E. Blacknose Dace	Longnose Dace	Creek Chub	Fallfish	Banded Killfish	Chain Pickerel	Yellow Bullhead	Brown Bullhead	Margined Madtom	Tessellated Darter	Yellow Perch	Log Perch	Rainbow Trout	Brown Trout	Oriental Weatherfish
6	1B	2009	3	3	2	19	-	2	7	10	1	-	-	-	-	10	-	-	-	-	-	-	1	-	-	-	-	9	-	-	12	-	6	-	-	-
		2012	1	3	1	52	-	1	-	35	4	-	-	-	2	6	-	-	-	1	3	-	24	-	15	1	-	6	-	18	75	-	1	-	-	-
		2013	3	1	-	23	-	1	-	33	2	-	-	-	9	3	-	1	2	-	8	-	10	-	1	-	-	1	-	37	50	-	1	-	-	-
		2014	1	41	9	14	-	-	1	30	1	-	-	-	5	9	-	-	-	-	12	0	14	-	4	1	-	4	-	29	70	-	1	-	-	-
		2017	1	2	15	68	-	3	-	74	2	-	-	-	-	42	-	-	-	-	21	1	1	1	27	36	-	3	-	7	30	-	3	-	-	-
7	2C	2012	4	2	7	38	-	-	1	6	-	-	-	-	-	2	-	-	-	-	-	-	12	-	2	-	-	24	-	1	40	-	-	-	-	-
		2013	4	20	2	33	-	1	14	11	7	-	-	-	65	1	-	-	-	-	11	-	14	-	31	1	1	19	1	-	42	-	-	-	-	-
		2014	-	5	3	14	-	-	-	12	13	-	-	-	111	3	40	-	3	14	21	1	16	-	18	1	-	21	-	-	30	-	-	-	-	-
		2017	2	4	3	39	-	5	7	37	0	-	-	-	42	5	-	-	-	2	19	1	5	-	170	1	-	9	-	3	21	-	-	-	-	4
8	2C	2012	7	11	20	54	-	-	18	10	-	-	-	-	71	5	-	-	-	10	-	3	15	-	54	-	5	13	1	-	60	-	12	-	-	-
		2013	3	21	7	29	-	20	10	4	2	-	-	-	35	-	-	-	-	-	-	-	25	-	-	-	1	18	-	-	128	-	11	-	-	-
		2014	-	60	11	31	-	5	-	3	5	-	-	-	69	13	1	2	-	3	2	11	20	4	74	3	-	2	-	-	48	-	6	-	-	-
		2017	-	17	20	52	-	9	6	9	3	-	-	-	9	16	-	-	-	-	15	4	9	-	55	-	1	6	-	1	65	-	3	-	-	-
9	3D	2012	47	3	2	88	-	10	191	21	31	-	-	-	13	-	1	2	-	1	-	-	7	-	5	-	-	34	-	-	65	-	119	-	-	-
		2013	35	-	-	15	1	3	19	26	-	-	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	7	2	3	-	-	-
		2014	28	1	-	7	-	1	8	10	3	-	-	-	47	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	41	-	12	1	1	-
		2017	44	1	9	66	1	22	70	39	11	3	-	-	1	1	-	-	-	-	-	-	1	-	15	1	-	37	-	-	57	-	7	-	-	1
10	3F	2012	165	1	8	45	-	1	18	19	1	-	-	-	9	-	-	-	-	-	-	-	1	-	-	-	-	3	-	-	11	-	6	-	-	-
		2013	101	-	-	26	1	1	4	90	-	-	-	-	16	-	-	-	-	-	-	-	-	-	8	-	-	3	-	-	2	-	3	-	-	-
		2014	197	-	4	18	-	-	-	9	0	-	-	-	21	-	-	-	-	3	-	-	-	-	9	-	-	2	-	-	19	-	10	0	-	-
		2017	109	2	3	115	1	3	27	48	10	1	-	-	13	12	-	3	-	1	-	-	2	-	16	-	-	24	-	-	32	-	5	-	-	-

SUBMERGED AQUATIC VEGETATION

Aerial survey data from the NYSDEC, collected between 2007 and 2014, identified the majority of the submerged aquatic vegetation (SAV) beds in the lower Esopus Creek area to be just beyond the confluence with the Hudson River at the downstream end of Valley Reach 3F. A significantly smaller SAV bed was also identified within the lower Esopus Creek channel upstream of the Hudson River confluence and downstream of the Cantine Dam near the center of Valley Reach 3F. **Figure 7.7-3** shows the extent of the documented SAV beds within or adjacent to the study area.

A field survey of the lower Esopus Creek estuary within and downstream of Valley Reach 3F (including both lower Esopus Creek and the Hudson River) was conducted in September 2018, to characterize the composition of the SAV beds within the tidal portion of lower Esopus Creek. The survey identified three main SAV species as occurring within defined beds in or near the study area. The survey results identified the most common native SAV species in the study area as water celery (*Vallisneria americana*). Typically, water celery grows in dense patches with high stem density (100 percent cover) where it occurs. However, the water celery patches observed during the field survey varied in size and distribution throughout the study area. The extent of SAV beds increased between the 2014 aerial survey and the 2018 field survey.

Water chestnut (*Trapa natans*) is the most dominant non-native, invasive SAV species within the study area. This species tends to form dense monocultures, as its surface foliage forms dense, impenetrable floating mats that inhibit other SAV species from receiving sunlight underneath the water surface. Other SAV species noted near the water chestnut beds were limited to Eurasian milfoil and patches of pond lily along the margins. Eurasian milfoil (*Myriophyllum spicatum*) is another exotic SAV species commonly found within the study area. This species is not as problematic as the water chestnut and was found to be distributed sporadically in low stem densities over a wide area.

Within the channel of lower Esopus Creek downstream of the Cantine Dam in the center of Valley Reach 3F, the small SAV bed predominately consisted of Eurasian milfoil and low-density water celery.

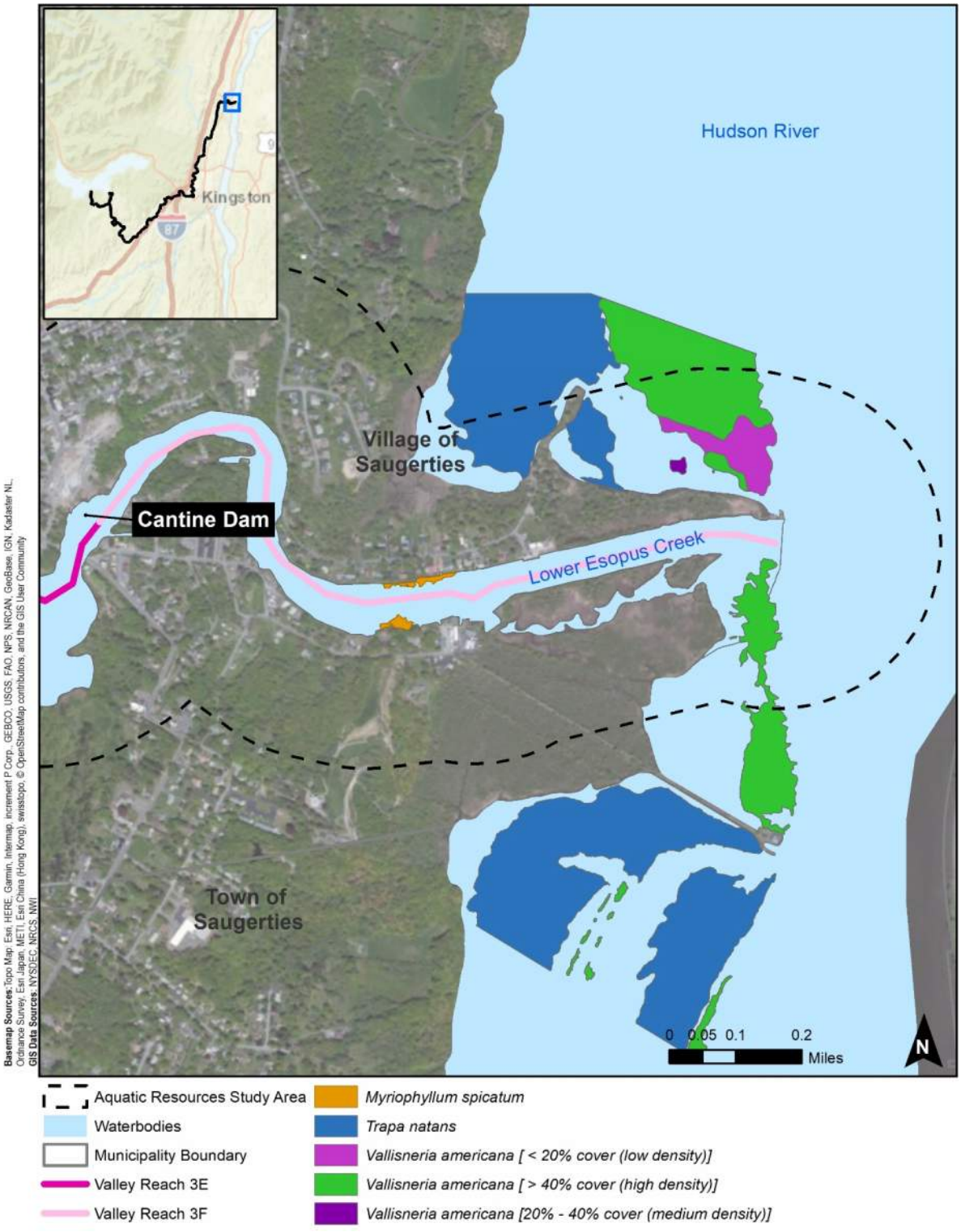


Figure 7.7-3
Lower Esopus Creek Study Area
Observed Submerged Aquatic Vegetation Beds

7.7.2 FUTURE WITHOUT THE PROPOSED ACTION

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from the contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

In the future without the Proposed Action, local populations of native SAV (*V. americana*) within Valley Reach 3F and the lower Esopus Creek estuary are expected to remain the same as baseline conditions or possibly decrease over longer periods of time (as observed in previous seasons 1997-2011). Natural succession by the invasive water chestnut is expected to continue, and any successional changes to the native SAV beds in the future without the Proposed Action are expected to be incremental.

7.7.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance with the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream and Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action. Turbidity levels in flows from Ashokan Reservoir would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow.

UPSTREAM OF SPILLWAY CONFLUENCE (VALLEY REACH 1A)

FLOW REGIME

Streamflow at the community release level would occur in the future with the Proposed Action as compared to the future without the Proposed Action, providing a potential benefit upstream of the spillway confluence by maintaining adequate streamflow, sufficient water depth, and cooler temperatures during summer. The community release in the future with the Proposed Action is likely to benefit most fish species in Valley Reach 1A during summer, especially in early life stages (fry and juveniles) since it would provide a sustained flow to lower Esopus Creek. In contrast to low flow conditions that would occur more frequently in the future without the Proposed Action, the community release in the future with the Proposed Action would benefit most life stages of white sucker, smallmouth bass, and rainbow and brown trout in Valley Reach 1A by providing sufficient velocity and pool depths to support their survival and growth. The community release would also inundate some portions of the stream channel that would not be wetted in the future without the Proposed Action, providing areas where species that prefer shallower depths (e.g., blacknose dace and creek chub) could find suitable habitat.

Fish communities upstream of the spillway confluence have experienced a range of streamflow over the monitoring period, similar to the range of streamflow anticipated in the future with the Proposed Action (all release magnitudes). Results of fish surveys conducted over multiple years in lower Esopus Creek did not provide any direct evidence of a significant effect or loss of any species during this time. These life

stages are able to withstand high stream velocities and depths by finding refuge in existing submerged bedrock structures, boulders, coarse woody debris and other microhabitats present in Valley Reach 1A. Therefore, maximum release magnitudes for spill mitigation and operational releases in accordance with the IRP are not anticipated to impact juvenile and adult fish species present within Valley Reach 1A.

To further investigate the potential for impacts from differences between the future without and with the Proposed Action, a review of the HSI literature and results of HEC-RAS modeling in Valley Reach 1A was performed to assess how the magnitude of spill mitigation and operational releases could affect fish at different life stages at different times of the year (i.e., during the spring and fall spawning and rearing for the most sensitive life stages: fry and embryo). The gradual increase in the magnitude of release flows as a result of ramping in accordance with the IRP would give fish an opportunity to adjust their spawning location, allowing them to find shallows, coarse woody debris, undercut banks, or riffles as streamflow (and velocities) increases in the main channel. The habitat variability along Valley Reach 1A (braided and side channels, numerous small stream inlets, wider and narrower portions of the streambed) would also provide areas that exhibit slower streamflow velocity regardless of increased streamflow as a result of the Proposed Action. These areas of slower streamflow velocity would provide suitable areas for spawning. Moreover, the species that are typically sensitive to higher velocity streamflow have adapted to variable streamflow velocity by protecting embryos within small nests or burying them in the substrate. In addition, there are natural variabilities in year class strength for each fish species due to changes in streamflow as a result of dynamic hydrologic conditions (spring runoff, large storm events) and predation. This year class variation is not anticipated to be altered by differences in streamflow that would occur in the future with the Proposed Action within Valley Reach 1A compared to the future without the Proposed Action.

Similar to fish, stream macroinvertebrates are adapted to withstand moderate, seasonal variation in water depths and streamflow velocity. Though they are adapted to such variable stream conditions, downstream transport (or "drift") of macroinvertebrates is recognized as a natural phenomenon in natural stream or river systems. There was no evidence of bed movement (erosion) in Valley Reach 1A during the monitoring period that would cause significant disruption of stream macroinvertebrate dispersal and colonization. Furthermore, there were no observed changes in the presence of benthic macroinvertebrate species within Valley Reach 1A over the monitoring period, including those species that are considered to be relatively intolerant of habitat disturbance. Lower Esopus Creek within Valley Reach 1A has continued to support the same macroinvertebrate communities since initial monitoring in 2009. Therefore, the magnitude and frequency of releases are unlikely to result in the disruption of stream macroinvertebrates or foraging habitat.

TEMPERATURE

Upstream of the confluence, all releases would have the potential to lower temperatures during summer months. However, no thermal impacts to stream macroinvertebrates are anticipated to occur in lower Esopus Creek as a result of changes in summertime water temperatures in the future with the Proposed Action. Based on the benthic macroinvertebrate studies in 2012 through 2014 and 2017, the highest EPT scores were found at Sampling Sites 1 through 5A, indicating that water quality and temperatures are suitable for these three sensitive insect families. Releases to Valley Reach 1A in the summer would also be a potential benefit to cold-water fish species that prefer cooler temperatures, such as trout (Raleigh et al. 1984, 1986). Moreover, the ramping of releases would provide the fish an opportunity to adjust to any water temperature fluctuations and, therefore, would not cause an abrupt change in environmental conditions that would adversely affect fish.

TURBIDITY

Turbidity levels of the community release in the future with the Proposed Action are not expected to impact aquatic species, as the majority of releases would have turbidity levels below 5 NTU. The median turbidity levels associated with the community release, the release which would occur most frequently, would be 1.8 NTU and the 10th to 90th percentile turbidity levels would range from 0 to 5 NTU, respectively, as discussed within Section 7.1.1, "Flow Regime and Water Quality in Lower Esopus Creek." Elevated turbidity levels associated with very fine particles (such as the colloidal clay present in the lower Esopus Creek) have the potential to impact fish by interfering with visual feeding and prey capture; this has been demonstrated under short-term experimental trials with various species of trout (Barrett et al. 1992, Sweka and Hartman 2001a, 2001b, Rowe et al. 2003, White and Harvey 2007) and sunfish/bass (Shoup and Wahl 2009, Shoup and Lane 2015).[39,40,41,42,43,44,45] In addition, chronic or sustained lower levels of turbidity may result in reduced growth, resistance to disease, increased stress, and interference with visual cues necessary for fish homing and migration (Berry et al. 2003, Chapman et al. 2014). Therefore, the IRP limits the number of days of releases with turbidity levels over 30, 60, and 100 NTU that may occur in the future with the Proposed Action.

As discussed, turbidity levels in streamflow would be similar between the future without and with the Proposed Action. Turbidity levels of flow from Ashokan Reservoir in the future with the Proposed Action would be within the range and variability of turbidity levels that occur in lower Esopus Creek in the future without the Proposed Action. It is anticipated that aquatic life within lower Esopus Creek, including trout, are adapted to the dynamic hydrological conditions that can occur, such as changes to streamflow and turbidity levels associated with storms in the watershed. [46] For most fish species upstream of the spillway confluence, analysis of HSI and a literature review indicate that the 30 NTU turbidity level included in the IRP would be within suitable habitat conditions for these species at each life stage. **Table 7.7-5** summarizes differences in suitable turbidity levels between the future without and with the Proposed Action for representative fish species upstream of the confluence.

Based on the literature review, adult trout can generally tolerate turbidity levels up to 50 NTU while trout fry and embryos are generally intolerant of turbidity levels above 25 NTU (Bash et al. 2001). The literature review also found that behavioral changes to feeding and growth can occur as a result of prolonged exposure to turbidity levels over 25 NTU in studies where the average test duration was

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[39] Barrett, J.C., G. Grossman, and J. Rosenfeld. "Turbidity-induced changes in reactive distance of rainbow trout." *Transactions of the American Fisheries Society,* 121:437-443. 1992.

[40] Sweka, J.A. and K.J. Hartman. "Influence of turbidity on brook trout reactive distance and foraging success." *Transactions of the American Fisheries Society,* 130:138-146. 2001.

[41] Sweka, J.A. and K.J. Hartman. "Effects of turbidity on prey consumption and growth in brook trout and implications for bioenergetics modeling." *Canadian Journal of Fisheries and Aquatic Sciences,* 58:386-393. 2001.

[42] Rowe, D.K., T.L. Dean, E. Williams, and J.P Smith. "Effects of turbidity on the ability of juvenile rainbow trout Oncorhynchus mykiss, to feed on benthic and limnetic prey in laboratory tanks." *New Zealand Journal of Marine and Freshwater Research,* 37:45-52. 2003.

[43] White, J.L. and B.C. Harvey. "Winter feeding success of stream trout under different streamflow and turbidity conditions." *Transactions of the American Fisheries Society,* 136:1187-1192. 2007.

[44] Shoup, D.E. and D.H. Wahl. "The effects of turbidity on prey selection by piscivorous largemouth bass." *Transactions of the American Fisheries Society,* 138:1018–1027. 2009.

[45] Shoup, D.E. and W.D. Lane. "Effects of turbidity on prey selection and foraging return of adult largemouth bass in reservoirs." *North American Journal of Fisheries Management,* 35:913–924. 2015.

[46] As presented in Section 7.1.1 "Flow Regime and Water Quality in lower Esopus Creek turbidity levels were observed to be similar along lower Esopus Creek; with a 25th to 75th percentile range of 10 NTU, and at times increasing to 50 NTU or above.

14 days (Sigler et al. 1984). Over the monitoring period, trout upstream of the spillway confluence (Valley Reach 1A) experienced streamflow associated with releases up to 600 MGD and a range of water quality conditions. As shown in **Table 7.7-3**, there were no apparent differences or trends in the presence and absence of rainbow and brown trout surveyed within Valley Reach 1A over the monitoring period.[47] Therefore, it is anticipated that trout would continue spawning, growth, and feeding activities during periods of elevated turbidity (i.e., above 25 NTU) when the period of exposure is fewer than 14 days. However, as discussed in Section 14, "Alternatives Analysis," the Proposed Revised Operating Protocol proposes to modify the release turbidity levels that trigger flushing to 25 and 50 NTU to reduce the potential for stress to aquatic species upstream of the spillway confluence.

Turbidity from Ashokan Reservoir is generally the result of very fine particles which are not anticipated to settle in lower Esopus Creek in the future without or with the Proposed Action, and therefore, are not anticipated to result in smothering or direct loss of habitat for macroinvertebrates in Valley Reach 1A.

[47] The monitoring period for Valley Reach 1A spans the timeframe that includes use of the Release Channel during episodic turbidity events resulting from several large storm events in October 2010 and Tropical Storms Irene and Lee in 2011.

Table 7.7-5. Suitable Turbidity Levels for Fish Species and Life Stages and Days Per Year Exceeded (Upstream of the Spillway Confluence)

Species	Life Stage	Seasonal Occurrence of Each Life Stage[2]	Maximum Suitable Turbidity Level (NTU)[3]	Suitable Turbidity Level Duration[a-h]	Annualized Data: Average Annual Days Per Year Above Suitable Turbidity Level									Episodic Events: Total Turbidity Events that Exceed Suitable Level & Duration (Average # of Events per Year)[5]		Comments
					IRP			Non-IRP			Difference of IRP and Non-IRP			IRP	Non-IRP	
					Wet	Normal	Dry	Wet	Normal	Dry	Wet	Normal	Dry			
Brown Trout[h, 1]	**Embryo**	October - December	25	Altered behavior at 25 NTU[4]	8	1	1	1	0	0	7	1	1	49 (0.77)	19 (0.30)	**Colloidal clays are unlikely to affect early life stages embryo/fry by smothering or feeding/respiratory interference, respectively.**
	Fry	January – March	25		2	3	1	1	1	0	1	2	0	35 (0.55)	24 (0.38)	
	Juveniles/Adults	Year-round	50	Reduced growth at 50 NTU[4]	2	1	0	1	0	0	1	1	0	22 (0.34)	13 (0.20)	
Rainbow Trout[h, 1]	**Embryo**	March - April	25	Altered behavior at 25 NTU[4]	1	2	1	1	1	0	0	1	1	36 (0.56)	20 (0.31)	**Colloidal clays are unlikely to affect early life stages embryo/fry by smothering or feeding/respiratory interference, respectively.**
	Fry	March - April	25		1	2	1	1	1	0	0	1	1	36 (0.56)	20 (0.31)	
	Juveniles/Adults	Year-round	50	Reduced growth at 50 NTU[4]	2	1	0	1	0	0	1	1	0	22 (0.34)	13 (0.20)	
Bluegill[a]	**Embryo**	May - July	165	Maximum monthly average	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - July	165		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	165		0	0	0	0	0	0	0	0	0	0	0	
Redbreast Sunfish[b]	**Embryo**	May - July	150	Maximum monthly average during spawning and growing season	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - July	150		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	150		0	0	0	0	0	0	0	0	0	0	0	
White Sucker[c]	**Embryo**	Mid April - June	100	Maximum monthly average during the year	0	0	0	0	0	0	0	0	0	0	0	
	Fry	Mid April - June	100		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	100		0	0	0	0	0	0	0	0	0	0	0	
Creek Chub[d, 1]	**Embryo**	April - May	70	Maximum monthly average during the summer	0	0	0	0	0	0	0	0	0	0	0	
	Fry	April - May	70		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	70		1	1	0	0	0	0	0	1	0	0	0	**Minimal impacts anticipated on juveniles/adults creek chub due to ability to seek other suitable habitats.**
Smallmouth Bass[f]	**Embryo**	May - June	75	Maximum monthly average during the summer	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - June	75		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	75		0	1	0	0	0	0	0	1	0	0	0	**Minimal impacts anticipated on juveniles/adults smallmouth bass due to ability to seek other suitable habitats.**

Table 7.7-5. Suitable Turbidity Levels for Fish Species and Life Stages and Days Per Year Exceeded (Upstream of the Spillway Confluence)

Species	Life Stage	Seasonal Occurrence of Each Life Stage[2]	Maximum Suitable Turbidity Level (NTU)[3]	Suitable Turbidity Level Duration[a-h]	Annualized Data: Average Annual Days Per Year Above Suitable Turbidity Level									Episodic Events: Total Turbidity Events that Exceed Suitable Level & Duration (Average # of Events per Year)[5]		Comments
					IRP			Non-IRP			Difference of IRP and Non-IRP			IRP	Non-IRP	
					Wet	Normal	Dry	Wet	Normal	Dry	Wet	Normal	Dry			
Blacknose Dace[g, 1]	**Embryo**	May - June	50	Maximum monthly average during the growing season	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - June	50		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	50		2	1	0	1	0	0	1	1	0	0	0	**Minimal impacts anticipated on juveniles/adults blacknose dace due to ability to seek other suitable habitats.**
Largemouth Bass[e]	**Embryo**	May - June	165	Maximum monthly average	0	0	0	0	0	0	0	0	0	0	0	
	Fry	June - July	165		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	165		0	0	0	0	0	0	0	0	0	0	0	

Notes:

[1] Species located primarily upstream.
[2] All seasonal occurrences of life stages are taken from Smith (1985) with the exception of largemouth bass and blacknose dace that were taken from Scott and Crossman (1973).
[3] All HSI turbidity values converted to NTU. JTU is considered equivalent to NTU and part per million (PPM) was converted to NTU based on the TSS/turbidity regression for the creek (B.M Wright, H&S, 1/18/2019).
[4] These values do not represent an instantaneous significant adverse impact, but are a conservative level at which fish may begin to experience altered behavior (e.g., reduced visibility and thus feeding) or reduced growth. These values can be sustained on the order of days, not weeks.
[5] Average # of events per year over the 64-year (1948-2011) model simulation = # events/64 years.

Sources:

[a] Stuber, R.J., G. Gebhart, and O.E. Maughan 1982a. Habitat Suitability Index Models: Bluegill. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.8.
[b] Aho, J.M., C.S. Anderson and J.W. Terrell. 1986. Habitat Suitability Index Models and Instream Flow Suitability Curves: Redbreast Sunfish. U.S. Fish and Wildlife Service Biological Report 82 (10.119).
[c] Twomey, K.A., K.L Williamson, and P.C. Nelson. 1984. Habitat Suitability Index Model and Instream Flow Suitability Curves: White Sucker. U.S. Fish and Wildlife Service. FWS/OBS-82/10.64.
[d] McMahon, T.E. 1982. Habitat Suitability Index Models: Creek Chub. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.4.
[e] Stuber, R.J., G. Gebhart, and O.E. Maughan 1982b. Habitat Suitability Index Models: Largemouth Bass. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.16.
[f] Edwards, E.A., G. Gebhart, and O.E. Maughan 1983. Habitat Suitability Index Models: Smallmouth Bass. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.16.
[g] Trial, J.G., J.G. Stanley, M. Batcheller, G. Gebhart, O.E. Maughan and P.C. Nelson. 1983. Habitat Suitability Information: Blacknose Dace. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.41.
[h] Bash, J., C. Berman, and S. Bolton. 2001.Effects of Turbidity and Suspended Solids on Salmonids. Final Research Report Prepared for Washington State Transportation Commission.

DOWNSTREAM OF THE SPILLWAY CONFLUENCE (VALLEY REACHES 1B, 2C, 3D, AND 3E)

FLOW REGIME

Like the survey results for Valley Reach 1A, results of fish surveys conducted over several years in stations downstream of the spillway confluence have not provided any direct evidence that a significant effect or loss of any species occurred over the monitoring period.

Various rates of streamflow were analyzed to further investigate whether differences in streamflow between the future without and with the Proposed Action would have the potential to affect aquatic species downstream of the spillway confluence. As stated in Section 7.1, "Water Resources and Water Quality," streamflow would be similar in both the future without and with the Proposed Action downstream of the spillway confluence. The community release would provide sustained flow to lower Esopus Creek in the future with the Proposed Action. Differences in the frequency of occurrence of streamflow between the future without and with the Proposed Action would be more apparent closer to the spillway confluence (Valley Reaches 1B and 2C) and differences would diminish moving downstream (see Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP"). The future with the Proposed Action would result in similar seasonal streamflow patterns for wet, normal, and dry years (i.e., higher streamflow occurs in the spring) as compared to the future without the Proposed Action but the Proposed Action would reduce peak streamflow in lower Esopus Creek, particularly in the spring. Differences in the velocity and depth of streamflow between the future without and with the Proposed Action would be limited, since the frequency and magnitude of streamflow is similar and diminishes moving downstream. In addition, a larger proportion of lower Esopus Creek is located downstream of the spillway confluence, and stream pattern and profile differ along the valley reaches in this location, providing areas with varied habitat that would allow fish to move to areas of suitable habitat in both the future without and with the Proposed Action. Finally, as necessary during spawning periods, and for species such as bluegill and redbreast sunfish that prefer lower velocity streamflow, it is anticipated that fish would seek out refuge in the form of pools, side-channel habitat, rocks, root wads, and coarse woody debris, maximizing survival and maintaining viable populations.

TEMPERATURE

In the future with the Proposed Action, the community release would provide sustained streamflow in the summer as compared to the future without the Proposed Action and would not result in changes to water temperature in lower Esopus Creek downstream of the spillway confluence. Spill mitigation and operational releases, which would rarely occur in the summer months, would have the potential to lower water temperatures in downstream portions of lower Esopus Creek through Valley Reach 1B. However, water temperatures are expected to be within the suitable ranges for downstream fish species. Juvenile and adult warmwater fish would not be adversely affected as they survive typical temperature fluctuations and/or are able to locate thermal refuge in deeper pools. Moreover, ramping of releases would provide fish an opportunity to adjust to any water temperature fluctuations and is not anticipated to cause an abrupt change in environmental conditions that would adversely affect fish species.

TURBIDITY

As discussed above, the community release would be the most frequently occurring release type in the future with the Proposed Action and the majority of community releases would have turbidity levels of less than 5 NTU. **Table 7.7-6** summarizes differences in suitable turbidity levels between the future without and with the Proposed Action downstream of the confluence. For most fish species downstream of the spillway confluence, analysis of HSI and a literature review indicate that the 30 NTU turbidity level

included in the IRP would be within suitable habitat conditions for these species and life stages. As discussed in Section 7.1, "Water Resources and Water Quality," turbidity levels of flows from Ashokan Reservoir in the future with the Proposed Action are anticipated to be similar to those that occur in the future without the Proposed Action. Turbidity levels of these flows would fall within the range and variability of turbidity levels that occur in lower Esopus Creek streamflow. Similar to Valley Reach 1A, any turbidity in flows from Ashokan Reservoir would be due to very fine particles which are not anticipated to settle in lower Esopus Creek, and therefore, would not result in smothering or direct loss of habitat for macroinvertebrates.

Table 7.7-6. Suitable Turbidity Levels for Fish Species and Life Stages and Days Per Year Exceeded (Downstream of the Spillway Confluence)

Species	Life Stage	Seasonal Occurrence[2]	Maximum Suitable Turbidity Level (NTU)[3]	Suitable Turbidity Level Duration[a-h]	Annualized Data: Average Annual Days Per Year Above Suitable Turbidity Level									Episodic Events: Total Turbidity Events that Exceed Suitable Level & Duration (Average # of Events per Year)[5]		Comments
					IRP			Non-IRP			Difference of IRP and Non-IRP			IRP	Non-IRP	
					Wet	Normal	Dry	Wet	Normal	Dry	Wet	Normal	Dry			
Brown Trout[h, 1]	**Embryo**	October - December	25	Altered behavior at 25 NTU[4]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**Species located primarily upstream. Trout in the LEC are reservoir wash-overs or fish spawned by wash-overs. Minimal to no impacts anticipated.**
	Fry	January – March	25		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	Juveniles/Adults	Year-round	50	Reduced growth at 50 NTU[4]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Rainbow Trout[h, 1]	**Embryo**	March - April	25	Altered behavior at 25 NTU[4]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**Species located primarily upstream. Trout in the LEC are reservoir wash-overs or fish spawned by wash-overs. Minimal to no impacts anticipated.**
	Fry	March - April	25		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	Juveniles/Adults	Year-round	50	Reduced growth at 50 NTU[4]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Bluegill[a]	**Embryo**	May - July	165	Maximum monthly average	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - July	165		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	165		0	0	0	0	0	0	0	0	0	0	0	
Redbreast Sunfish[b]	**Embryo**	May - July	150	Maximum monthly average during spawning and growing season	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - July	150		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	150		0	0	0	0	0	0	0	0	0	0	0	
White Sucker[c]	**Embryo**	Mid April - June	100	Maximum monthly average during the year	0	0	0	0	0	0	0	0	0	0	0	
	Fry	Mid April - June	100		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	100		1	0	0	1	0	0	0	0	0	0	0	
Creek Chub[d, 1]	**Embryo**	April - May	70	Maximum monthly average during the summer	0	0	0	0	0	0	0	0	0	0	0	
	Fry	April - May	70		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	70		2	1	0	1	1	0	1	0	0	0	0	**Minimal impacts anticipated on juveniles/adults creek chub due to ability to seek other suitable habitats.**
Smallmouth Bass[f]	**Embryo**	May - June	75	Maximum monthly average during the summer	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - June	75		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	75		2	1	0	1	0	0	1	0	0	0	0	**Minimal impacts anticipated on juveniles/adults smallmouth bass due to ability to seek other suitable habitats.**

Table 7.7-6. Suitable Turbidity Levels for Fish Species and Life Stages and Days Per Year Exceeded (Downstream of the Spillway Confluence)

Species	Life Stage	Seasonal Occurrence[2]	Maximum Suitable Turbidity Level (NTU)[3]	Suitable Turbidity Level Duration[a-h]	Annualized Data: Average Annual Days Per Year Above Suitable Turbidity Level									Episodic Events: Total Turbidity Events that Exceed Suitable Level & Duration (Average # of Events per Year)[5]		Comments
					IRP			Non-IRP			Difference of IRP and Non-IRP			IRP	Non-IRP	
					Wet	Normal	Dry	Wet	Normal	Dry	Wet	Normal	Dry			
Blacknose Dace[g, 1]	**Embryo**	May - June	50	Maximum monthly average during the growing season	0	0	0	0	0	0	0	0	0	0	0	
	Fry	May - June	50		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	50		5	2	0	3	1	0	2	1	0	0	0	**Minimal impacts anticipated on juveniles/adults blacknose dace due to ability to seek other suitable habitats.**
Largemouth Bass[e]	**Embryo**	May - June	165	Maximum monthly average	0	0	0	0	0	0	0	0	0	0	0	
	Fry	June - July	165		0	0	0	0	0	0	0	0	0	0	0	
	Juveniles/Adults	Year-round	165		0	0	0	0	0	0	0	0	0	0	0	

Notes:

[1] Species located primarily upstream

[2] All seasonal occurrences of life stages taken from Smith (1985) with the exception of largemouth bass and blacknose dace that were taken from Scott and Crossman (1973)

[3] All HSI turbidity values converted to NTU. JTU is considered equivalent to NTU and PPM was converted to NTU based on the TSS/turbidity regression for the creek (B.M Wright, H&S, 1/18/2019)

[4] These values do not represent an instantaneous significant adverse impact, but are a conservative level at which fish may begin to experience altered behavior or reduced growth. It is anticipated these values can be sustained on the order of days, not weeks.

[5] Average # of events per year over the 64-year (1948-2011) model simulation = # events/64 years.

Sources:

[a] Stuber, R.J., G. Gebhart, and O.E. Maughan 1982a. Habitat Suitability Index Models: Bluegill. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.8

[b] Aho, J.M., C.S. Anderson and J.W. Terrell. 1986. Habitat Suitability Index Models and Instream Flow Suitability Curves: Redbreast Sunfish. U.S. Fish and Wildlife Service Biological Report 82 (10.119).

[c] Twomey, K.A., K.L Williamson, and P.C. Nelson. 1984. Habitat Suitability Index Model and Instream Flow Suitability Curves: White Sucker. U.S. Fish and Wildlife Service. FWS/OBS-82/10.64.

[d] McMahon, T.E. 1982. Habitat Suitability Index Models: Creek Chub. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.4.

[e] Stuber, R.J., G. Gebhart, and O.E. Maughan 1982b. Habitat Suitability Index Models: Largemouth Bass. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.16.

[f] Edwards, E.A., G. Gebhart, and O.E. Maughan 1983. Habitat Suitability Index Models: Smallmouth Bass. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.16.

[g] Trial, J.G., J.G. Stanley, M. Batcheller, G. Gebhart, O.E. Maughan and P.C. Nelson. 1983. Habitat Suitability Information: Blacknose Dace. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.41.

[h] Bash, J., C. Berman, and S. Bolton. 2001.Effects of Turbidity and Suspended Solids on Salmonids. Final Research Report Prepared for Washington State Transportation Commission

NA – Not applicable

DOWNSTREAM (VALLEY REACH 3F)

Valley Reach 3F, which is downstream of Cantine Dam, is tidally influenced by flows from the Hudson River. This valley reach includes large SAV beds at the confluence of the Hudson River.

Streamflow and water quality conditions within lower Esopus Creek are expected to have minimal influence on the native SAV beds identified in the Hudson River at the mouth of lower Esopus Creek because of local topography to the north and a jetty to the south that directs lower Esopus Creek streamflow toward the center of the Hudson River channel. The smaller SAV beds located within lower Esopus Creek, downstream of the Cantine Dam, mainly consist of invasive milfoil (M. *spicatum*). Size fluctuations of the smaller SAV beds over time are likely due to the relatively small area of the beds, which makes them more susceptible to natural fluctuations in local water conditions. The SAV patch within lower Esopus Creek is also an insignificant portion of the SAV in the estuary given its size (i.e., minimal aerial coverage) and is, therefore, not representative of the larger defined beds in the estuary. For the larger SAV beds, aerial coverage indicated that the extent of the beds remained relatively consistent over time. Native SAV species may be able to recover or shift in density or distribution following disturbances (e.g., large storm events) in both the future without and with the Proposed Action. Field surveys (described above) found the overall extent of SAV beds has increased since the IRP has been in place, Therefore, the Proposed Action is not anticipated to adversely affect SAV beds within the study area.

CONCLUSIONS

A summary comparing the suitability of streamflow, depth, temperature, turbidity and dissolved oxygen conditions in the future without and with the Proposed Action based on the assessed HSI values is presented in **Table 7.7-7** and **Table 7.7-8**. Suitability of habitat based on each of these parameters ranges from 0.0 (unsuitable habitat) to 1.0 (optimal habitat), for the selected representative fish species upstream and downstream of the spillway confluence. In the table, colored cells denote differences between the future without and with the Proposed Action: yellow denotes a decrease in overall habitat suitability in the future with the Proposed Action, and green denotes an increase in overall suitability in the future with the Proposed Action.

The Proposed Action would provide sustained flow to lower Esopus Creek from Ashokan Reservoir which would have the potential to benefit fish, particularly during low streamflow conditions and within Valley Reach 1A. Flow from Ashokan Reservoir to Valley Reach 1A during the summer would be a potential benefit to the cold-water fishery in this reach (e.g., trout) that prefer cooler temperatures, while warm-water species (e.g., bass, sunfish) would not be affected by alterations in temperature as a result of flow from the Reservoir in the future with the Proposed Action.

As discussed, turbidity levels in streamflow would be similar between the future without and with the Proposed Action. Turbidity levels of flow from Ashokan Reservoir in the future with the Proposed Action would be within the range and variability of turbidity levels that occur in lower Esopus Creek in the future without the Proposed Action. Overall, lower Esopus Creek supports a diverse and stable benthic community including taxa considered relatively intolerant of poor water quality conditions. Based on observed differences between benthic sampling stations during field assessments conducted to support the EIS, it is likely that localized factors affect benthic communities. The type of localized factors that may affect these communities include surface water runoff and water quality conditions that would occur in the future both without and with the Proposed Action.

Literature searches and field analyses indicated that the turbidity levels and duration in the IRP are appropriate for protection of most fish species found within lower Esopus Creek downstream of the spillway confluence under all life stages. Therefore, there are no anticipated significant adverse impacts to aquatic resources as a result of the Proposed Action.

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Table 7.7-7. HSI Matrix for Upstream, Future Without and With the Proposed Action Hydrological Conditions (Wet, Normal and Dry Years)

Species	Life Stage	Upstream No IRP Dry					Upstream IRP Dry					Upstream No IRP Norm					Upstream IRP Norm					Upstream No IRP Wet					Upstream IRP Wet				
		Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO
White Sucker	embryos	1	0.2	0.2	1	1	1	1	0.2	1	1	1	0.5	0.2	1	1	1	0.2	0.2	1	1	1	0.8	0.2	1	1	1	0.2	0.2	1	1
	fry	1	0.2	0.2	1	1	1	1	0.2	1	1	1	0.5	0.2	1	1	1	0.2	0.2	1	1	1	0.8	0.2	1	1	1	0.2	0.2	1	1
	juveniles	1	0.5	1	1	1	1	0.5	1	1	1	1	0.5	1	1	1	1	0.5	1	1	1	1	0.8	1	1	1	1	0.5	1	1	1
	adults	1	0.8	1	1	1	1	0.8	1	1	1	1	0.5	1	1	1	1	0.8	1	1	1	1	0.8	1	1	1	1	0.8	1	1	1
Lepomis sp.	embryos	1	0.2	0.2	1	1	0.2	1	0.2	1	1	1	0.2	0.2	1	1	0.2	1	0.2	1	1	1	0.2	0.5	1	1	0.2	1	0.2	1	1
	fry	1	0.2	0.2	1	1	0.2	1	0.2	1	1	1	0.2	0.2	1	1	0.2	1	0.2	1	1	1	0.2	0.5	1	1	0.2	1	0.2	1	1
	juveniles	1	0.8	1	1	1	0.5	1	1	1	1	1	0.8	1	1	1	0.2	1	1	1	1	0.8	0.8	1	1	1	0.2	1	1	1	1
	adults	1	1	0.8	1	1	0.5	1	0.8	1	1	1	1	0.8	1	1	0.5	1	0.8	1	1	1	1	0.8	1	1	0.5	1	0.8	1	1
Smallmouth Bass	embryos	1	0.2	1	1	1	0.5	1	1	1	1	1	0.2	1	1	1	0.5	1	1	1	1	0.2	1	1	1	1	0.5	1	1	1	1
	fry	1	0.2	1	1	1	0.5	1	1	1	1	1	0.2	1	1	1	0.5	1	1	1	1	0.2	0.5	1	1	1	0.5	1	1	1	1
	juveniles	1	0.2	1	1	1	1	1	1	1	1	1	0.2	1	1	1	1	1	1	1	1	0.5	1	1	1	1	0.8	1	1	1	1
	adults	1	0.2	1	1	1	1	1	1	1	1	1	0.2	1	1	1	1	1	1	1	1	0.5	0.5	1	1	1	0.5	1	1	1	1
Largemouth Bass	embryos	0.2	0.5	1	1	1	0.2	1	0.2	1	1	0.2	0.5	1	1	1	0.2	1	0.2	1	1	0.2	0.5	1	1	1	0.2	1	0.2	1	1
	fry	0.2	0.2	1	1	1	0.2	1	0.2	1	1	0.2	0.2	1	1	1	0.2	1	0.2	1	1	0.2	0.2	1	1	1	0.2	1	0.2	1	1
	juveniles	1	0.5	0.8	1	1	0.2	0.8	0.5	1	1	1	0.5	0.8	1	1	0.5	1	0.5	1	1	0.2	0.5	0.8	1	1	0.2	1	0.5	1	1
	adults	1	0.2	0.8	1	1	0.2	0.5	0.5	1	1	1	0.2	0.8	1	1	0.5	1	0.5	1	1	0.2	0.2	0.8	1	1	0.2	1	0.5	1	1
Salmonids (trout)	embryos	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	fry	1	1	1	1	1	0.2	1	1	1	1	1	1	1	1	1	0.2	1	1	1	1	1	1	1	1	1	0.2	1	1	1	1
	juveniles	0.8	0.5	1	1	1	0.2	1	1	1	1	0.8	0.5	1	1	1	0.2	1	1	1	1	0.5	1	1	1	1	0.2	1	1	1	1
	adults	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Blacknose Dace	embryos	1	1	0.5	1	1	0.5	1	1	1	1	1	1	0.5	1	1	0.2	1	1	1	1	1	1	0.5	1	1	0.2	1	1	1	1
	fry	1	1	1	1	1	0.2	1	1	1	1	0.8	1	1	1	1	0.2	1	1	1	1	1	1	1	1	1	0.2	1	1	1	1
	juveniles	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1
	adults	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1
Creek Chub	embryos	1	1	0.8	1	1	1	1	0.5	1	1	1	1	0.8	1	1	0.5	1	0.5	1	1	1	1	0.8	1	1	0.2	1	0.5	1	1
	fry	0.8	1	1	1	1	0.5	1	1	1	1	0.8	1	1	1	1	0.5	1	1	1	1	0.8	1	1	1	1	0.2	1	1	1	1
	juveniles	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	0.2	1	1	1	1
	adults	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	0.2	1	1	1	1

Notes:
Yellow denotes a decrease in suitability for the future with the Proposed Action as compared to the future without the Proposed Action.
Green denotes an increase in suitability for the future with the Proposed Action as compared to the future without the Proposed Action.

Table 7.7-8. HSI Matrix for Downstream, Future Without and With the Proposed Action Hydrological Conditions (Wet, Normal and Dry Years)

Species	Life Stage	Downstream No IRP Dry					Downstream IRP Dry					Downstream No IRP Norm					Downstream IRP Norm					Downstream No IRP Wet					Downstream IRP Wet				
		Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO	Flow	Depth	Temp	Turb	DO
White Sucker	embryos	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1
	fry	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1
	juveniles	1	0.5	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	0.5	1	1	1	1	0.5	1	1	1	1	0.5	1	1	1
	adults	1	0.8	0.8	1	1	1	1	0.8	1	1	1	0.8	0.8	1	1	1	0.8	0.8	1	1	1	0.8	0.8	1	1	1	0.8	0.8	1	1
Lepomis sp.	embryos	0.8	1	0.5	1	1	0.8	1	0.5	1	1	0.8	1	0.5	1	1	0.5	1	0.5	1	1	0.2	1	0.5	1	1	0.2	1	0.5	1	1
	fry	0.2	1	0.5	1	1	0.2	1	0.5	1	1	0.2	1	0.5	1	1	0.2	1	0.5	1	1	0.2	1	0.5	1	1	0.2	1	0.5	1	1
	juveniles	0.5	0.8	1	1	1	0.5	1	1	1	1	0.5	1	1	1	1	0.5	1	1	1	1	0.2	1	1	1	1	0.2	1	1	1	1
	adults	0.8	1	0.8	1	1	0.8	1	0.8	1	1	0.8	1	0.8	1	1	0.5	1	0.8	1	1	0.5	1	0.8	1	1	0.2	1	0.8	1	1
Smallmouth Bass	embryos	0.2	0.5	1	1	1	0.2	0.8	1	1	1	0.2	0.5	1	1	1	0.2	0.8	1	1	1	0.2	0.8	1	1	1	0.2	1	1	1	1
	fry	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.5	1	1	1	0.2	1	1	1	1
	juveniles	0.2	0.5	1	1	1	0.2	0.8	1	1	1	0.2	0.5	1	1	1	0.2	0.8	1	1	1	0.2	0.8	1	1	1	0.2	1	1	1	1
	adults	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.5	1	1	1	0.2	1	1	1	1
Largemouth Bass	embryos	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.5	1	1	1	0.2	1	1	1	1
	fry	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.5	1	1	1	0.2	1	1	1	1
	juveniles	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.5	1	1	1	0.2	1	1	1	1
	adults	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.2	1	1	1	0.2	0.5	1	1	1	0.2	0.5	1	1	1	0.2	1	1	1	1

Notes:
Yellow denotes a decrease in suitability for the future with the Proposed Action as compared to the future without the Proposed Action.
Green denotes an increase in suitability for the future with the Proposed Action as compared to the future without the Proposed Action.

7.8 WETLANDS AND FLOODPLAIN FORESTS

This section presents an assessment of the potential for the Proposed Action to change the extent or composition of wetlands and floodplain forests within the lower Esopus Creek study area.

7.8.1 BASELINE CONDITIONS

The wetlands study area includes the area around lower Esopus Creek that would experience inundation during releases from Ashokan Reservoir between 15 and 600 MGD (23 and 928 cfs).[48]

Baseline conditions for wetlands and floodplain forests were evaluated upstream of the spillway confluence in Valley Reach 1A (**Figure 7.8-1**) and downstream of the spillway confluence to Cantine Dam (Valley Reaches 1B through 3E) (**Figure 7.8-2** through **Figure 7.8-4)** based on the resources present and the anticipated flow regime. Valley Reach 3F, which is located downstream of Cantine Dam, was not evaluated since this is the tidally-influenced portion of lower Esopus Creek and is not anticipated to be affected by the Proposed Action.

UPSTREAM WETLANDS

Forty-seven wetlands were mapped and monitored along lower Esopus Creek upstream of the spillway confluence (Valley Reach 1A) from 2006 to 2018. The total documented wetland area increased slightly from 2010 to 2012 due to a remapping of one wetland (Wetland L) in 2012. Apart from the small change in study area, the wetland extent remained unchanged over the monitoring period. Wetland type (Cowardin, et al., 1979)[49], number of wetlands, and delineated wetland area from each field investigation are summarized in **Table 7.8-1** and photographs of representative wetlands taken over the course of the monitoring period are provided in **Photographs 1 and 2**.

[48] Refer to Section 7.1.4, "Parameters Evaluated for the Technical Impact Area Assessments – Flow Regime and Water Quality" for a description of the inundation analysis.

[49] Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior.

Table 7.8-1. Summary of Delineated Wetlands Upstream of the Spillway Confluence

Cowardin Classification	Number of Wetlands Identified	Delineated Wetland Areas (Acres)				
		2006/2010	2012	2014	2015	2018
Palustrine Emergent (PEM)	30	2.7	2.7	2.8	2.8	2.8
Palustrine Scrub-Shrub (PSS)	1	1.2	1.2	1.2	1.2	1.2
Palustrine Forested (PFO)	2	0.1	0.1	0.1	0.1	0.1
Palustrine Emergent/Forested (PEM/PFO)	12	7.2	8.4	8.4	8.4	8.4
Palustrine Emergent/ Scrub-Shrub/Forested (PEM/PSS/PFO)	2	4.5	4.7	4.6	4.6	4.6
TOTAL	**47**	**15.7**	**17.1**	**17.1**	**17.1**	**17.1**

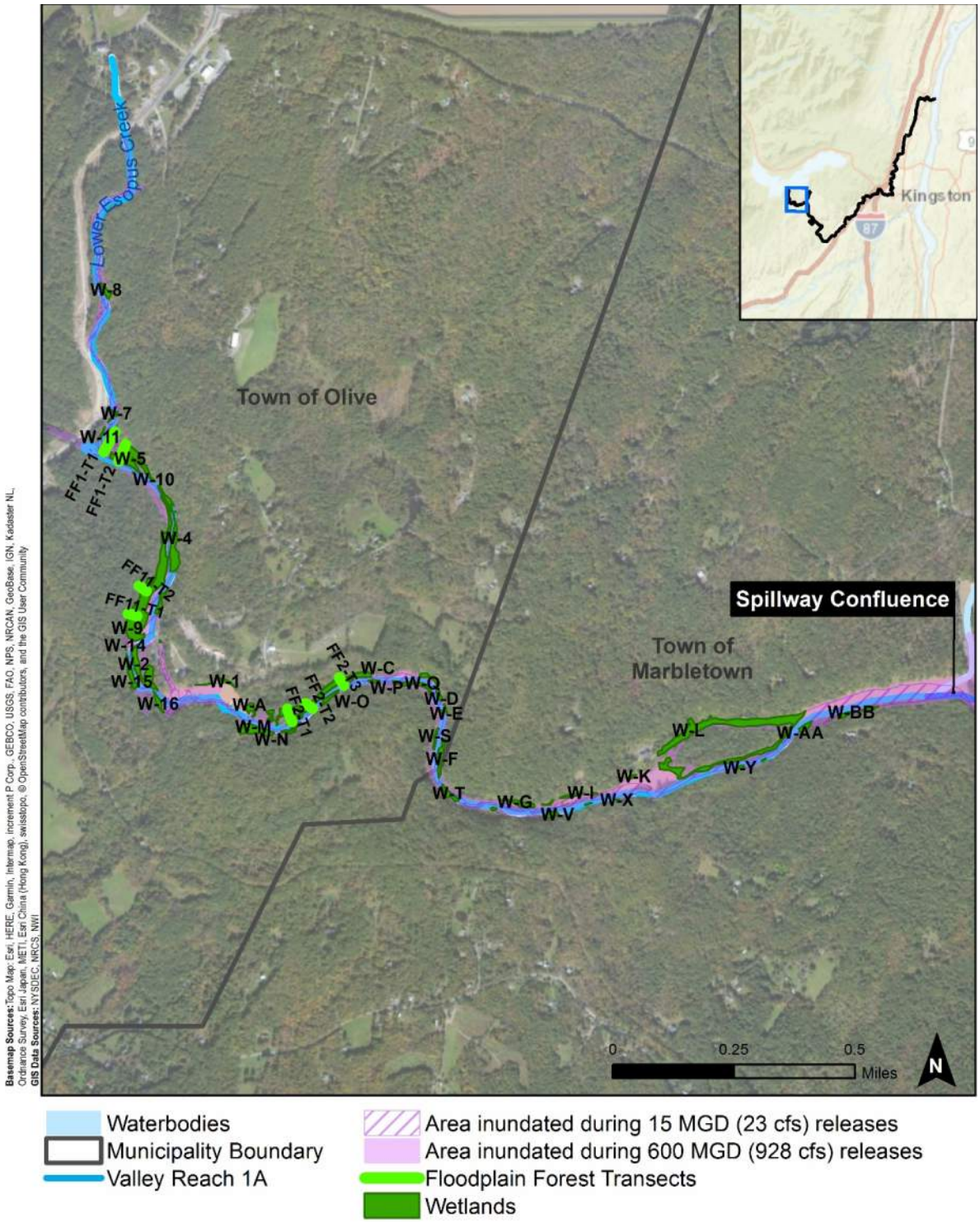


Figure 7.8-1
Lower Esopus Creek
Wetlands and Floodplain Forests – Upstream of Spillway Confluence

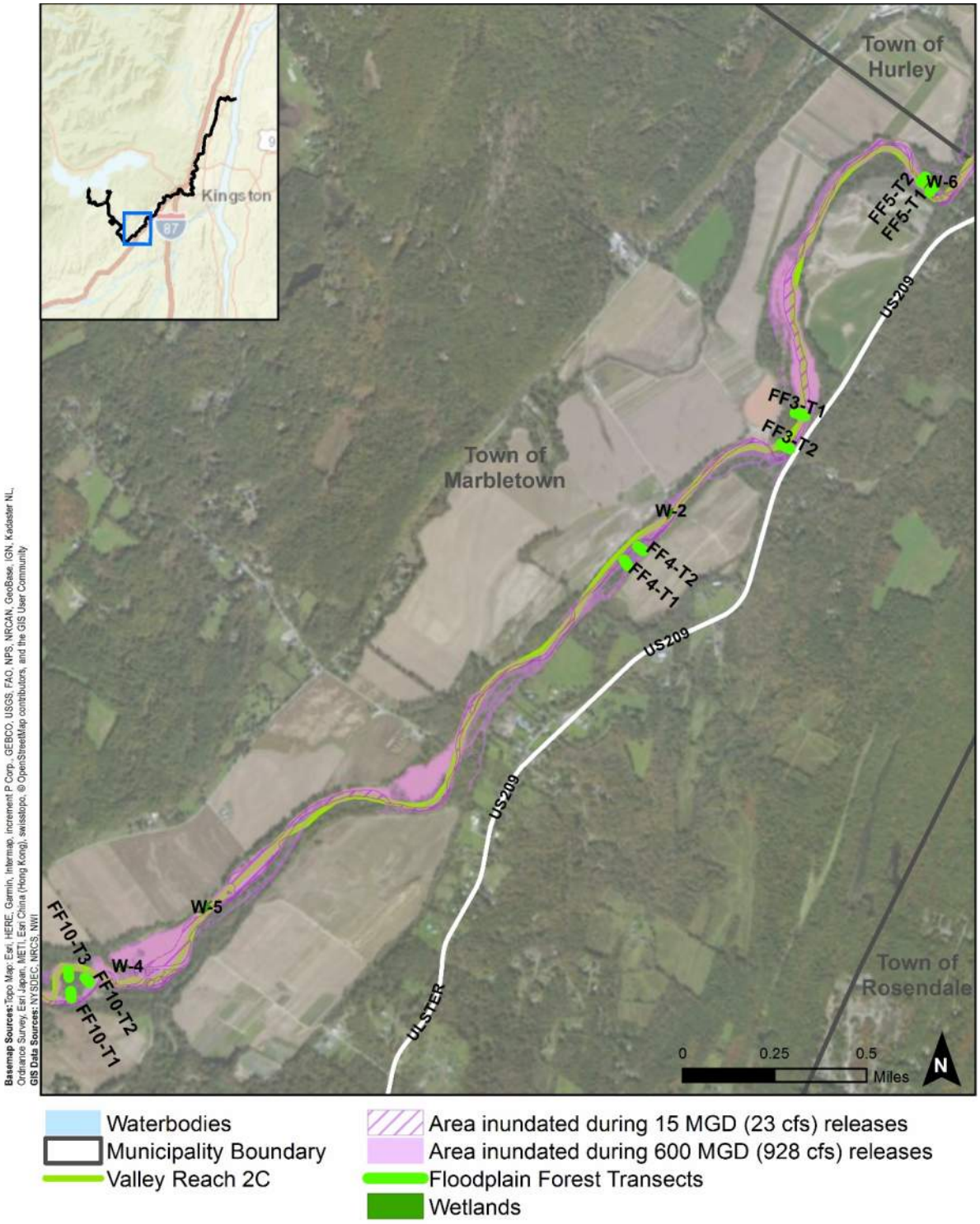


Figure 7.8-2
Lower Esopus Creek
Wetlands and Floodplain Forests – Downstream of Spillway Confluence

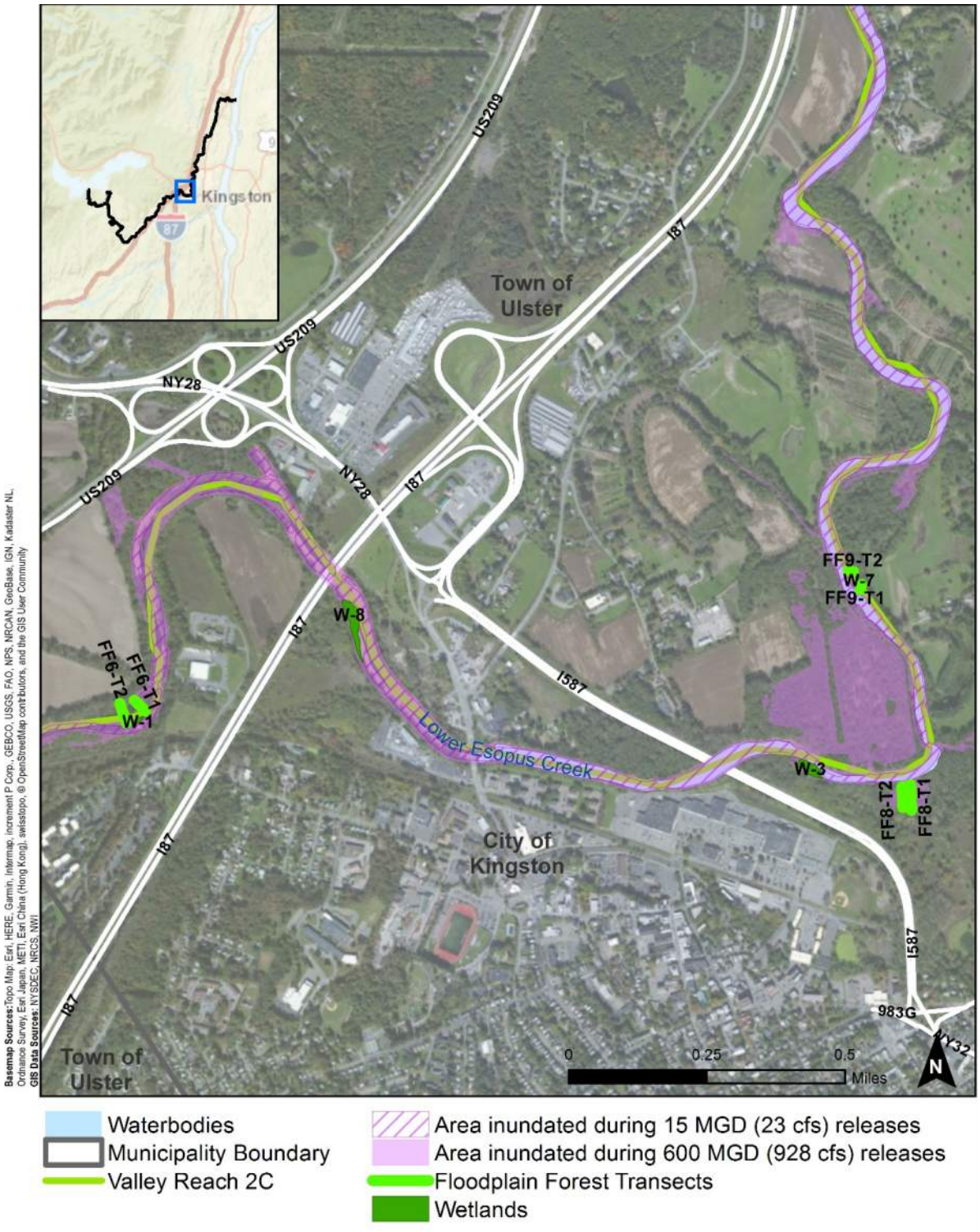


Figure 7.8-3
Lower Esopus Creek
Wetlands and Floodplain Forest – Downstream of Spillway Confluence

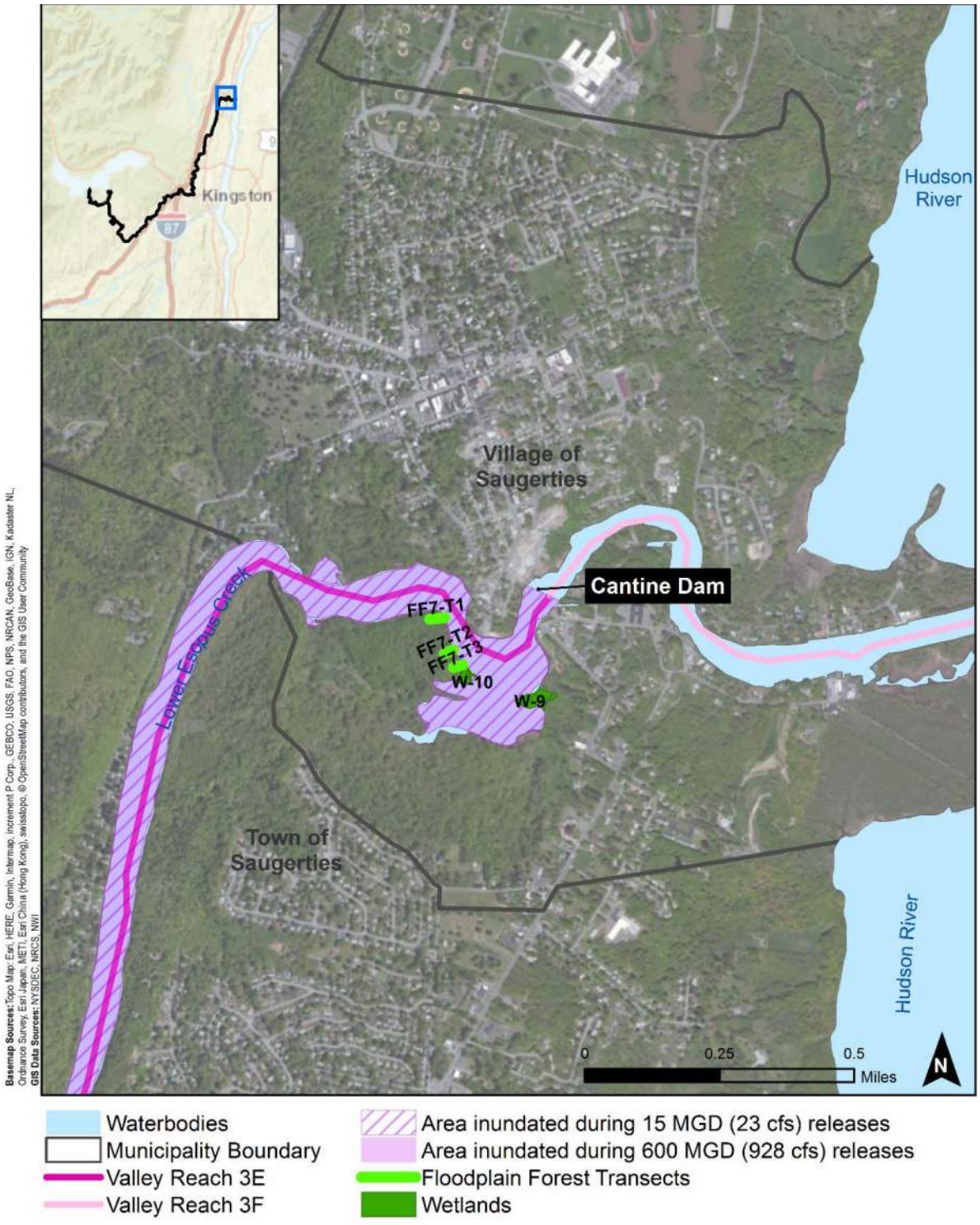


Figure 7.8-4
Lower Esopus Creek
Wetlands and Floodplain Forest – Downstream of Spillway Confluence

Photograph 1. Representative Upstream Wetland (Wetland 9 in Valley Reach 1A) in 2012

Photograph 2. Representative Upstream Wetland (Wetland 9 Valley Reach 1A) in 2018

As described in Section 5.3.8, "Natural Resources" methodology, vegetation data were also collected to document changes in relative abundance of dominant native herbaceous species, native woody species, and invasive species, as well as relative species composition, in wetland vegetative communities over the monitoring period. The dominant wetland vegetation observed in these wetland complexes are summarized in **Table 7.8-2**.

The field investigations documented little to no changes in wetland boundaries, sizes, and Cowardin wetland types. However, changes in the relative abundance of native woody and herbaceous species were observed over the monitoring period. Within the wetlands upstream of the spillway confluence (Valley Reach 1A), the relative abundance of dominant native woody vegetation decreased between 2014 and 2018 (**Figure 7.8-5A**). Conversely, the relative abundance of dominant native herbaceous species increased slightly between 2012 and 2018 (**Figure 7.8-5B**). This decline in the number of woody vegetation provided an influx of light that may have led to the increase in the relative abundance of herbaceous species. The change in the vegetative community composition was not significant enough to change the wetland classification (Cowardin) type.

Table 7.8-2. Summary of Dominant Wetland Vegetation Documented Upstream of the Spillway Confluence between 2006 and 2018[1]

Common Name	Scientific Name	Indicator Status[2]
Native Woody Species		
American Elm	*Ulmus americana*	FACW
American Hornbeam	*Carpinus caroliniana*	FAC
American Sycamore	*Platanus occidentalis*	FACW
Brookside Alder	*Alnus serrulata*	OBL
Eastern Hemlock	*Tsuga canadensis*	FACU
Eastern White Pine	*Pinus strobus*	FACU
Green Ash	*Fraxinus pennsylvanica*	FACW
Northern Spicebush	*Lindera benzoin*	FAC
Red Maple	*Acer rubrum*	FAC
Slippery Elm	*Ulmus rubra*	FAC
Yellow Birch	*Betula alleghaniensis*	FAC
Native Herbaceous Species (Forbs, Grass, Sedges)		
Arrowleaf Tearthumb	*Polygonum sagittatum*	OBL
Bearded Sedge	*Carex comosa*	OBL
Bladder Sedge	*Carex intumescens*	FACW
Blue Vervain	*Verbena hastata*	FACW
Blueflag	*Iris versicolor*	OBL
Blunt Spikerush	*Eleocharis obtusa*	OBL
Broadleaf Cattail	*Typha latifolia*	OBL
Canadian Rush	*Juncus canadensis*	OBL
Common Marsh Bedstraw	*Galium palustre*	OBL
Deertongue Grass	*Dichanthelium clandestinium*	FACW
Fox Sedge	*Carex vulpinoidea*	OBL
Fringed Loosestrife	*Lysimachia ciliata*	FACW
Fringed Sedge	*Carex crinita*	OBL
Green Bulrush	*Scirpus atrovirens*	OBL
Halberdleaf Tearthumb	*Polygonum arifolium*	OBL
Jack-in-the-Pulpit	*Arisaema triphyllum*	FAC
Jewelweed	*Impatiens capensis*	FACW
Least Spikerush	*Eleocharis acicularis*	OBL
Marsh Marigold	*Calthus palustris*	OBL
Nodding Bur Marigold	*Bidens cernua*	OBL
Northern Swamp Buttercup	*Ranunculus hispidus*	FAC
Pennsylvania Bittercress	*Caradmine pensylvanica*	FACW
Pointed-Broom Sedge	*Carex scoparia*	FACW
Reed Canarygrass	*Phalaris arundinacea*	FACW
Rice Cutgrass	*Leersia oryzoides*	OBL
Sensitive Fern	*Onoclea sensibilis*	FACW

Table 7.8-2. Summary of Dominant Wetland Vegetation Documented Upstream of the Spillway Confluence between 2006 and 2018[1] (Continued)

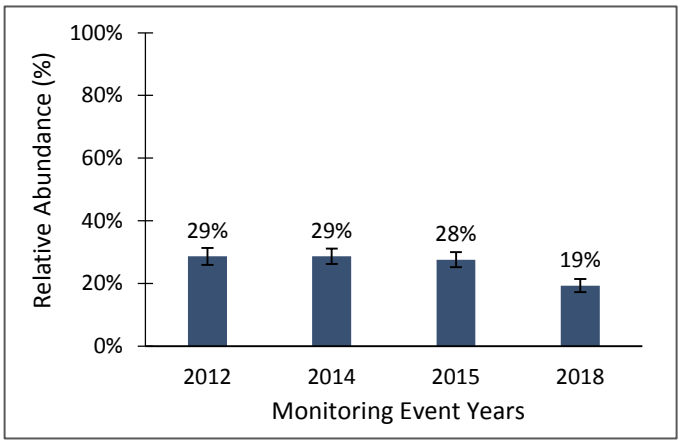
Common Name	Scientific Name	Indicator Status[2]
Shallow Sedge	*Carex lurida*	OBL
Skunk Cabbage	*Symplocarpus foetidus*	OBL
Smallspike False Nettle	*Boehmeria cylindrica*	OBL
Soft Rush	*Juncus effusus*	FACW
Stalk-Grain Sedge	*Carex stipata*	OBL
Swamp Smartweed	*Polygonum hydropiperoides*	OBL
Three-Way Sedge	*Dulichium arundinaceum*	OBL
Uptight Sedge	*Carex stricta*	OBL
Water Speedwell	*Veronica anagallis-aquatica*	OBL
Woolgrass	*Scirpus cyperinus*	OBL
Invasive (Non-Native) Species		
Creeping Jenny	*Lysimachia nummularia*	FACW
Japanese Barberry	*Berberis thunbergii*	FACU
Japanese Stiltgrass	*Microstegium vimineum*	FAC
Marshpepper Smartweed	*Polygonum hydropiper*	OBL
Spotted Ladysthumb	*Polygonum persicaria*	FAC
True Forget-Me-Not	*Myosotis scorpioides*	OBL
Yellow Nut Sedge	*Cyperus esculentus*	FACW

Notes:

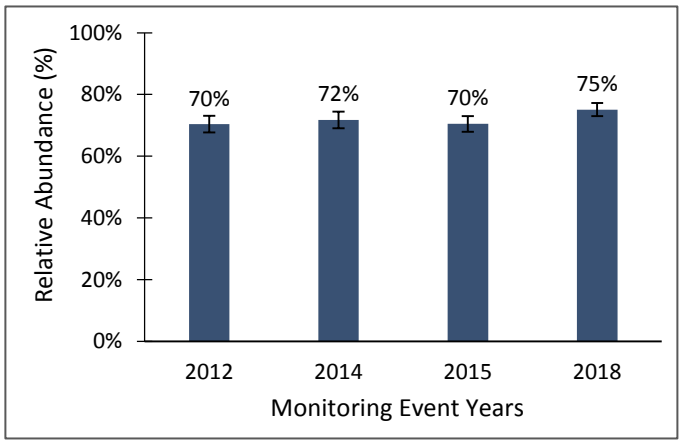
[1] Dominance is defined by USACE Wetland Determination Form's 50/20 rule.

[2] Indicator Status Definitions:

- OBL – Obligate Wetland Plants – Plants that almost always occur (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1%) in non-wetland areas.
- FACW – Facultative Wetland Plants – Plants that usually occur (estimated probability >67% to 99%) in wetlands under natural conditions, but occasionally occur in non-wetland areas.
- FAC – Facultative Plants – Plants that are equally likely to occur in wetlands and non-wetlands (estimated probability 34% to 66%).



(A) Relative Abundance of Native Woody Species in Wetlands Upstream of the Spillway Confluence (Valley Reach 1A)



(B) Relative Abundance of Native Herbaceous Species in Wetlands Upstream of the Spillway Confluence (Valley Reach 1A)

Figure 7.8-5. Vegetative Community Changes Documented Wetlands Upstream of the Spillway Confluence

DOWNSTREAM WETLANDS

Ten wetland sample sites were established in 2012 to document baseline wetland conditions downstream of the spillway confluence. The ten wetland sample sites were located within the floodplain of lower Esopus Creek between the spillway confluence and Cantine Dam (Valley Reaches 1B through 3E). Located on floodplain benches, bars, and terraces immediately adjacent to lower Esopus Creek, the ten sample sites included eight PEM wetlands, one PEM/PSS wetland complex, and one PEM/PSS/PFO wetland complex. As shown in **Table 7.8-3**, no measurable changes to wetland acreages or Cowardin wetland types were observed during the 2014, 2015, and 2018 mapping and monitoring. Dominant vegetation documented at these wetland sample sites are summarized in **Table 7.8-4**.

Similar to wetlands upstream of the confluence, the relative abundance of native woody vegetation decreased over the monitoring period between 2014 and 2018. In addition, the relative abundance of dominant herbaceous species increased slightly between 2012 and 2018. Similar to upstream wetlands, the decrease in native woody vegetation allowed for additional light that may have led to the increase in the relative abundance of herbaceous species. These trends were less pronounced in comparison to those observed upstream of the spillway confluence, as shown in **Figure 7.8-6**.

Table 7.8-3. Summary of Delineated Wetlands Downstream of the Spillway Confluence

Cowardin Classification	Number of Wetlands Identified	Delineated Wetland Areas (Acres)			
		2012	2014	2015	2018
Palustrine Emergent (PEM)	8	2.59	2.59	2.59	2.59
Palustrine Emergent/ Scrub-Shrub (PEM/PSS)	1	0.98	0.98	0.98	0.98
Palustrine Emergent/ Scrub-Shrub/Forested (PEM/PSS/PFO)	1	0.38	0.38	0.38	0.38
TOTAL	**10**	**3.95**	**3.95**	**3.95**	**3.95**

Table 7.8-4. Summary of Dominant Wetland Vegetation Documented Downstream of the Spillway Confluence Between 2012 and 2018[1]

Common Name	Scientific Name	Indicator Status
Native Woody Species		
Black Willow	*Salix nigra*	OBL
Common Buttonbush	*Cephalanthus occidentalis*	OBL
Green Ash	*Fraxinus pennsylvanica*	FACW
Northern Spicebush	*Lindera benzoin*	FAC
Red Maple	*Acer rubrum*	FAC
Silky Dogwood	*Cornus amomum*	FACW
Silver Maple	*Acer saccharinum*	FACW
Slippery Elm	*Ulmus rubra*	FAC
Yellow Birch	*Betula alleghaniensis*	FAC
Native Herbaceous Species (Forbs, Grass, Sedges)		
Arrowleaf Tearthumb	*Polygonum sagittatum*	OBL
Common Spikerush	*Eleocharis palustris*	OBL
Fall Panicgrass	*Panicum dichotomiflorum*	FACW
Meadow Sweet	*Spiraea alba*	FACW
Pennsylvania Smartweed	*Polygonum pensylvanicum*	FACW
Poison Ivy	*Toxicodendron radicans*	FAC
Reed Canarygrass	*Phalaris arundinacea*	FACW
Rice Cutgrass	*Leersia oryzoides*	OBL
Rough Horsetail	*Equisetum hyemale*	FAC
Sensitive Fern	*Onoclea sensibilis*	FACW
Slender Rush	*Juncus tenuis*	FAC
Strawcolored Flatsedge	*Cyperus strigosus*	FACW
Swamp Beggarticks	*Bidens discoidea*	FACW
Swamp Smartweed	*Polygonum hydropiperoides*	OBL
Umbrella Flatsedge	*Cyperus diandrus*	OBL
Water Purslane	*Ludwigia palustris*	OBL
Woodland Horsetail	*Equisetum sylvaticum*	FACW

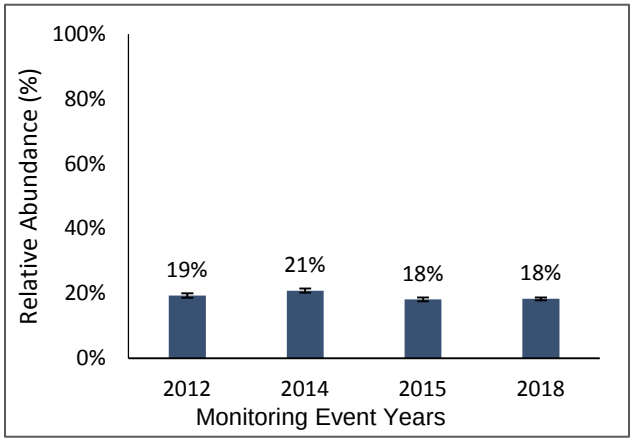
Table 7.8-4 Summary of Dominant Wetland Vegetation Documented Downstream of the Spillway Confluence Between 2012 and 2018[1] (Continued)

Common Name	Scientific Name	Indicator Status
Invasive (Non-Native) Species		
Asiatic Bittersweet	*Celastrus orbiculatus*	UPL
Japanese Stiltgrass	*Microstegium vimineum*	FAC
Purple Loosestrife	*Lythrum salicaria*	OBL
Rambler Rose	*Rosa multiflora*	FACU

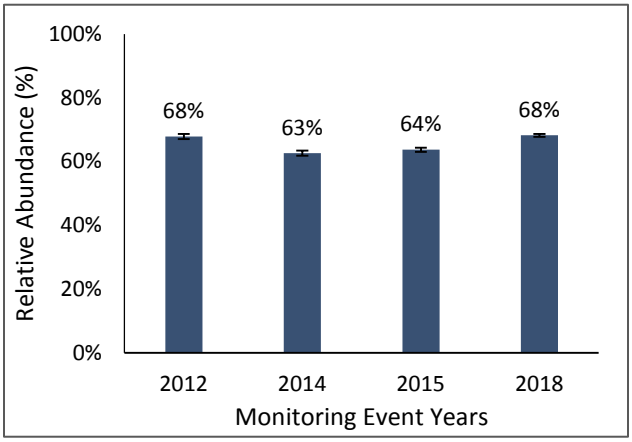
Notes:

[1] Dominance is defined by USACE Wetland Determination Form's 50/20 rule.
Indicator Status Definitions:

- OBL – Obligate Wetland Plants – Plants that almost always occur (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1%) in non-wetland areas.
- FACW – Facultative Wetland Plants – Plants that usually occur (estimated probability >67% to 99%) in wetlands under natural conditions, but occasionally occur in non-wetland areas.
- FAC – Facultative Plants – Plants that are equally likely to occur in wetlands and non-wetlands (estimated probability 34% to 66%).
- FACU – Facultative Upland Plants – Plants that usually occur (estimated probability >67% to 99%) in non-wetland areas, "uplands," under natural conditions, but occasionally occur in wetland areas.
- UPL – Upland Plants – Plants that usually occur (estimated probability >99%) in non-wetland areas, "uplands," under natural conditions, but occasionally occur in wetland areas.



(A) Relative Abundance of Native Woody Species in Wetlands Downstream of the Spillway Confluence (Valley Reaches 1B through 3E)



(B) Relative Abundance of Native Herbaceous Species in Wetlands Downstream of the Spillway Confluence (Valley Reaches 1B through 3E)

Figure 7.8-6. Vegetative Community Changes Documented Wetlands Downstream of the Spillway Confluence

UPSTREAM FLOODPLAIN FORESTS

In 2012, three floodplain forest sample sites were established for monitoring upstream of the spillway confluence following methods described in Section 5.3.8 "Natural Resources" methodology. **Photographs 3 and 4** are representative of floodplain forests in Valley Reach 1A. While there were no significant changes observed in the floodplain forest community upstream of the spillway confluence between the 2012 and 2014 investigations, there were changes to forest composition in terms of decreasing trends in species richness, diversity, and distribution throughout the floodplain forest community. Between 2014 and 2018, there was a noticeable decline in the number of ash trees within the sample sites and throughout the floodplain forest.[50]

Photograph 3. Representative Upstream Floodplain Forest (Floodplain Forest Site 2 in Valley Reach 1A) in 2012

Photograph 4. Representative Upstream Floodplain Forest (Floodplain Forest Site 2 in Valley Reach 1A) in 2018

The field surveys documented a forest structure change in the floodplain forest community between 2012 and 2018 upstream of the Spillway Confluence. In 2012, green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and slippery elm (*Ulmus rubra*) accounted for six, four, and five percent of the trees sampled during the 2012 survey, respectively. During the 2018 survey, there were no green ash sampled; previously sampled green ash trees were located and documented as having become standing dead trees with Emerald Ash Borer damage on the trunks and limbs. During the 2018 survey, American elm accounted for three percent of trees sampled, showing a slight decline in comparison to 2012 survey results, while slippery elm still accounted for five percent. Field notes documented that the sampled American and slippery elm trees exhibited bark damage from an unknown blight/infestation.

DOWNSTREAM FLOODPLAIN FORESTS

In 2012, eight floodplain forest sample sites were established downstream of the spillway confluence following methods described in Section 5.3.8, "Natural Resources" methodology. Between the 2014 and 2018 investigations, there was a noticeable decline in the number of white ash, green ash, and slippery

[50] This decline in the number of trees provided an influx of light that may have led to the increase in the relative abundance of herbaceous species. The change in the vegetative community composition was not significant enough to change the wetland classification (Cowardin) type.

elm within the sample sites and throughout the floodplain forest downstream of the spillway confluence. However, between 2012 and 2014, no significant changes were observed in forest structure metrics or composition for the floodplain forest community downstream of the spillway confluence.

During the 2012 survey downstream of the spillway confluence, green ash (*Fraxinus pennsylvanica*) and American ash (*Fraxinus americana*) accounted for three and two percent of trees sampled, respectively. During the 2018 survey, green ash accounted for one percent of trees sampled and no American ash were sampled. Previously sampled American ash trees were located and documented as having become standing dead trees with Emerald Ash Borer damage on the trunks and limbs, as seen in **Photographs 5 and 6**. Slippery elm (*Ulmus rubra*) accounted for five percent of trees sampled during the 2012 survey, but only three percent of trees sampled during the 2018 survey. The sampled slippery elm trees exhibited bark damage from an unknown blight/infestation.

Photograph 5. View of Floodplain Forest Site 5 (Valley Reach 2C) in 2012

Photograph 6. View of Floodplain Forest Site 5 (Valley Reach 2C) in 2018

WOODY DEBRIS

DEP began mapping downed and leaning trees located upstream of the confluence in Valley Reach 1A in 2012. Downed and leaning trees were observed within wetlands, floodplain forest, and upland areas. Excluding those felled by beaver, approximately 84 downed or leaning trees (counting multiple trunks) were observed along Valley Reach 1A during the initial 2012 investigation. Some trees were uprooted while others had been snapped off near the base of the trunk. The number of new downed and leaning trees mapped during each field survey and the cumulative total of downed and leaning trees for each field survey year are summarized in **Table 7.8-5**.

Some of the previously identified toppled trees within the wetlands were attributed to severe storm events in 2011 and 2012 (including Tropical Storms Irene and Lee) and are likely not a direct result of releases from Ashokan Reservoir. Many of the other downed or leaning trees identified over the monitoring period can be attributed to the aforementioned infestation and disease. The 201 downed and leaning trees identified along Valley Reach 1A are a small percentage of the thousands of trees located along Little Beaverkill and lower Esopus Creek. Downed trees are a natural occurrence when trees die or are toppled by high winds. The downed trees provide wildlife habitat in the water, in wetlands, and in upland areas.

Table 7.8-5. Summary of Downed and Leaning Trees within the Floodplain Upstream of the Spillway Confluence (Valley Reach 1A)

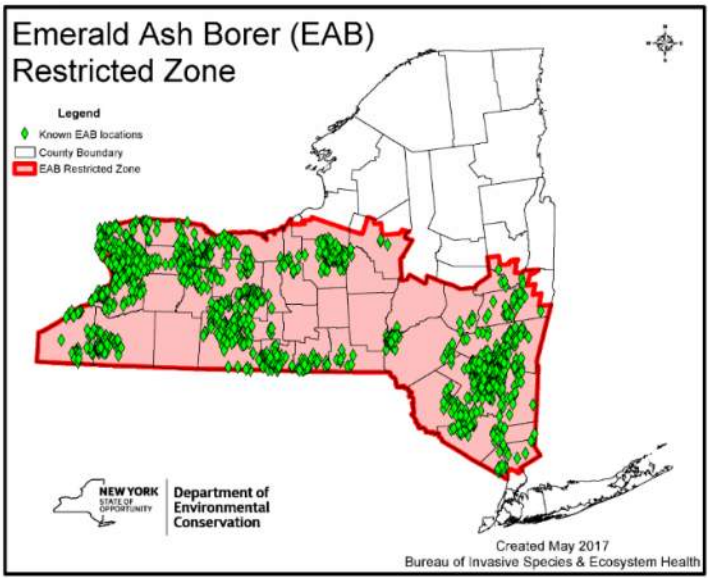
Survey Year	New Downed and Leaning Trees			Cumulative Total Downed and Leaning Trees		
	Downed	Leaning	Total	Downed	Leaning	Total
2012	77	7	**84**	77	7	**84**
2014	25	11	**36**	102	18	**120**
2015	4	2	**6**	106	20	**126**
2018	64	11	**75**	170	31	**201**

7.8.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP has consulted the municipalities within the study area and Ulster County and has not been informed of any upcoming proposed projects or developments that would alter wetlands within the lower Esopus Creek study area.

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from contributing sub-watersheds and spills from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

The documented decreased abundance of native woody species and increased abundance of native herbaceous species in the wetlands along the length of lower Esopus Creek are anticipated to continue due to tree mortality associated with Emerald Ash Borer. Green ash was a dominant tree species within the wetlands along Little Beaverkill and lower Esopus Creek. The widespread die-off of this tree species is the likely driver behind the decrease in the woody vegetation documented by these field investigations over the last six years (**Figure 7.8-7**) and is anticipated to continue in the future without the Proposed Action.



(A) Emerald Ash Borer Restricted Zone (NYDEC, 2017)

(B) Emerald Ash Borer (U. Illinois)

Figure 7.8-7. Emerald Ash Borer (EAB) in New York State

Woody debris due to downed or leaning trees would remain in the study area. Ash trees (*Fraxinus americana*) are a minor constituent of the floodplain forest. Their ongoing loss as a result of the Emerald Ash Borer (*Agrilus planipennis*) is expected in the future without the Proposed Action. Similarly, this would be the case for the eastern hemlock (*Tsuga canadensis*) and elms (*Ulmus* spp.) as a result of the hemlock woolly adelgid (*Adeleges tsugae*) and Dutch elm disease, respectively. Likewise, if beavers continue to deplete the numbers of smaller diameter trees in the future without the Proposed Action, they would be anticipated to target larger trees in the floodplain forest and adjacent uplands.

7.8.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action. Turbidity levels in flows from Ashokan Reservoir would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow.

WETLANDS

The Proposed Action would result in increased inundation within the stream channel along Valley Reach 1A when compared to the future without the Proposed Action. Upstream of the spillway confluence, lower Esopus Creek and the Little Beaverkill would experience sustained flows year-round in the future with the Proposed Action as the result of the community release. In addition, larger releases (up to 600 MGD, 928 cfs) in the form of spill mitigation and operational releases would occur approximately 22 percent of the time, predominately in the winter and spring (see Section 7.1.1, "Flow Regime and Water Quality in Lower Esopus Creek"). Inundation associated with these releases would have a greater extent than that resulting from the community release. These flows above the community release would occur more frequently in the winter and early spring, which is outside the growing season for wetlands and floodplain forests.

Wetlands upstream of the spillway confluence have experienced a full range of streamflow variability over the monitoring period similar to what is anticipated in the future with the Proposed Action. It is not anticipated that any increases in streamflow velocity within Valley Reach 1A would result in bed movement (erosion) that would significantly affect existing wetland soils or vegetation. Streamflow would be consistent with baseline conditions, which did not show a reduction in wetland acreage over the monitoring period in this valley reach (see **Figure 7.1-39)**; small changes in the size of individual wetlands documented during the studies were attributed to beaver activity and man-made changes to lower Esopus Creek (i.e., stream crossing near Ashokan Field Campus).

In the future with the Proposed Action, wetland composition is anticipated to be similar to baseline conditions. Native woody species is anticipated to decline and native herbaceous species is anticipated to increase. These changes are not anticipated to be significant to result in changes to the Cowardin wetland type. As discussed above, the increase in the abundance of native herbaceous species is likely a response to the influx of additional resources, particularly light, from the decline of the overstory trees. It should be noted that the abundance of dominant invasive species, primarily Japanese stilt grass (*Microstegium vimineum*), has remained relatively constant, especially when considering the abundance of resources to

which the native species are responding. Additionally, slippery elm (*Ulmus rubra*) and American elm (*Ulmus americana*) trees have been impacted by disease or a combination of insect and fungal infestation based on field observations. There was evidence of bark and wood damage associated possibly with Dutch elm disease or other disease/infestation of elm along lower Esopus Creek. The Proposed Action is not anticipated to result in any acceleration of the existing decline in these tree species because disease and infestation are the primary drivers of the observed tree mortality. Continued loss of these species are anticipated to remain largely the same in the future with or without the Proposed Action.

Downstream of the spillway confluence, the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. However, in the future with the Proposed Action, spill mitigation and operational releases in the range of 600 MGD (928 cfs) may inundate the stream channel. Similar to Valley Reach 1A, these flows would occur more frequently in the future with the Proposed Action as result of spill mitigation and operational releases, but generally outside the growing season. Downstream wetlands have previously experienced the full variability of streamflow during the monitoring period that are similar to those anticipated in the future with the Proposed Action. Streamflow in the future with the Proposed Action would be consistent with baseline conditions, which did not show a reduction in wetland acreage over the monitoring period. Changes in species composition are also anticipated to continue to be influenced by external factors (such as Emerald Ash Borer and disease).

FLOODPLAIN FORESTS

No appreciable changes to floodplain forests are anticipated to occur as a result of the Proposed Action when compared to the future without the Proposed Action. The observed changes to the floodplain forest vegetative community (decline in ash and elm trees) during the monitoring period were likely attributed to natural forest succession and tree mortality associated with insect infestation, disease, windthrow, deer browse, and beaver damage. These natural processes would occur at similar rates in the future with and without the Proposed Action. The field surveys also documented changes in species composition in terms of decreasing trends in species richness, diversity, and distribution, throughout the floodplain forest community.

As noted above, the decline of ash trees is likely attributed to Emerald Ash Borer, an invasive wood damaging beetle. According to NYSDEC, Emerald Ash Borer was discovered in the Hudson River Valley in 2010. Ulster County is located within the NYSDEC's Emerald Ash Borer Restricted Zone with many known locations of Emerald Ash Borer infestation within the lower Esopus Creek watershed. All native ash species are susceptible including white ash and green ash, and most trees die within two to four years of infestation. The timeline of infestation and tree mortality is consistent with field observations of Emerald Ash Borer damage documented during the 2012 and 2014 surveys and subsequent tree mortality in the 2014, 2015, and 2018 surveys.

WOODY DEBRIS

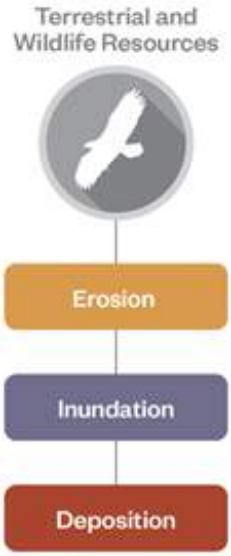
Leaning or downed trees in the future with the Proposed Action would continue to be attributed to the aforementioned infestation and disease and are not anticipated to be a direct result of releases from Ashokan Reservoir. The Proposed Action is not anticipated to result in an increase in toppled trees beyond what is anticipated in the future without the Proposed Action.

CONCLUSION

The Proposed Action would provide sustained flow to lower Esopus Creek year-round from the community release. Streamflow velocity and inundation associated with the Proposed Action would be similar to magnitudes and levels anticipated to occur in the future without the Proposed Action and the same as baseline conditions. Observed changes to wetlands and floodplain forest communities along

lower Esopus Creek during monitoring conducted to support the EIS were related to tree mortality associated with insect infestation and disease. Wetland and floodplain forest communities in the study area have experienced a range of streamflow conditions with no discernible changes to wetland boundaries or flow-related vegetative composition. Therefore, there are no anticipated significant adverse impacts to wetlands and floodplain forests as a result of the Proposed Action.

7.9 TERRESTRIAL AND WILDLIFE RESOURCES



This section presents an assessment of the potential for the Proposed Action to result in effects on wildlife or terrestrial habitat within the lower Esopus Creek study area.

7.9.1 BASELINE CONDITIONS

The terrestrial and wildlife resources study area includes the area within a quarter-mile area along the length of lower Esopus Creek beginning at Ashokan Reservoir and ending in the Village of Saugerties at the confluence of lower Esopus Creek and the Hudson River.

This section summarizes terrestrial, including vegetation, and wildlife resources that are documented or expected to be present in the vicinity of lower Esopus Creek based on desktop studies. Vegetation resources include habitat communities, land cover types, and species documented as occurring or potentially occurring within the study area. Wildlife resources include avian, reptile, amphibian, as well as mammalian species and federally- and State-Threatened, Endangered, and Special Concern Species that have the potential to be present within the lower Esopus Creek study area. As the desktop studies do not provide location-specific data for these resources, this assessment was conducted for lower Esopus Creek as a whole, and not by valley reaches.

TERRESTRIAL RESOURCES

Land cover types include mixed forests (floodplain forests, beech-maple mesic), evergreen forests (hemlock-northern hardwood), deciduous forests (floodplain forests), woody wetlands (floodplain forests), emergent herbaceous wetlands (freshwater tidal marsh, freshwater tidal mudflats, tidal river shoreline), cultivated crops (cropland), pasture/hay (pastureland), shrub/scrub, barren land, and grassland/herbaceous (see **Table 7.9-1** and **Figure 7.9-1** through **Figure 7.9-4**). Areas around the cities of Kingston and Saugerties are also heavily developed and contain less natural land coverage and potential wildlife habitat. Edinger's *Ecological Communities of New York State,* as published by NYSDEC in 2014, was consulted to determine representative species and conditions present in each community type based on the land cover type in the National Land Cover Data published by USGS in 2011.

Table 7.9-1. National Land Cover Data for the Lower Esopus Creek Study Area

NLCD Land Cover Type (Edinger Community)	Area (Acres)	Percent of Study Area[1]
Deciduous Forest	2,268	20.9%
Cultivated Crops	2,139	19.7%
Mixed Forest	1,808	16.6%
Woody Wetlands	1,279	11.8%
Evergreen Forest	512	4.7%
Pasture/Hay	250	2.3%
Emergent Herbaceous Wetlands	81	0.7%
Shrub/Scrub	23	0.2%
Unvegetated Land	17	0.2%
Grassland/Herbaceous	10	0.1%

Note:
[1] The remaining portion of the study area is either developed (approximately 2,004 acres [18.1%]) or open water (approximately 541 acres [4.9%]). Further information on wetlands can be found in Section 7.8, "Wetlands and Floodplain Forests."

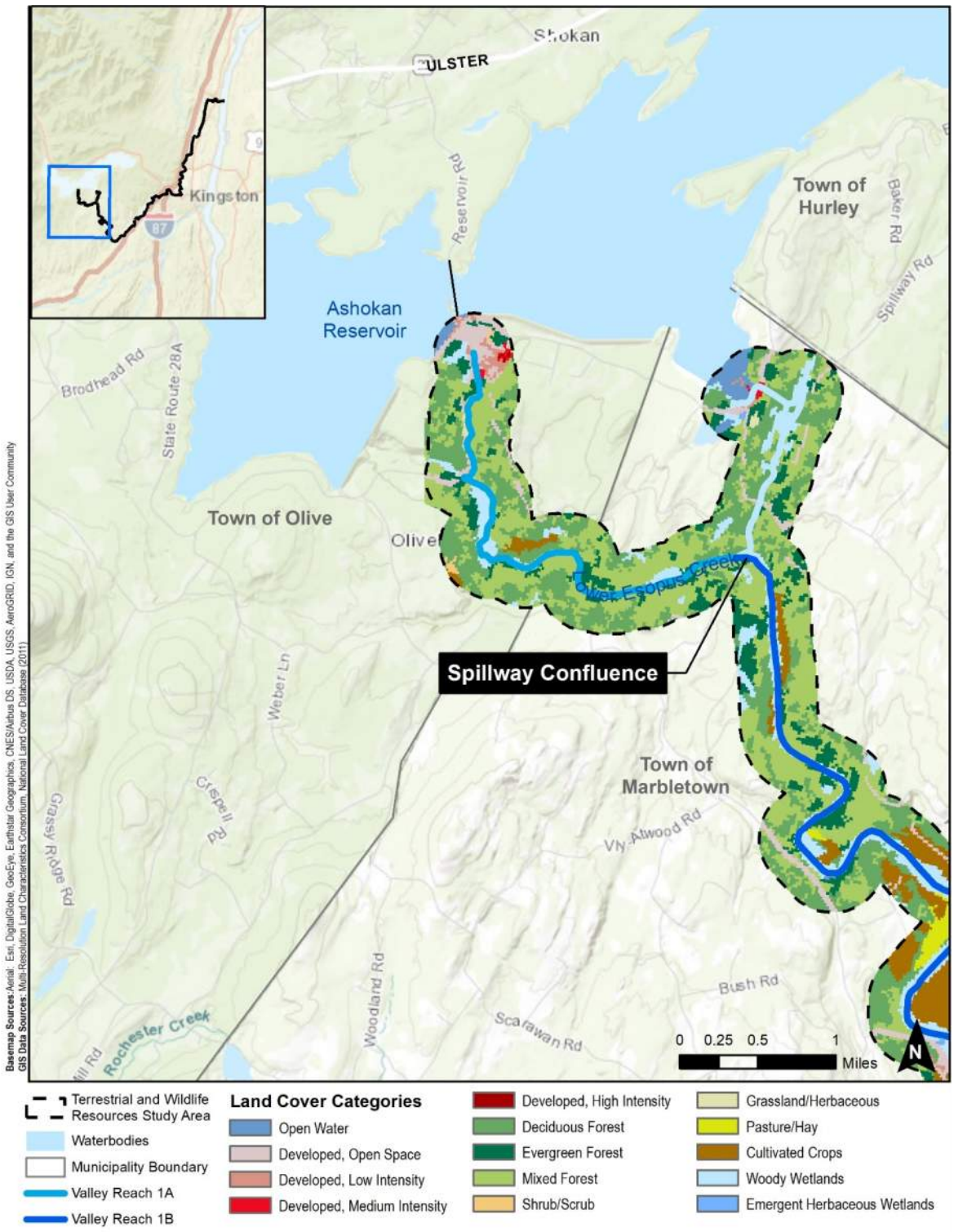


Figure 7.9-1
Lower Esopus Creek
National Land Cover Data for the Lower Esopus Creek Study Area

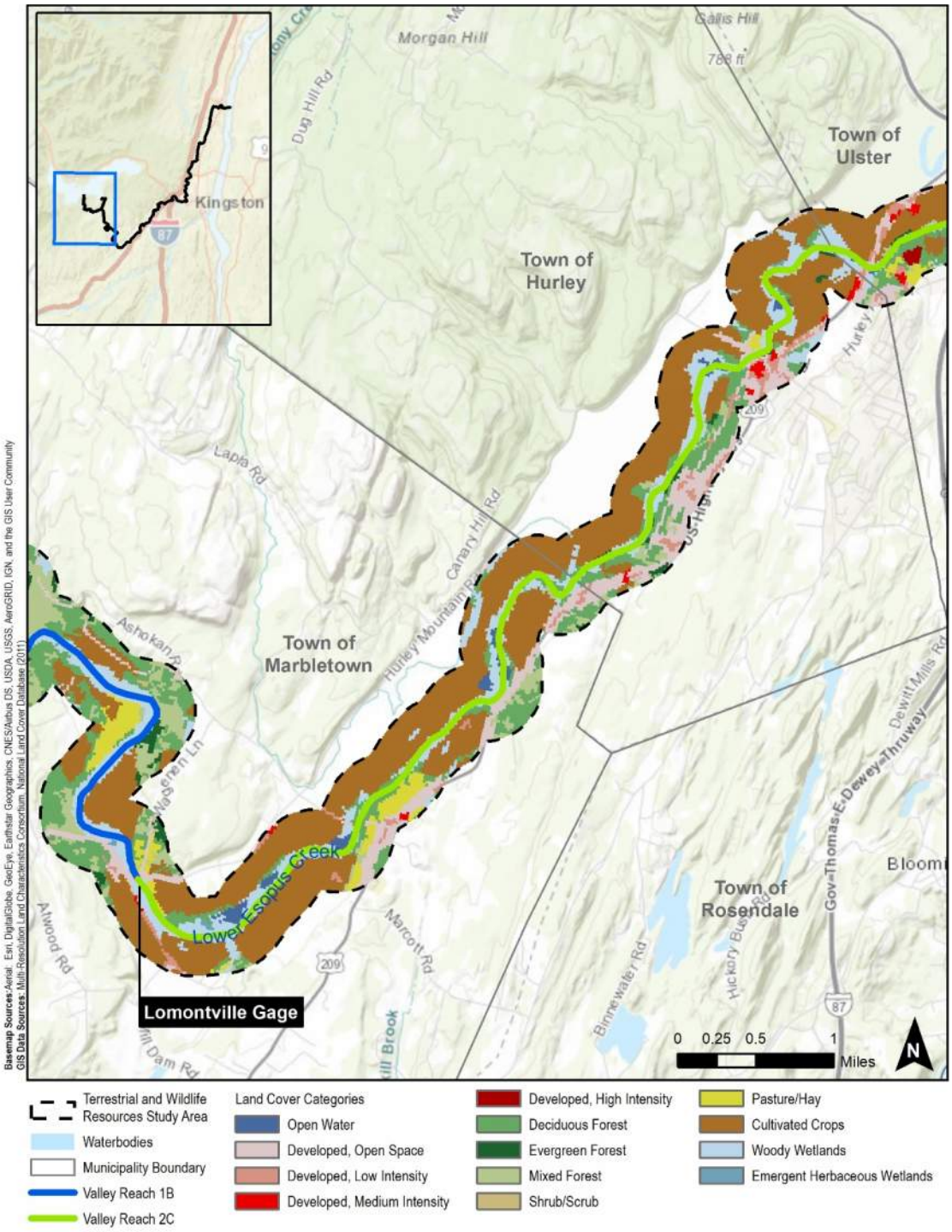


Figure 7.9-2
Lower Esopus Creek
National Land Cover Data for the Lower Esopus Creek Study Area

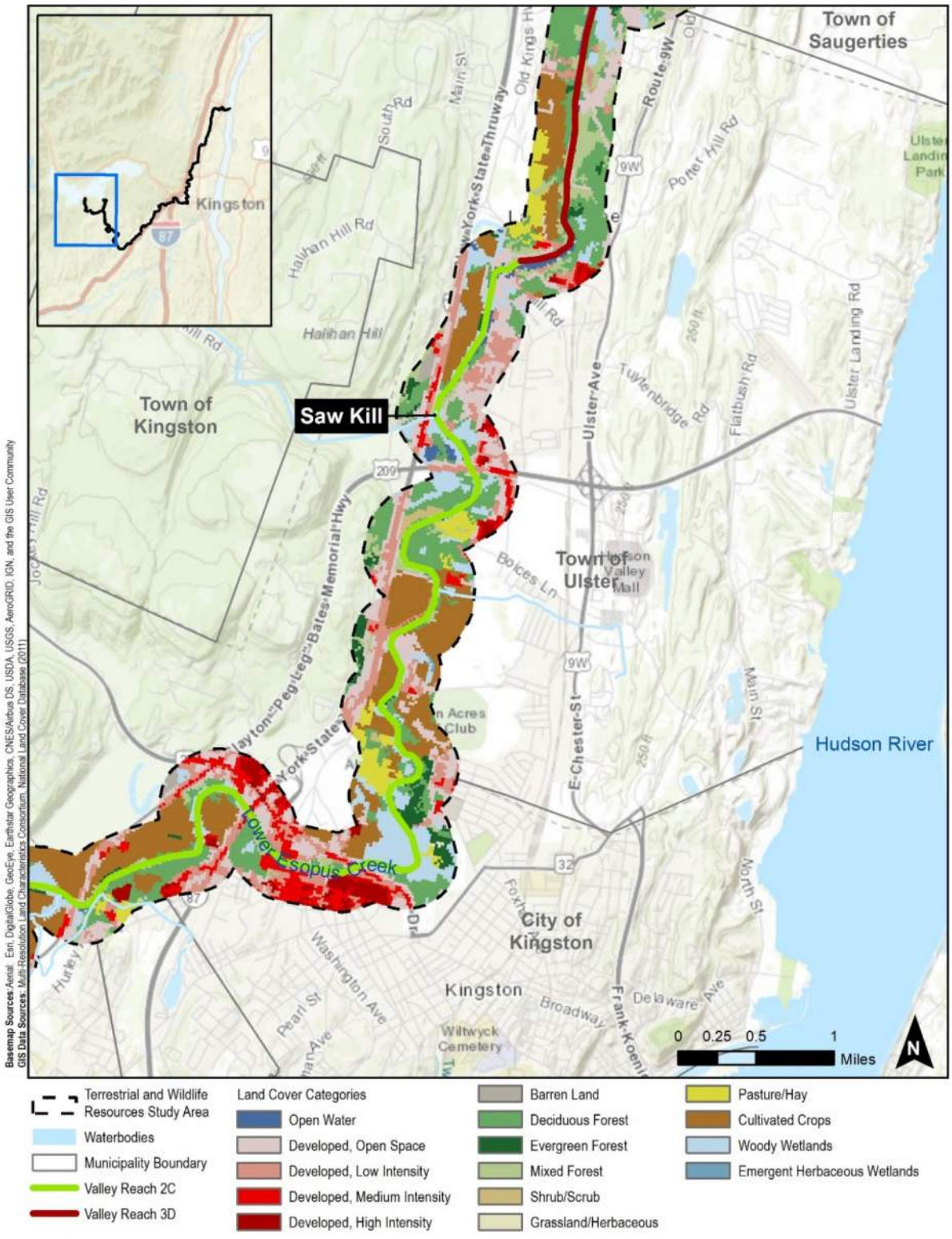


Figure 7.9-3
Lower Esopus Creek
National Land Cover Data for the Lower Esopus Creek Study Area

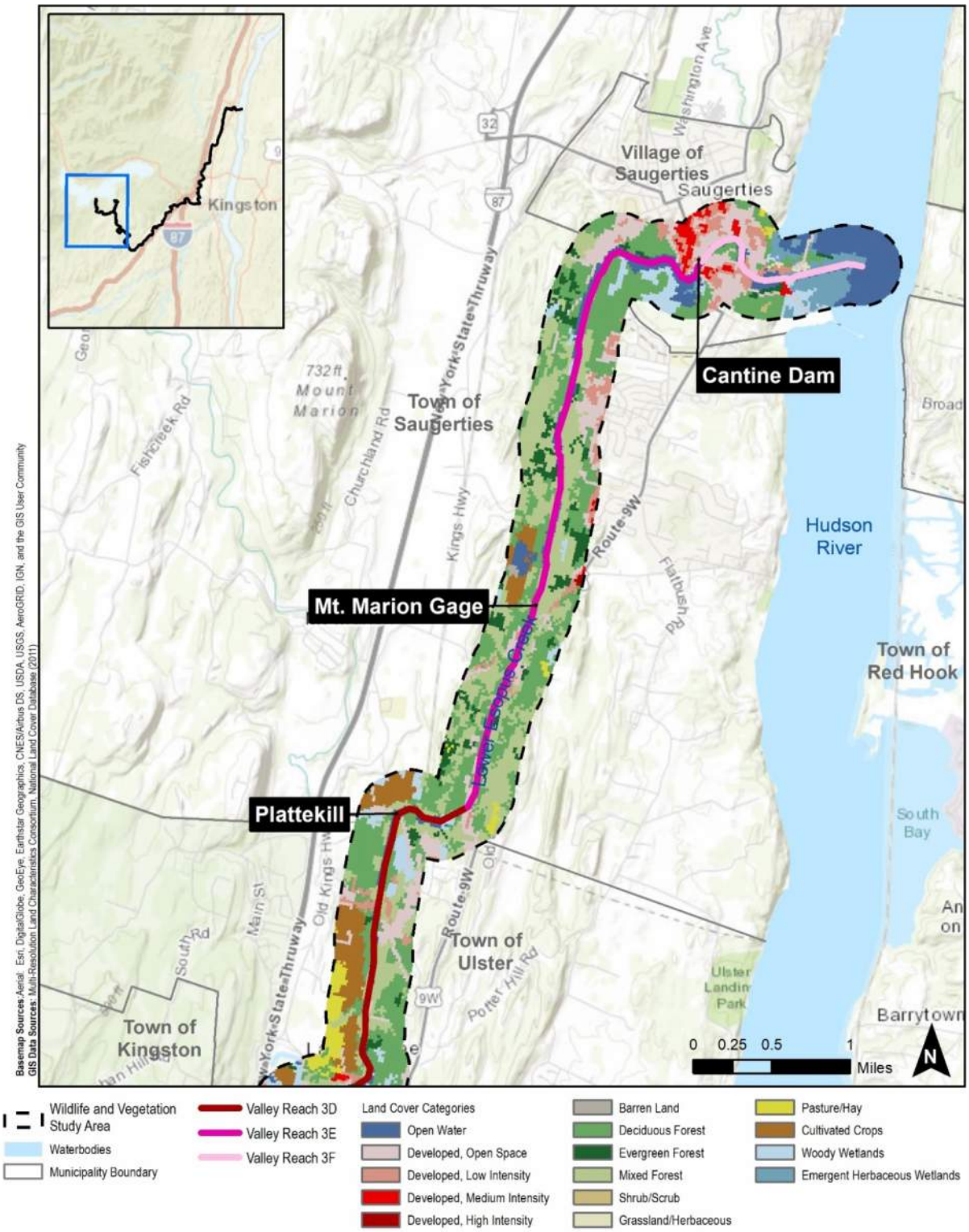


Figure 7.9-4
Lower Esopus Creek
National Land Cover Data for the Lower Esopus Creek Study Area

WILDLIFE RESOURCES

The variety of wildlife habitats identified in the previous section support a wide range of reptiles, amphibians, birds, and mammals. Over 35 mammals, 45 herpetofauna (reptiles and amphibians), and 120 species of birds were identified within the vicinity of the study area.

AVIAN SPECIES

Migratory and nesting forest interior passerines (songbirds) identified include warblers, thrushes, vireos, and flycatchers. Forest raptors such as Red-shouldered Hawk (*Buteo lineatus*), Cooper's Hawk (*Accipiter cooperii*), and Northern Goshawk (*Accipiter gentilis*) would be expected to nest in these forest expanses. Lowland and floodplain forests and scrub-shrub wetlands would be expected to support a diversity of bird life such as Barred Owl (*Strix varia*), flycatchers, Blue-winged Warbler (*Vermivora cyanoptera*), Wood Thrush (*Hylocichla mustelina*), Veery (*Catharus fuscescens*), Common Raven (*Covus corax*), and Pileated Woodpecker (*Dryocopus pileatus*). Examples of common bird species that would be expected among edges, fields and/or shrub successional habitats include Northern Harrier (*Circus cyaneus*), American Kestrel (*Falco sparverius*), Yellow Warbler (*Setophaga petechia*), Tree Swallow (*Tachycineta bicolor*), Black-capped Chickadee (*Poecile atricapillus*), Chimney Swift (*Chaetura pelagica*), and many other generalist bird species.

AMPHIBIAN AND REPTILE SPECIES

Upland forests support a diversity of reptiles including timber rattlesnake (*Crotalus horridus*), Northern copperhead (*Agkistrodon contortirx*), and black ratsnake (*Pantherophis spiloides*). Examples of herptiles in the floodplain forests would include box turtle (*Terrapene carolina*), wood turtle (*Glyptemys insculpta*), ribbon snake (*Thamnophis sauritus*), *Plethodon* and *Ambystoma* salamander species, red-spotted newt (*Notopthalmus viridescens*) wood frog (*Lithobates sylvatica*), gray treefrog (*Hyla versicolor*), American toad (*Anaxyrus americanus*) and spring peeper (*Pseudacris crucifer*).

Mammalian Species

Mammals including various bat species, bobcat (*Lynx rufus*), black bear (*Ursus americanus*), and mustelid (weasel) species would be expected within the upland forest.

THREATENED AND ENDANGERED SPECIES

The USFWS IPaC System was consulted for the lower Esopus Creek study area in November 2018. According to IPaC, three federally-listed terrestrial species were identified as potentially occurring near the study area. These include the endangered Indiana bat (*Myotis sodalis*), the threatened Northern long-eared bat (*Myotis septentrionalis*), and the threatened bog turtle (*Clemmys muhlenbergii*). Additionally, the Bald Eagle (*Haliaeetus leucocephalus*) is protected under the Bald and Golden Eagle Protection Act (BGPA) and the Migratory Bird Treaty Act (MBTA). The New York Natural Heritage Program (NYNHP) identified three eagle nests within the study area.

The NYNHP Database was searched to obtain information on any known occurrences of federally- or State-listed animals or plants, or significant habitats in the immediate vicinity of the lower Esopus Creek study area. Correspondence with the NYNHP in November 2018 indicated 13 State-listed, currently documented species with the potential to occur within the lower Esopus Creek study area. NYSDEC Nature Explorer was also utilized to identify rare, threatened and endangered species potentially occurring within the study area.

7.9.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP has consulted the municipalities within the study area and Ulster County and has not been informed of any upcoming projects within the study area that would alter terrestrial and wildlife resources in or around lower Esopus Creek.

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

The upland portion of the study area, which contains large unbroken swathes of forest, is anticipated to continue providing the same suitable habitat that hosts a variety of mammals, migratory and nesting birds, and snakes as baseline conditions. Upland areas are subject to land fragmentation, urbanization, and agricultural use in accordance with their land use and zoning classifications. Natural conditions such as insect infestation, disease, windthrow, and predation would continue to down trees.

7.9.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases would follow a similar seasonal pattern as compared to the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action. Turbidity levels in flows from Ashokan Reservoir would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow.

TERRESTRIAL AND WILDLIFE RESOURCES

As presented in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," releases would be contained within the stream channel. Therefore, flows in the range of the releases under the Proposed Action would only inundate in-channel features such as the inner berm and mid-channel bars, features that would be frequently wetted in both the future without and with the Proposed Action. This is supported by field surveys that revealed that there were no observed changes in Cowardin classification or overall extent of wetlands during the monitoring period (see Section 7.8, "Wetlands and Floodplain Forests") when releases in accordance with the IRP were in place. Furthermore, as discussed in Section 7.8, "Wetlands and Floodplain Forests," wetland studies indicated that downed trees in the study area would continue to be driven by natural processes such as beaver predation, invasive species (i.e., Emerald Ash Borer), and disease. Because habitat is not anticipated to be affected as a result of the Proposed Action, conditions for amphibians, insects, and wading birds are anticipated to continue to remain suitable for these wildlife and terrestrial resources. Additionally, species that do utilize in-channel features are well adapted to the dynamic hydrological conditions that occur within stream channels.

THREATENED AND ENDANGERED SPECIES

Table 7.9-2 summarizes the evaluation for the potential impacts to threatened, endangered, rare, or special concern species that potentially occur in the study area.

Table 7.9-2. Assessment of Threatened, Endangered, Special Concern, and Rare Species that Potentially Occur in the Study Area

Species (Common/Scientific)	Potential Habitat Present?[1]	Critical Habitat Present?	Federal and State Status	Determination	Notes/Documentation Summary
Arrowhead Spiketail (*Cordulegaster obliqua*)	Yes	NA (State-listed)	Federal – None State - Unlisted	No Effect	Arrowhead spiketail utilizes small, muddy streams and spring fed rivulets. Substrates are soft bottomed and sometimes rocky. Streams are often surrounded by forest but may have components of spring fed herbaceous wetland. The species ovaposits within these small spring fed streams and seeps, and may forage for insects in open clearings adjacent to the forested habitats. While seepages and small streams may be within the study area, lower Esopus Creek does not fulfill the habitat requirements of the arrowhead spiketail. Therefore, **no effect** on arrowhead spiketail is anticipated as a result of the Proposed Action.
Bald Eagle (nesting) *(Haliaeetus leucocephalus)*	Yes	No	Federal – Protected by Bald and Golden Eagle Act and Migratory Bird Treaty Act State – Threatened	No Effect	Breeding habitat for Bald Eagle consists of large nesting trees in deciduous, conifer, or mixed forest patches or stands near open water areas suitable for (primarily fish) foraging (NJDEP 2013). Tree loss (i.e., toppled or leaning trees, tree mortality) in the study area observed during field surveys was determined to be due to insect infestation and disease, as well as beaver activity, which are anticipated to continue both in the future without and with the Proposed Action. The Proposed Action is not anticipated to cause tree damage or loss. Therefore, **no effect** on Bald Eagle is anticipated as a result of the Proposed Action.
Bog turtle (*Glyptemys muhlengergii*)	No	No	Federal – Threatened State – NA	No Effect	Fen or wet meadow with cool, predominantly groundwater fed, shallow and slow-moving water are suitable bog turtle habitat. Hibernacula often occur adjacent to spring or seep heads in and among woody vegetation root structures (USFWS 2001; Gibbs et al. 2007). Bog turtles do not require streams for any part of their life history. Wetland surveys within the study area did not identify wetlands fed by groundwater seeps. Furthermore, wetlands in the study area have experienced a range of streamflow conditions. There were no observed changes to Cowardin classification or overall extent of wetlands over the monitoring period (2006 to 2018). Therefore, **no effect** on bog turtle or its potential habitat is anticipated as a result of the Proposed Action.
Indiana bat (*Myotis sodalist*)	Yes	No	Federal – Endangered State – Endangered	No Effect	Live trees and/or snags ≥5 inches diameter at breast height (dbh) that have exfoliating bark, cracks, crevices, and/or hollows, as well as linear features such as fencerows, riparian forests, and other wooded corridors provide female summer roosts (USFWS 2015). Roost colonies have been identified as close as 0.33 miles from lower Esopus Creek in the vicinity of Lomontville. No hibernacula were identified. Tree loss (i.e., toppled or leaning trees, tree mortality) in the study area observed during field surveys was determined to be due to insect infestation and disease, as well as beaver activity, which are anticipated to continue both in the future without and with the Proposed Action. The Proposed Action is not anticipated to cause tree damage or loss. Therefore, **no effect** on the Indiana bat is anticipated as a result of the Proposed Action.
Northern Harrier (*Circus cyaneus*)	Yes	NA (State-listed)	Federal – None State – Threatened	No Effect	Northern Harriers use a wide range of open grasslands, shrubland, and salt and open, expansive grassland marshlands. Their nests are placed on the ground, usually in dense cover. The wetlands located along lower Esopus Creek have canopy cover, which is not ideal for Northern Harrier foraging. Any potential nesting habitat is likely located in upland portions of the study area which would not be affected by the Proposed Action. Therefore, **no effect** on the Northern Harrier is anticipated as a result of the Proposed Action.

Table 7.9-2. Assessment of Threatened, Endangered, Special Concern, and Rare Species that Potentially Occur in the Study Area

Species (Common/Scientific)	Potential Habitat Present?[1]	Critical Habitat Present?	Federal and State Status	Determination	Notes/Documentation Summary
Northern long-eared bat (*Myotis septentrionalis*)	Yes	No	Federal – Threatened State – Threatened	No Effect	Summer roosting habitat for the Northern long-eared bat includes live or dead trees of >3 inch dbh with crevices, flaky bark, or cracks. Northern long-eared bats prefer roost trees in elevated portions of the forest, such as along a slope or at the top of slopes. Small canopy gaps are used by maternal Northern long-eared bats for roosting and foraging (Owen et al. 2003[51]). Proximity to aquatic habitats may be particularly important for maternal females. Most known hibernation sites are caves or abandoned mines. Tree loss (i.e., toppled or leaning trees, tree mortality) in the study area observed during field surveys was determined to be due to insect infestation and disease, as well as beaver activity, which are anticipated to continue both in the future without and with the Proposed Action. The Proposed Action is not anticipated to cause tree damage or loss. No hibernacula are located within the study area. Therefore, **no effect** on the Northern long-eared bat is anticipated as a result of the Proposed Action.
Spatterdock darner (*Rhionaeschna mutate*)	Yes	NA (State-listed)	Federal – None State - Unlisted	No Effect	Spatterdock darner has been documented to prefer fishless ponds or lakes for oviposition. The species has been documented within the study area, in the vicinity of beaver ponds which are located west of the spillway channel. The Proposed Action would not affect ponds located west of the spillway channel, and there are no lakes within the study area. Wetlands in the study area have experienced a range of streamflow. There were no observed changes to Cowardin classification or overall extent of wetlands over the monitoring period (2006 to 2018). Therefore, **no effect** on spatterdock darner is anticipated as a result of the Proposed Action.
Timber Rattlesnake (*Crotalus horridus*)	Yes	NA (State-listed)	Federal – None State - Threatened	No Effect	Timber rattlesnakes are generally found in deciduous forests in rugged terrain. Field monitoring from 2006 to 2018 showed only minor changes to the wetlands and floodplain forest communities that were all related to tree mortality associated with insect infestation and disease. Inundation of floodplain forests in the future with the Proposed Action are not anticipated to adversely affect floodplain forests. Therefore, **no effect** on timber rattlesnake is anticipated as a result of the Proposed Action.
Wood turtle (*Glyptemys insculpta*)	Yes	No	Federal – None State – Special Concern	May Affect, Not Likely to Adversely Affect	Wood turtles have been documented within lower Esopus Creek in the vicinity of the Town of Hurley (J. Tesauro, Pers. Com 2018[52]). Riparian deciduous and mixed forests, forest edges, and grassy/scrub-shrub vegetation areas with less or little canopy are used for basking and foraging. Nests in elevated, well-drained, open areas with loose soil and ample sunlight (CWF 2016). Hibernation occurs directly within streams with flowing water. Hibernacula microhabitats include stream bottoms, stream banks, submerged rocks overhanging root systems, and abandoned muskrat holes. Specifically, winter hibernacula include undercut river banks, overhanging root systems, log jams, beaver dams, leaf packs in deep slow-moving pools, or other sheltered structures directly within streams. Changes due to erosion, deposition, or collapses of undercut banks were assessed for their potential to adversely affect hibernacula. As noted in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime ad Water Quality," while areas of higher bank retreat have been observed in Valley Segment 2C, based on composition of the streambanks in this valley reach, this erosion is anticipated to occur in both the future without and with the Proposed Action. In the future with the Proposed Action, releases would typically occur in the spring and would not coincide with the wood turtle nesting season and incubation period of June through August. In addition, wood turtles typically nest in areas at least three feet above the normal water level. Therefore, it is not anticipated that they would nest on in-channel features, such as mid-channel bars, that are frequently wetted. Further, wood turtles are adapted to dynamic stream environments that would experience fluctuations in water levels and streamflow magnitudes. In the future with the Proposed Action, habitat within the lower Esopus Creek study area would continue to be suitable hibernacula for wood turtles. Therefore, the Proposed Action **would affect but is not likely to adversely affect** wood turtles.

[51] Owen, S.F. M.A. Menzel, W.M. Ford, B.R. Chapman, K.V. Miller, J.W. Edwards and P.B. Wood. 2003. Home-range Size and Habitat Used by the Northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 156:352-359.
[52] Tesauro, J. 2018. Personal Communication Regarding Observations and Behavior of Wood Turtles in Lower Esopus Creek. Jason Tesauro Ecological Consulting, LLC.

Table 7.9-2. Assessment of Threatened, Endangered, Special Concern, and Rare Species that Potentially Occur in the Study Area

Species (Common/Scientific)	Potential Habitat Present?[1]	Critical Habitat Present?	Federal and State Status	Determination	Notes/Documentation Summary
Alpine Cliff Fern (*Woodsia alpina*)	Yes	NA (State-listed)	Federal – None State - Endangered	No Effect	Alpine cliff ferns are known to be found in: dry to moist, shaded, acidic cliffs or ledges in the mountains; rock crevices in cool sites; and, in shaded or exposed, damp to dry slaty or calcareous rocky banks. The study area does not contain suitable alpine cliff fern habitat. Therefore, **no effect** on alpine cliff fern is anticipated as a result of the Proposed Action.
Common roseroot (*Rhodiola rosea*)	Yes	NA (State-listed)	Federal – None State - Endangered	No Effect	Roseroot has been found at only a few sites in the State, all of them cliffs, and all but one near waterfalls. The species appears to prefer shaded and cool sites. It occupies cliffs of both calcareous and acidic rock. The study area does not contain suitable roseroot habitat. Therefore, **no effect** on roseroot is anticipated as a result of the Proposed Action.
Green rock cress (*Arabis missouriensis*)	Yes	NA (State-listed)	Federal – None State – Threatened	No Effect	In the Northeast, this is a species of rocky upland habitats, growing from cracks and crevices in cliffs, ledges, talus slopes, and rocky woodlands. Green rock cress may reside in the upland portions of the study area which are not anticipated to be affected by the Proposed Action. Therefore, **no effect** on green rock cress is anticipated as a result of the Proposed Action.
Heart-leaved Plantain (*Plantago cordata*)	Yes	NA (State-listed)	Federal – None State - Rare	No Effect	Heart-leaved plantain habitat is restricted to the edges of freshwater intertidal mudflats, sandy or rocky shorelines of tidal creeks and other waterways, edges of freshwater tidal marshes, and gravel shores along the freshwater tidal portions of the Hudson River. With the exception of a few populations in the Tonawanda Creek drainage of western New York, all known and historical populations are located along the Hudson River. Any potential heart-leaved plantain habitat would be along the freshwater tidal portions of the Hudson River within Valley Reach 3F. Valley Reach 3F is tidally influenced, and therefore, would not be affected by differences between the future without and with the Proposed Action. Therefore, **no effect** on heart-leaved plantain is anticipated as a result of the Proposed Action.
Hudson water nymph (*Najas muenscheri*)	Yes	NA (State-listed)	Federal – None State - Threatened	No Effect	This taxon occurs in shallow water or pools of tidal mud flats of the Hudson River on mucky or gravel and rock soils. It is endemic to the lower regions of the Hudson River. Any potential Hudson water nymph habitat would be along the freshwater tidal portions of the Hudson River within Valley Reach 3F. Valley Reach 3F is tidally influenced, and therefore, would not be affected by differences between the future without and with the Proposed Action. Therefore, **no effect** on Hudson water nymph is anticipated as a result of the Proposed Action.
Northern quillwort (*Isoetes septentrionalus*)	Yes	NA (State-listed)	Federal – None State - Endangered	No Effect	Northern quillwort is an aquatic plant found along pond margins, cobble shorelines of large rivers, tidal mudflats, and shallow gravelly areas of lakes. Any potential northern quillwort habitat would be along the freshwater tidal portions of the Hudson River within Valley Reach 3F. Valley Reach 3F is tidally influenced, and therefore, would not be affected by differences between the future without and with the Proposed Action. Therefore, **no effect** on Northern quillwort is anticipated as a result of the Proposed Action.
Rhodora (*Rhododendron canadense)*	Yes	NA (State-listed)	Federal – None State - Threatened	No Effect	Rhodora is typically found in bog environments including thickets, wet woods, acidic rocky summits, fens, heath barrens, and shrub swamps according to NYNHP. Wetlands in the study area have experienced a range of streamflow. There were no observed changes in Cowardin classification or overall wetland extent. Neither Cowardin classification, overall wetland extent, nor upland habitat, is anticipated to be affected in the future with the Proposed Action. Therefore, **no effect** on rhodora is anticipated as a result of the Proposed Action.
Rough avens (*Geum virginianum*)	Yes	NA (State-listed)	Federal – None State - Threatened	No Effect	Rough avens is found in a variety of habitats including oak-hickory and Northern hardwood forests, limestone woodlands, muddy riverbanks, forested swamps, marshes and roadsides. The species is known to have a broad habitat tolerance. Observations made during wetland studies do not show change in wetland extent. Neither Cowardin classification, overall wetland extent, nor upland habitat, is anticipated to be affected in the future with the Proposed Action. Furthermore, the study area has experienced a range of streamflow similar to those that are anticipated in future with the Proposed Action. Therefore, **no effect** on Rough avens is anticipated as a result of the Proposed Action.
Swamp buttercup (*Ranunculus septentrionalis)*	Yes	NA (State-listed)	Federal – None State – Endangered	No Effect	Swamp buttercup are found in emergent wetlands. Wetlands in the study area have experienced a range of streamflow. There were no observed changes in Cowardin classification or overall wetland extent. Cowardin classification and overall wetland extent are not anticipated to be affected in the future with the Proposed Action. Therefore, **no effect** on Swamp Buttercup is anticipated as a result of the Proposed Action.

Table 7.9-2. Assessment of Threatened, Endangered, Special Concern, and Rare Species that Potentially Occur in the Study Area

Species (Common/Scientific)	Potential Habitat Present?[1]	Critical Habitat Present?	Federal and State Status	Determination	Notes/Documentation Summary
Tidal spikerush (*Eleocharis aestuum*)	Yes	NA (State-listed)	Federal – None State – Endangered	No Effect	This taxon occurs in shallow water or pools of tidal mud flats of the Hudson River on mucky or gravel and rock soils. Any potential water pigmyweed habitat would be along the freshwater tidal portions of the Hudson River within Valley Reach 3F. Valley Reach 3F is tidally influenced, and therefore, would not be affected by differences between the future without and with the Proposed Action. Therefore, **no effect** on water pigmyweed is anticipated as a result of the Proposed Action. Hudson water nymph may reside in the tidal portions of lower Esopus Creek which are not anticipated to be affected by the Proposed Action.
Water pigmyweed (*Crassula aquatica*)	Yes	NA (State-listed)	Federal – None State - Endangered	No Effect	In New York this species has been found in tidal mud flats, marshes, and rocky shores along the lower Hudson River, and along the banks of an intertidal river on Long Island. Any potential water pigmyweed habitat would be along the freshwater tidal portions of the Hudson River within Valley Reach 3F. Valley Reach 3F is tidally influenced, and therefore, would not be affected by differences between the future without and with the Proposed Action. Therefore, **no effect** on water pigmyweed is anticipated as a result of the Proposed Action.

Notes:
No field surveys were conducted as part of this assessment.
NA – Not applicable

CONCLUSIONS

In the future with the Proposed Action, releases would be contained within the stream channel. Therefore, streamflow in the range of the releases in the future with the Proposed Action would only inundate in-channel features such as the inner berm and mid-channel bars, features that would be frequently wetted in both the future without and with the Proposed Action. Furthermore, wetland studies indicated that downed trees in the study area would continue to be influenced by natural processes such as beaver predation, invasive species (i.e., Emerald Ash Borer), and disease. Because habitat is not anticipated to be affected as a result of the Proposed Action, conditions for amphibians, insects, and wading birds are anticipated to continue to remain suitable for these wildlife and terrestrial resources. Additionally, species that do utilize in-channel features are well adapted to the dynamic hydrological conditions that occur within stream channels. Furthermore, the Proposed Action is anticipated to have no effect on any threatened or endangered species or their habitat that have the potential to occur within the study area. Therefore, there are no anticipated significant adverse impacts to terrestrial and wildlife habitat, wildlife corridors, or wildlife species that occur within the lower Esopus Creek study area as a result of the Proposed Action.

7.10 HAZARDOUS MATERIALS

The hazardous materials assessment was conducted to identify the potential for the Proposed Action to increase the exposure of people or the environment to hazardous materials, and if this potential increased exposure would result in a potential significant impact to public health or the environment. The Proposed Action would not include the use or generation of potentially hazardous substances (e.g., petroleum or pesticides, hazardous waste, or hazardous chemicals) within the lower Esopus Creek study area.

7.10.1 BASELINE CONDITIONS

The hazardous materials study area consists of the immediate area along lower Esopus Creek, within a 150-foot radius from its banks. The majority of the area in the immediate vicinity of lower Esopus Creek consists of wooded land and vegetated areas. Development along lower Esopus Creek includes agricultural land and scattered commercial, industrial, and residential properties. Several readily available public databases containing information on the presence of hazardous materials in and near the study area were reviewed to conduct this assessment (see Section 5.3.9 "Hazardous Materials" methodology). Where not specifically mentioned, publicly available environmental databases did not indicate the presence of hazardous materials in the study area.

The NYSDEC Environmental Site Database Search identified three NYSDEC bulk storage tank sites located adjacent to lower Esopus Creek and within the study area: the Saugerties Power Boat Association, located approximately 130 feet from the banks of lower Esopus Creek; the Saugerties Marina site, located approximately 150 feet from the banks of lower Esopus Creek; and Lynch Marina site (also known as the Saugerties Steamboat Co), located approximately 75 feet from the banks of lower Esopus Creek (see **Figure 7.10-1**).[53] The Saugerties Power Boat Association has one registered aboveground storage tank (AST) that is currently in service and contains gasoline. The Saugerties Marina site is registered with two ASTs currently in service that contain gasoline/ethanol and diesel fuel. In addition, the site had three underground storage tanks (USTs) that have been closed-removed. These closed USTs formerly contained gasoline and No. 2 fuel oil. The Lynch Marina site is registered with two USTs that contained gasoline and diesel fuel and have been closed-removed. The "closed-removed" status of the former USTs at the Saugerties Marina and Lynch Marina sites indicates that the tanks have been properly closed or any potential contamination associated with the tanks has been remediated to the satisfaction of NYSDEC. No reported leaks or spills have been identified in connection with the ASTs. Each of the NYSDEC bulk storage tank sites identified through the database review are located downstream of the Cantine Dam, which is tidally influenced (see Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality").

[53] The NYSDEC database refers to the business commonly known as the Saugerties Marina as the Saugerties Marine.

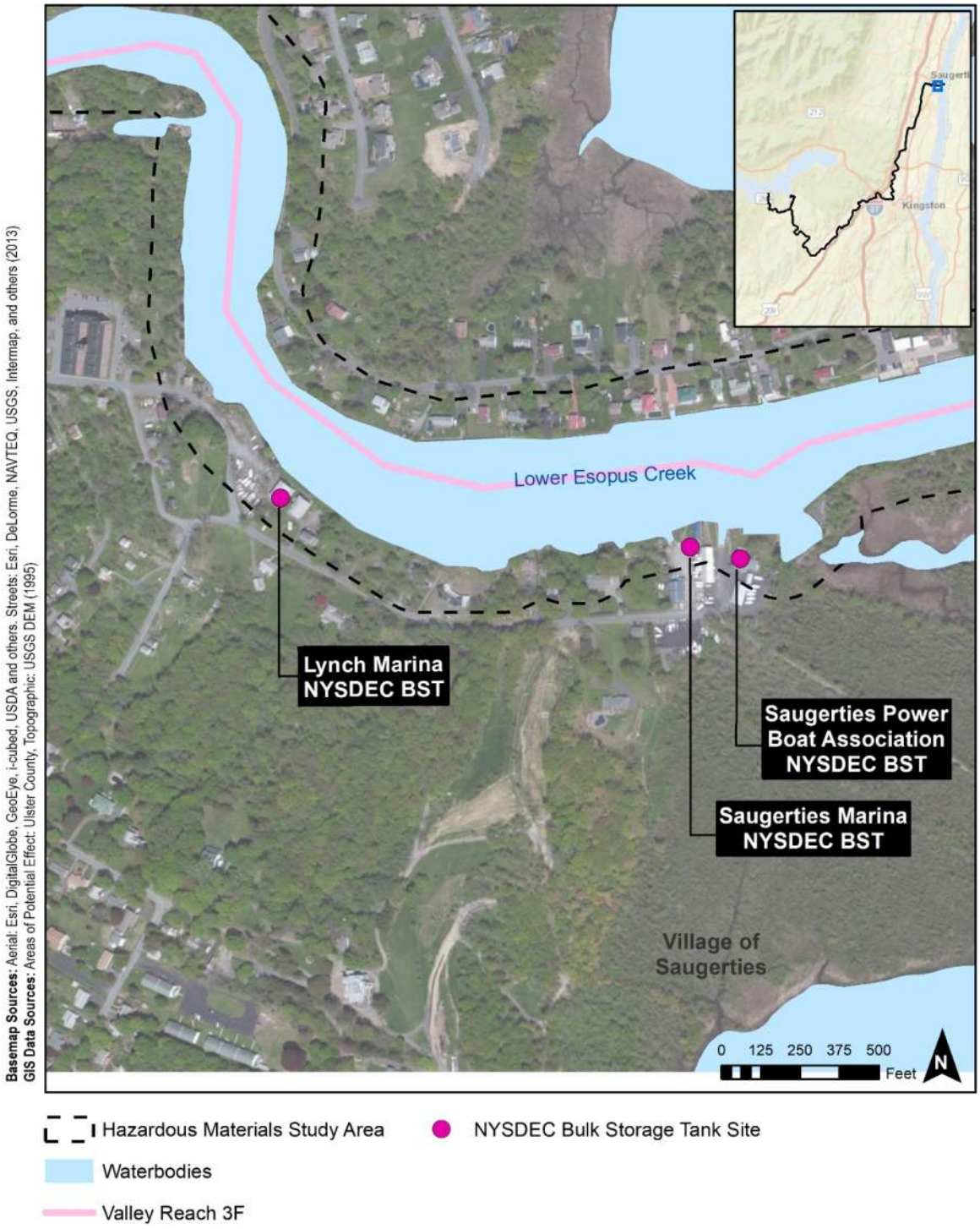


Figure 7.10-1
Lower Esopus Creek
Bulk Storage Tank Sites

7.10.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP has consulted with the Town of Saugerties and Ulster County and has not been informed of upcoming new projects that would introduce hazardous materials to the environment. The ASTs currently in service were installed in 1997 and 2000, prior to implementation of the IRP. There have been no identified or reported spills associated with the petroleum bulk storage tanks.

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. As a result, benefits of a sustained flow of water from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

7.10.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Furthermore, as discussed in Section 5.3.10, "Hazardous Materials" methodology, assessment of hazardous materials considered locations where identified hazardous materials sites would be co-located with areas where there would be potential differences in inundation or erosion. As noted in Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality," erosion is anticipated to be highest in Valley Reach 2C but would be comparable between the future without and with the Proposed Action. All of the hazardous materials sites identified within the study area are located in Valley Reach 3F, which is downstream of Cantine Dam and tidally influenced from the Hudson River and would not be affected by differences between the future without and with the Proposed Action. Therefore, no significant adverse impacts to hazardous materials are anticipated as a result of the Proposed Action.

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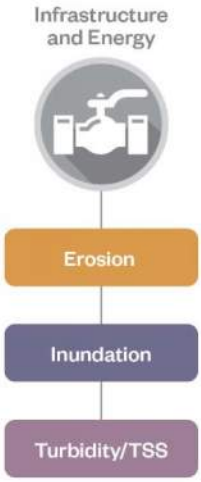
7.11 INFRASTRUCTURE AND ENERGY

The infrastructure assessment consisted of identifying the potential for the Proposed Action to result in changes to conveyance and demand for water and sewer infrastructure including municipal drinking water intakes, storm sewer discharges, drinking water wells, and septic systems. As discussed in Section 5.3.10, "Infrastructure and Energy," impact assessment, there are no anticipated changes to energy use in the future with the Proposed Action.



7.11.1 BASELINE CONDITIONS

DEP has consulted with the municipalities within the study area and Ulster County to identify existing water and sewer infrastructure within the study area. Water supply and wastewater treatment for communities along lower Esopus Creek are provided through various municipal and/or private suppliers dependent on the municipality. Specific sewer distribution infrastructure within the study area includes: a sewer interceptor operated by the Town of Ulster Wastewater Treatment Plant along the east bank of lower Esopus Creek south of the Route 209 Bridge crossing (Valley Reach 2C), and; the Town of Ulster Water Plant in Lake Katrine (Valley Reach 2C). In addition, there are private wells and septic systems within the study area that provide water and wastewater service for those that are not served by municipal or private water suppliers and/or by wastewater treatment utilities.

7.11.2 FUTURE WITHOUT THE PROPOSED ACTION

DEP has consulted with the municipalities within the study area and Ulster County and has not been informed of upcoming new projects or structures that would affect water and sewer infrastructure within the study area. In addition, no upcoming new projects or structures that would affect the demand, generation, or transmission of energy are anticipated within the study area.

In the future without the Proposed Action, streamflow in lower Esopus Creek would be based on background streamflow from contributing sub-watersheds and spill from Ashokan Reservoir. There would be no releases from Ashokan Reservoir, including the community release. Therefore, benefits of a sustained flow of water from Ashokan Reservoir to lower Esopus Creek through the community release and enhanced flood attenuation provided by maintaining the CSSO would not occur.

7.11.3 FUTURE WITH THE PROPOSED ACTION

In the future with the Proposed Action, the community release would provide sustained flow to lower Esopus Creek year-round (Section 7.1, "Water Resources and Water Quality"). This would provide a potential benefit to resources in and along lower Esopus Creek, particularly in Valley Reach 1A. Releases from Ashokan Reservoir would maintain the CSSO, providing a flood attenuation benefit beyond that provided by Ashokan Reservoir. Releases in the future with the Proposed Action would follow a similar seasonal pattern to spills in the future without the Proposed Action, with larger magnitude releases occurring in winter and spring. As discussed in Section 6.2, "Operation of Ashokan Reservoir in Accordance With the IRP," the percentage of streamflow attributed to flow from Ashokan Reservoir would diminish moving downstream. Valley Reach 3F, which is tidally influenced, would not be affected by differences between the future without and with the Proposed Action. Turbidity levels in flows from Ashokan Reservoir would be similar between the future without and with the Proposed Action and would fall within the range and variability of turbidity levels in lower Esopus Creek streamflow.

The existing water and wastewater infrastructure within the study area is not located within the stream channel and therefore, would not be at risk of flooding nor would it experience the benefit of additional flood attenuation in the future with the Proposed Action. Valley Reach 2C is most susceptible to erosion in both the future without and with the Proposed Action (see Section 7.1.4, "Parameters Evaluated for the Technical Area Assessments – Flow Regime and Water Quality"). The sewer interceptor operated by the Town of Ulster Wastewater Treatment Plant is located in Valley Reach 2C. This sewer interceptor and several manholes associated with the Town of Ulster Wastewater Treatment Plant are located near areas of observed erosion, or on the outside of meander bends which are more susceptible to erosive forces. However, the rate of erosion is anticipated to be comparable between the future without and with the Proposed Action. Inundation and erosion are not anticipated to affect other municipal water supply and wastewater facilities and distribution infrastructure. Similarly, properly constructed and maintained private wells and septic systems with appropriate separation distances from the ordinary high-water mark for lower Esopus Creek would be unaffected by changes to flows. In addition, a review of water quality reports for the Town of Ulster, which draws its water from three wells located in the floodplain of lower Esopus Creek, did not reveal any changing trends in turbidity levels or other water quality data over the period in which the reports are available, which includes the occurrence of Tropical Storms Irene and Lee in 2011. Furthermore, the Proposed Action does not have the potential to affect water consumption, sewage generation rates, or electrical demand. Therefore, there are no anticipated significant adverse impacts to existing water and sewer infrastructure within the study area as a result of the Proposed Action.