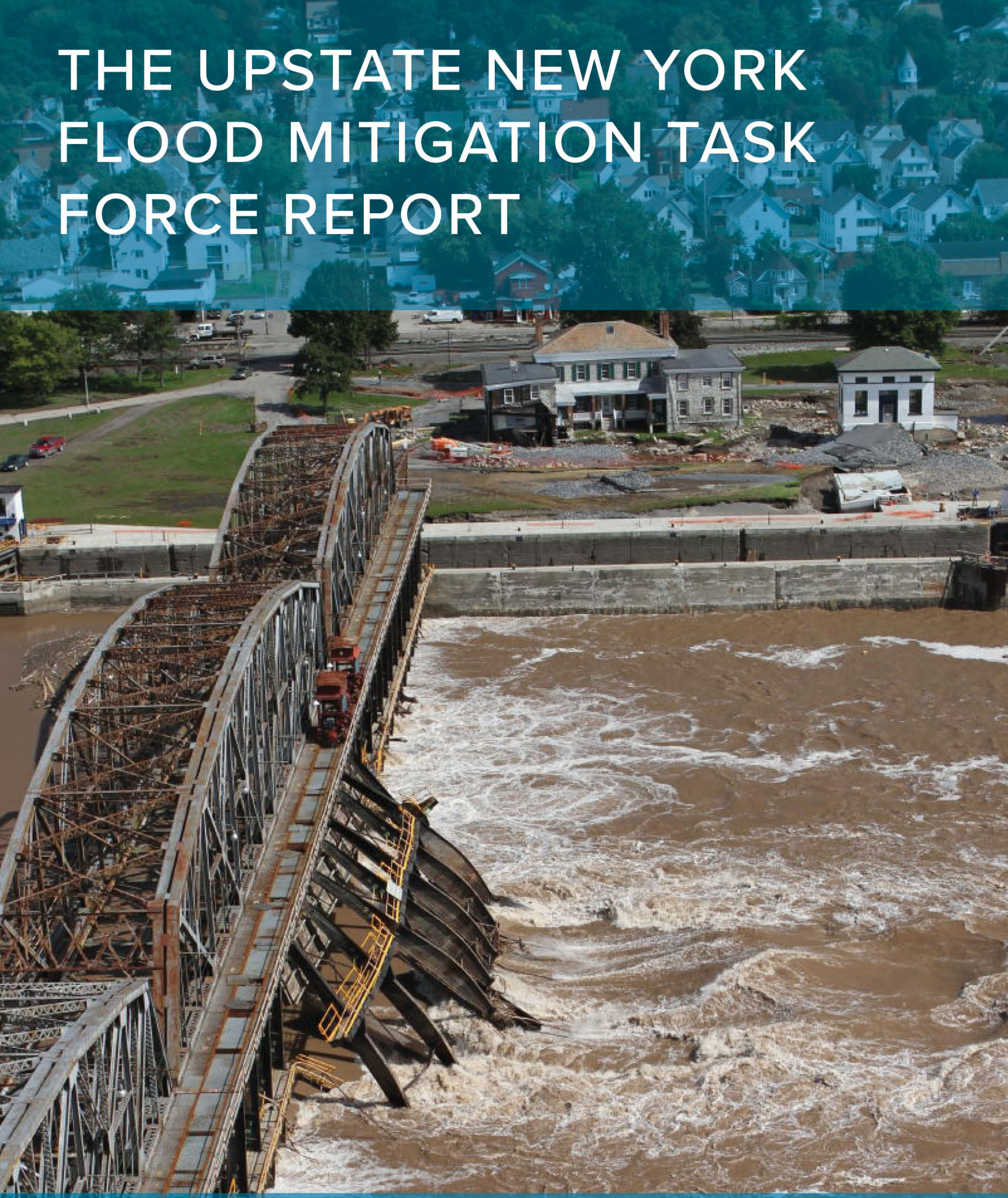
THE UPSTATE NEW YORK FLOOD MITIGATION TASK FORCE REPORT



Movable Dam MD 7 at Erie Canal Lock E-11 (Amsterdam)

JULY 2023

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A LETTER FROM THE CHAIR:

On July 1, 2022, Governor Kathy Hochul announced approval of legislation (S.8204a/A.9177) to reauthorize the Upstate Flood Mitigation Task Force, charging it with an essential mission: identifying and recommending reasonable measures to enhance flood management and mitigation along the New York Canal System.

The Governor explicitly recognized that a new, more robust effort was required to address upstate flooding. Consequently, with the Canal Corporation Director named as Task Force Chair, the updated legislation refined the scope of study to flood-related impacts within the sprawling Oswego River and Mohawk River Basins over the last five years.

Because New York's Canal system was designed for navigation and not flood control, the involvement and input of several other state agencies, as well as subject matter experts, was necessary and invaluable to the process. As we approach the celebration of the Erie Canal's bicentennial, we seek to honor the Canals' historic and storied mission while providing even greater protection for its communities across New York.

The Governor's action embraced that fact and empowered the Task Force with a clear direction and framework, setting a date for delivery of this Final Report, including findings and recommendations, by July 1, 2023. Our report meets this important deadline.

Here is some essential background that guided the Task Force's thinking: combined, the geographic footprint of the Oswego River and Mohawk River Basins cover nearly one third of the Upstate New York region. Encompassing more than 8,500 square miles in all and spanning from the Capital Region west to the Finger Lakes, the two drainage basins are individually distinct in their respective geology, topography, and hydrological dynamics.

In essence, their narrative is a tale of two watersheds:

The 3,460-square-mile Mohawk River Basin, with its steep elevation and lack of large water bodies to provide flood water storage, experiences fast-moving and violent flood events that leave destruction in their wake. By contrast, the Oswego River Basin is an expansive 5,122-square-mile geologic trough with minor elevation changes along the Canal, which receives the combined flows from seven of New York's 11 Finger Lakes and therefore experiences the insidious impacts of long exposure to standing floodwaters in the basin's relatively flat northernmost section.

Since August of 2022, the Upstate Flood Mitigation Task Force and three established subcommittees have convened more than a dozen times to assess the wide range of impacts and associated costs of weather-related flooding respective to each basin. Expert analysis and public input from stakeholders provided the framework for this report and guided potentially cost-effective and sustainable flood-mitigation strategies to protect and relieve impacted communities.

Task Force recommendations include those for cross implementation, as well as basin-specific measures. For instance, there is broad agreement among Task Force members and subject matter experts that the development of basin-wide hydrologic flow models will immediately provide the basis for improved communication and outreach. In the near- and long-term, such information will provide the data-based foundation for measures such as the restoration of flood plains and regulatory and structural interventions.

The detailed basin models would allow State agencies to pursue the purchase and restoration of disconnected floodplains and the purchase of flood-prone structures in a more strategic fashion. When coupled with appropriate local zoning and property disclosure requirements, such interventions have the potential to achieve a marked improvement to the quality of life of those communities that are impacted by chronic flooding.

Specific to the Mohawk River Basin, the Task Force seeks to strengthen the water management findings published in Mohawk River Action Agenda, including improved management of the Canal System's movable dams and identifying measures to mitigate the impact of ice jams along the river's eastern corridor.

In the hydrologically-complex Oswego River Basin, there are multiple water-control entities that largely function independently. In this regard, the Task Force believes the creation of a multi- jurisdictional, basin-wide entity – a regulating body - with authority to coordinate water level management and flow releases in a singular fashion warrants further study and analysis. Accordingly, the Task Force strongly recommends further examination by the Governor, the Legislature, and stakeholders of the feasibility of a regulating body in this basin.

The Task Force also recommends studying improvements at Baldwinsville Dam, the restoration of the Montezuma floodplain, updating flood insurance maps and expanding the state's Resilient New York studies to include the Oswego River Basin.

Finally, while this report completes the Governor's initial assignment, Task Force members believe it should be viewed as the impetus for a workable blueprint for long-term action.

The Canal Corporation, along with our New York State agency partners and stakeholders in the public and private sectors, look forward to working with Governor Hochul and the Legislature to establish a more sustainable flood mitigation strategy that is shared, fair to all and can improve the lives of millions of New Yorkers -- one that fully anticipates and supports the Canal system's third century of operation.

Brian U. Stratton
Director, NYS Canal Corporation
Task Force Chair

GLOSSARY

AHPS: Advanced Hydrologic Prediction Services
BCD: Barge Canal Datum
BFE: Base Flood Elevation
BOD - Biochemical Oxygen Demand
BMP: Best Management Practice
BRIC: Building Resilient Infrastructure and Communities
CAP-SSSE: Community Assistance Program – State Support Services Element
CRRA: Community Risk and Resiliency Act
CRS: Community Rating System
CSO: Combined Sewer Overflow
CTP: Cooperating Technical Partner
EAL: Expected Annual Loss
EB: Engineering Bulletin
EI: Engineering Instruction
EFC: Environmental Facilities Corporation
EPA: Environmental Protection Agency
EPF: Environmental Protection Fund
EPG: NYS DEC/EFC Wastewater Infrastructure Engineering Planning Grant
FEMA: Federal Emergency Management Agency
FERC: Federal Energy Regulatory Commission
FHWA: Federal Highway Administration
FIB: Fecal Indicator Bacteria
FIRM: Flood Insurance Rate Map
FIS: Flood Insurance Studies
FMAP: Flood Mitigation Assistance Program
HMGP: Hazard Mitigation Grant Program
IHP: Individuals and Households Program
LFA: Local Flood Analysis
LOMR: Letter of Map Revision
MS4: Municipal Separate Storm Sewer System
NFIP: National Flood Insurance Program
NGO: Non-Governmental Organizations
NRCS: Natural Resources Conservation Service
NRI: National Risk Index
NYCDEP: New York City Department of Environmental Protection

NYS: New York State
NYSCC: New York State Canal Corporation
NYSDEC: New York State Department of Environmental Conservation
NYSDHSES: New York State Division of Homeland Security and Emergency Services
NYSDOT: New York State Department of Transportation
NYSFSMA: New York State Floodplain and Stormwater Managers Association
NYSGOSR: New York State Governor's Office of Storm Recovery
NYSOPRHP: New York State Office of Parks, Recreation, and Historic Preservation
NYSORHC: New York State Office of Resilient Homes and Communities
NYPA: New York Power Authority
NYSTA: New York State Thruway Authority
O&M: Operation and Maintenance
PA: Public Assistance Program
SFHA: Special Flood Hazard Area
SPDES: State Pollution Discharge Elimination System
STORM: Safeguarding Tomorrow through Ongoing Risk Mitigation
SUNY ESF: State University of New York Environmental Science & Forestry
SWMP: Stormwater Management Plans
TSS: Total Suspended Solids
USACE: United State Army Corps of Engineers
USFMTF: Upstate Flood Mitigation Task Force
WIIA: NYS Water Infrastructure Improvement Act
WQIP: Water Quality Improvement Project

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1.0 Introduction

1.1 PURPOSE

The Upstate Flood Mitigation Task Force (USFMTF) was established by legislative action in 2017 and revised in 2022[1]. The Task Force is chaired by the Director of the New York State Canal Corporation (NYSCC) with the purpose of conducting "an in-depth examination of flood control study sectors and issues related to floodplain management, debris management, flood control and flood mitigation in the Upstate Flood Mitigation Region" encompassed by the Mohawk and the Oswego River Basins, presented as a public report no later than July first, Two Thousand Twenty Three, in accordance with the requirements of the legislation. The upstate flood mitigation region includes any county through which the Erie Canal passes in whole or part. Specifically, this report must:

- Describe the cost or impact of flooding over the last five years to agriculture; transportation; land use; public health; insurance; economic sectors such as tourism, recreation and power generation; as well as impacts on infrastructure including bridges, low lying roads, dams, locks, roads, water and wastewater treatment plants and docks.
- Assess Erie Canal operation procedures and plans which may have a direct or indirect impact on flood mitigation and flood management including but not limited to debris management, communication, water management, and flood response.
- Provide a list of adaptive measures, procedures and associated costs that could be executed to mitigate flood damages including, but not limited to, feasible floodplain management activities, debris management, construction of flood control structures, construction of communication systems and flood mitigation education for public and private landowners.

Under the direction of the chairperson, the Task Force was required to meet at least four times between the execution of the legislation and July 1, 2023, and will meet on an annual basis thereafter. The Task Force was also required to hold public hearings as necessary to solicit relevant information and data as well as meet with various county, state and local entities, which it did as further discussed in this report.

1.2 SCOPE

The geographic scope of this examination includes areas that are within Flood Mitigation Regions. Flood Mitigation Regions are defined as upstate counties through which the Erie Canal passes in whole or in part (listed below) and which are within the Federal Emergency Management Agency (FEMA) Special Flood Hazard Area (SFHA) or 100-year floodplain, and those areas tributary to the Erie Canal system. Refer to Figure 1 and Figure 2, respectively for maps of the project area.

The legislation does not limit recommended adaptive measures to only those which could be implemented by NYSCC, but also includes other proposed initiatives that may be undertaken by other State agencies independently, or working with federal and local partners, as needed.

The counties that comprise the Flood Mitigation Regions include the following:

- Mohawk River Basin Flood Mitigation Regions (West to East): Oneida, Herkimer, Montgomery, Schenectady, Saratoga, and Albany Counties
- Oswego River Basin Flood Mitigation Regions (West to East): Ontario, Wayne, Yates, Schuyler, Seneca, Tompkins, Cayuga, Onondaga, Oswego, Madison, and Oneida Counties

[1] New York State Canal Law, Article XIII-B.

The legislation called for an in-depth examination of flood impacts over the past five years. This Report includes this data, but also expanded the research to include other major flood events that occurred beyond the last five years. As required by the legislation, the flooding damage types examined included agriculture, infrastructure, land use, public health, insurance, tourism, recreation, and power generation. The Erie Canal operations procedures and plans which may have a direct or indirect impact on flood mitigation and flood management were also assessed. Finally, a listing of recommended adaptive measures with associated costs that could be executed is provided.

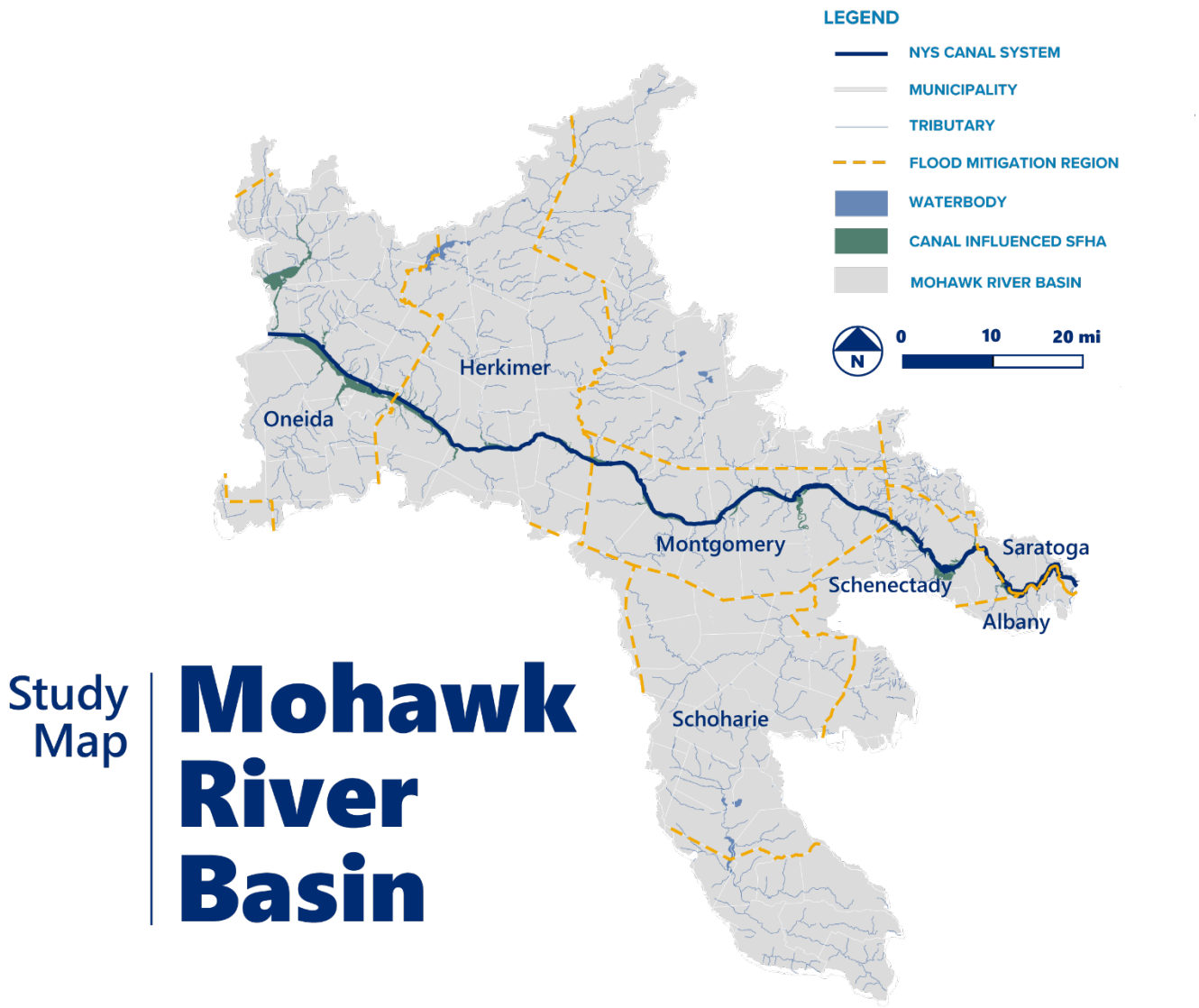


Figure 1: Study Map, Mohawk River Basin

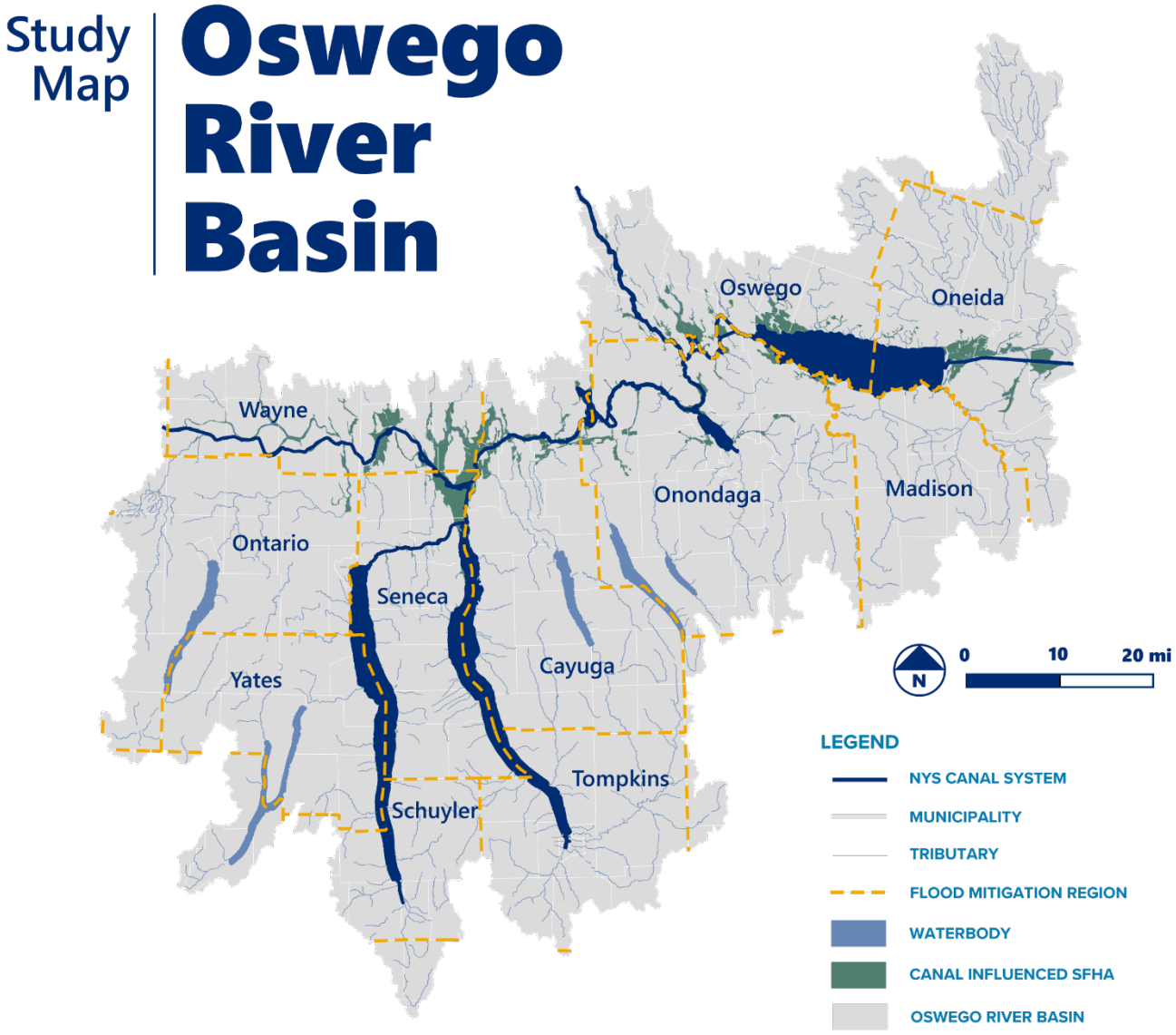


Figure 2: Study Map, Oswego River Basin

1.3. STUDY APPROACH AND LIMITATIONS

Data presented in this report was sourced from river and meteorological gages, previous studies conducted within the Flood Mitigation Regions, and available damage records from previous flooding events. River gage records were obtained from several sources including the National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS), HydroSphere, United States Geological Survey (USGS) WaterWatch, and New York State (NYS) Mesonet. The river and meteorological gages are further described in Chapter 3. No new hydrologic or hydraulic analysis was performed as a part of this Report. The effect of climate change on recent flood events was not considered, however, the adaptive measures included in this Report will consider resiliency and adaptability for the potential effect of future climate change.

As part of this effort, previously completed reports and studies related to the Mohawk and Oswego River Basins were reviewed and summarized. A total of 38 reports were reviewed for the Mohawk River Basin and 16 reports

were reviewed for the Oswego River Basin. The report summaries prepared, including a bibliography, are included in Appendices A (Mohawk Basin) and B (Oswego Basin).

For the review of each report, answers were provided to the following questions:

- What flooding problems does the report identify?
- What, if any, flood mitigation measures are recommended and what are the associated costs?
- What further investigations and actions are recommended and by which state agencies?
- What actions are specifically recommended to be undertaken by the NYSCC?
- What actions from this study can be considered by the Upstate Flood Mitigation Task Force as a potential recommended adaptive measure?

The reports and summaries provided the foundation for understanding historic flood impacts and more recent flood impacts (within the past five years), historic and current NYSCC operations, and adaptive measures recommended by previous reports/studies reviewed which have or have not been implemented.

Task Force and Subcommittees

The Task Force consists of nine members, including:

- Director of the NYSCC, Brian Stratton
- Commissioner of the NYS Department of Transportation (NYSDOT), Marie Therese Dominguez
- Commissioner of the NYS Division of Homeland Security and Emergency Services (NYSDHSES), Jackie Bray
- Commissioner of the NYS Department of Environmental Conservation (NYSDEC), Basil Seggos

Five additional members (three appointed by the Governor, one appointed by the President Pro Tempore of the Senate, and one appointed by the Speaker of the Assembly) are also part of the Task Force and include name, company, and specialty:

- William Nechamen, Nechamen Consulting, LLC, Floodplain Management
- Orrin MacMurray, PE, C&S Companies, Civil Engineering
- Theodore Endreny, PE, State University of New York – Environmental Science and Forestry (SUNY ESF), Hydrology
- Peter Nichols, Schoharie County Soil & Water Conservation District, Soil & Water Conservation
- Nagappa Ravindra, PE, Ravi Engineering & Land Surveying, PC, Civil Engineering

The Task Force members created three subcommittees to assist in accomplishing the legislation's ambitious objectives. These subcommittees include:

- Grants and Policies
- Hydrology and Engineering
- Public Engagement and Outreach

Each subcommittee convened monthly to review and discuss prior reports and studies, best practices in their respective areas of expertise, prior experience with various flood mitigation measures and tactics, and to discuss the preliminary recommendations of the Task Force including their potential efficacy as well as any possible indirect impacts as a result of the implementation of such measures.

The Hydrology and Engineering Subcommittee is chaired by Kenneth Kemp, NYPA, and tasked with reviewing prior reports and research, identifying information/data gaps, and recommending adaptive measures specifically for reducing flooding risks.

The Grants and Policies Subcommittee is chaired by Thomas Snow, NYSDEC, and tasked with identifying applicable state and federal grants and funding sources and analyzing and recommending system-level policy technical interventions.

The Public Engagement and Outreach Subcommittee is Chaired by Rebecca Hughes, NYPA and tasked with establishing a website for public information sharing, identifying and collaborating with relevant stakeholders, and considering public impacts of recommended actions.

1.4. BASIN DESCRIPTIONS AND FLOOD CHARACTERISTICS

1.4.1. Mohawk River Basin

The Mohawk River Basin drainage area covers approximately 3,460 square miles from Central New York to the Capital Region. The total length of the Mohawk River from its headwaters in the Adirondack Foothills to its confluence with the Hudson River is 155 miles. The Erie Canal is collocated with or runs parallel to the Mohawk River, beginning 6.5 miles downstream from Delta Dam, where the Mohawk River joins the Erie Canal at Rome to Erie Canal Lock E-6 (Crescent Dam) at the upper end of the Waterford flight of locks. This section of the Mohawk River flows 130 miles southeast through the cities of Rome, Utica, Little Falls, Amsterdam, and Schenectady, experiencing a 300-foot elevation change, with an average gradient of 2.3 feet per mile. The dominant land covers are forest (58%), agriculture (23%), wetlands (7%), and developed open space, which is less than 20% impervious area (5%).

The Erie Canal and Mohawk River between Rome and Erie Canal Lock E-6 at Crescent Dam stretches a distance of 130 miles along the Canal and alternates between being bifurcated and collocated eight times. The Mohawk River and Erie Canal are bifurcated for a total of 32 miles and collocated for a total of 98 miles. From Rome to Frankfort Harbor, 3.5 miles downstream of Erie Canal Lock E-19, the Canal and Mohawk River are bifurcated, with the Mohawk River occupying the south side of the valley. From Frankfort Harbor to Movable Dam MD 14 (Herkimer) the Canal and Mohawk River are collocated. From Movable Dam MD 14 to Erie Canal Lock E-18 (Jacksonburg) they are bifurcated, with the Mohawk River occupying the north side of the valley with West Canada Creek entering the Mohawk River in this reach. Between Erie Canal Lock E-18 and immediately upstream of Little Falls they are collocated, before bifurcating again before re-joining at the lower end of Erie Canal Lock E-17 (Little Falls). Between the lower end of Erie Canal Lock E-17 and Movable Dam MD 12 (Rocky Rift) they are collocated. Between Movable Dam MD 12 (Rocky Rift) and Erie Canal Lock-E-16 (St. Johnsville) the Canal and Mohawk River are bifurcated with the Mohawk River occupying the north side of the valley. East Canada Creek enters the Mohawk River and Nowadaga Creek enters the Canal in this reach. The Canal and Mohawk River rejoin immediately downstream of Erie Canal Lock E-16 (St. Johnsville) and remain collocated to Guard Gate 2 upstream of Erie Canal Lock E-6 (Crescent Dam). Downstream of Crescent Dam, the Mohawk River steepens and is non-navigable, requiring vessels navigating the Erie Canal to or from the Hudson River to travel through the Waterford flight of locks that raise or lower the navigation pool 169 feet in 1.5 miles between Erie Canal Locks E-6 and E-2 (Hudson River), upstream of the Troy Federal Lock.

The Mohawk River has a significant number of tributaries (over 70) with the majority having significant gradients well in excess of the 2.3 feet per mile on the Mohawk River from Rome to Erie Canal Lock E-6 (Crescent). Please refer to the Basin Schematic Diagram (Figure 3) for the approximate locations of the major and minor tributaries and reservoirs discussed. There are four major tributaries that individually contribute 4% or more, and collectively contribute 55% of the Mohawk River watershed area. From upstream to downstream, they include Oriskany, West Canada, East Canada, and Schoharie Creeks. There are 11 minor tributaries (shown on Figure 3) that individually contribute 1 to 3%, and collectively contribute 14% of the Mohawk River watershed area, from upstream to downstream, include Nine Mile, Sauquoit, Moyer, Steele, Fulmer, Nowadaga, Caroga, Otsquago, Canajoharie, and North Chuctununda Creeks and the Alplaus Kill. It should also be noted there are approximately 55 additional Mohawk River tributaries not individually listed or shown in Figure 3. Four significant reservoirs are located within the Mohawk River Basin, including Delta Reservoir (Mohawk River), Hinkley Reservoir (West Canada Creek), Schoharie Reservoir (Schoharie Creek), and Blenheim-Gilboa Lower Reservoir (Schoharie Creek.

Tributary flows into the Mohawk River are generally uncontrolled with no reservoir in the watershed designed for flood control. The upper reaches of the Mohawk River flow into Delta Reservoir, north of Rome, which was designed and constructed to provide supplemental base flow to the Canal during navigation season. To ensure the flow is available, the reservoir is kept full (at spillway crest). Keeping the reservoir full also provides the in-stream minimum flow to the Mohawk River to support fisheries. This prevents use of the reservoir for flood mitigation/storage during the navigation season. The reservoir is lowered after navigation season to provide some flood storage for the spring freshet/snow melt.

Hinckley Reservoir is located on West Canada Creek, roughly 25 miles upstream of its confluence with the Mohawk. Hinkley Reservoir was also designed and constructed to provide supplemental flow to the Canal. It serves as the City of Utica's main domestic water supply and five Federal Energy Regulatory Commission (FERC) licensed hydroelectric facilities are located on West Canada Creek between Hinkley Reservoir and the Mohawk River. The remaining two reservoirs, Schoharie and Blenheim-Gilboa Lower, are located on Schoharie Creek approximately 40 miles upstream of the Mohawk River. Schoharie Reservoir was constructed as a water supply reservoir for New York City and the Blenheim-Gilboa Lower Reservoir was constructed as the lower/source reservoir for the Blenheim-Gilboa Pumped Storage Hydroelectric Project currently licensed to NYPA by FERC. Neither reservoir has significant flood storage capacity, and neither was designed for flood mitigation.

The remaining Mohawk River tributaries do not have significant reservoirs other than East Canada Creek which supports three hydroelectric facilities. Some tributaries have small dams near their confluence with the Mohawk River which contain no appreciable water storage capacity.

NYSCC is responsible for operating the Erie Canal in the Mohawk River Basin but does not have operational control of all water control structures that have the potential to reduce flooding. This document defines operational control as any operator's ability to regulate, start or stop water flow at a water control structure by means of adjustable gates, valves, hydroelectric turbines or spillway gates. The degree and timing of control is typically governed by operating procedures, FERC or NYSDEC requirements, or reservoir rule curves in the case of lakes and reservoirs. Locations where NYSCC has operational control of water control structures that have the potential to be operated to reduce flooding include:

- Movable Dams MD 4 through MD 11, adjacent to Erie Canal Locks E-8 through E-15
- Movable Dam MD 12 at Rocky Rift
- Hinged crest gates and Movable Dam MD 14 associated with Erie Canal Lock E-18
- Nine Mile Feeder Dam
- Utica Harbor Dam
- Guard Gates 1 through 7
- Delta Dam

Water control structures owned and/or operated by other entities that the NYSCC consults with:

- Hinckley Reservoir and the Jarvis hydroelectric project in coordination with NYPA and Brookfield Power.
- Blenheim-Gilboa Lower Reservoir, owned and operated by NYPA (Note: The Blenheim-Gilboa Hydroelectric Facility also includes the off-stream Upper Reservoir.)
- Vischer Ferry Dam regulated through the NYPA Vischer Ferry Hydroelectric Project.
- Crescent Dam regulated through the NYPA Crescent Hydroelectric Project.

Water control structures owned and/or operated by other entities that do not currently consult with the NYSCC:

- Schoharie Reservoir, owned and operated by New York City Department of Environmental Protection (NYCDEP)

- Hydroelectric projects on West Canada Creek further downstream of the Jarvis project at Hinckley Reservoir Dam. These include Prospect, Trenton Newport and Herkimer. These hydroelectric facilities are privately owned and operated and do not currently consult with NYSCC prior to releases.
- Hydroelectric projects on East Canada Creek include Dolgeville in the Village of Dolgeville, Inghams, and Beardslee located downstream. All are privately owned and operated and not currently required to consult with NYSCC prior to water releases.

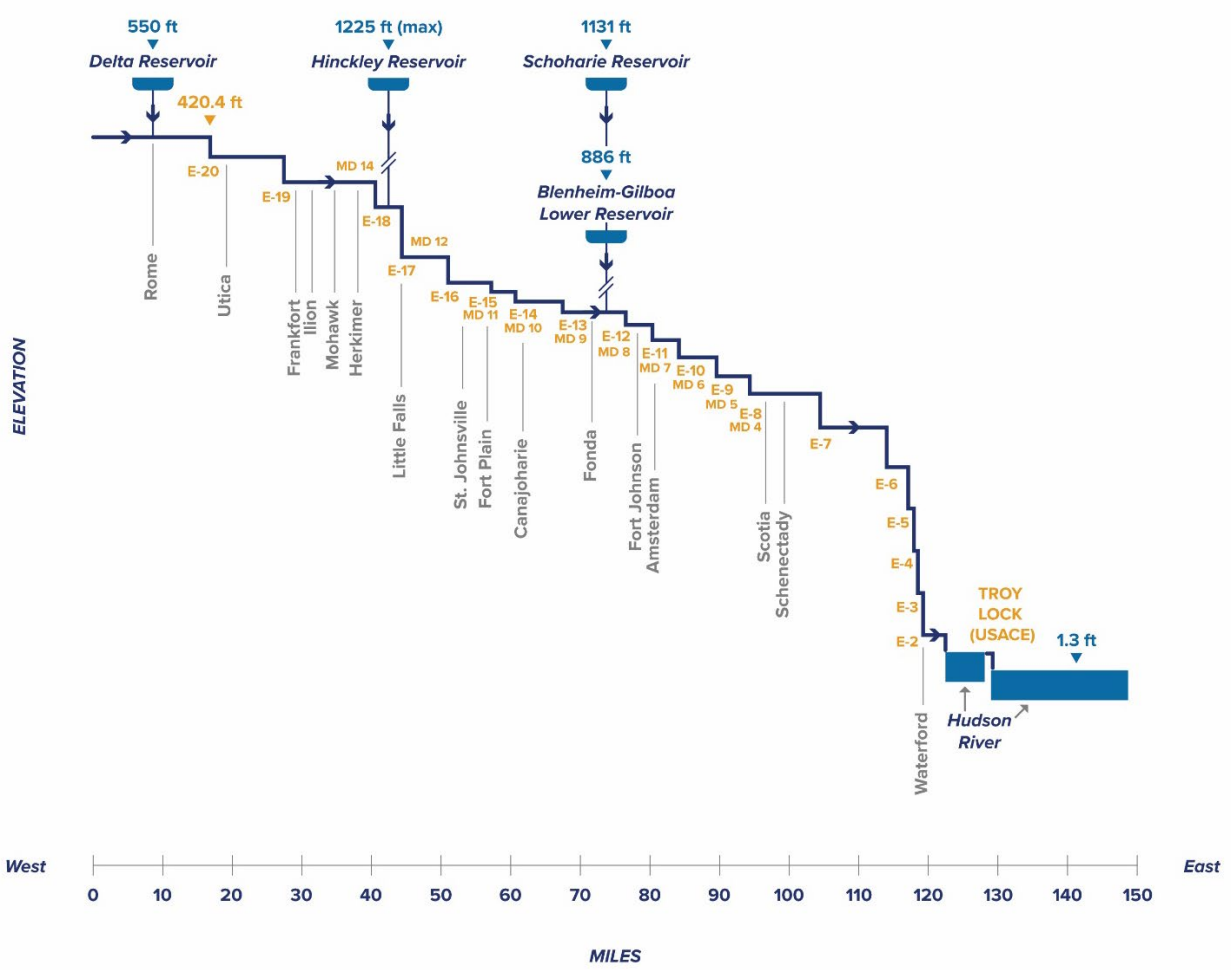


Figure 3: Schematic Diagram, Mohawk River Basin

1.4.2. Oswego River Basin

The Oswego River Basin drainage area covers approximately 5,122 square miles in Central New York and the Finger Lakes Region. The western portion of the Basin drains to the Seneca River while the eastern portion drains to the Oneida River. The two rivers combine 2.2 miles upstream of the Village of Phoenix at Three Rivers Junction to form the Oswego River, which flows northwest into Lake Ontario. The dominant land cover types include agriculture (37%), forest (33%), wetlands (10%), and developed open space (6%). The National Land Coverage Data describes developed, open space as areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Please refer to the Basin Schematic Diagram (Figure 4) for the approximate locations of the major and minor tributaries and lakes. The Canal, which is fed with water from the Niagara and Genesee Rivers, enters the Oswego River Watershed at Lock E-30 (Macedon), after being conveyed through the 60-mile pool (between Erie

Canal Locks E-34 and E-33), and through the 17-mile pool [between Erie Canal Locks E-32 and E-30 (there is no Lock E-31)]. Flow from west of Erie Canal Lock E-30 is not conveyed into the Oswego River Basin during flood events. Through the Basin, the Canal/River system has an elevation change of 217-feet from the upper pool of Erie Canal Lock E-30 to Lake Ontario via the Erie Canal (Seneca River and tributaries) and Oswego Canal (Oswego River). The average gradient, from Erie Canal Lock E-25 (May's Point) to Oswego Canal Lock O-1 (Phoenix), is relatively flat at 0.4 feet of elevation change per mile, however, in the Oswego Canal from Phoenix to Lake Ontario the average gradient increases dramatically to 5.5 feet per mile.

There are a total of 285 miles of Canal within the Oswego River Basin, including Oneida, Cayuga and Seneca Lakes. In the western portion, Ganargua Creek, the first significant tributary entering the Canal, enters immediately downstream of Erie Canal Lock E-29 (Palmyra). The Canal flows east towards Erie Canal Lock 28B (Newark) for approximately 5 miles until levels in excess of Canal operational needs pass over the Harrison Spillway Dam into a north flowing Ganargua Creek. The Canal continues eastward through Erie Canal Locks 28B (Newark)and 28A (Lyons) before Ganargua Creek re-enters the Canal in the Erie Canal Lock E-27 (Lyons) upper pool. The Clyde River is formed by the confluence of the Canal with the Canandaigua Outlet and Flint Creek immediately downstream of Erie Canal Lock E-27. The Clyde River and Canal are either co-located or adjacent to each other from this point to the confluence with the Seneca River/Cayuga Seneca Canal outlet.

The Oswego River Basin is significantly influenced by the Finger Lakes. There are over 7,000 miles of river and streams, seven Finger Lakes (Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Otisco), two other large lakes (Onondaga and Oneida), and numerous smaller lakes, including Cross Lake, which is part of the Seneca River west (upstream) of Erie Canal Lock E-24 (Baldwinsville). Keuka Lake, the most southern finger lake, discharges at the Village of Penn Yan with the outlet discharging into the west side of Seneca Lake roughly 13 miles south of Geneva. The Seneca River is canalized to form the Cayuga Seneca Canal between Seneca Lake at East Geneva through a series of four locks (Cayuga Seneca Canal Locks CS-4, CS-3, CS-2, and CS-1) that lower the Canal level 72-feet between Seneca Lake and the lower pool of Cayuga Seneca Canal CS-1 (Mud Lock). Immediately downstream of Cayuga Seneca Canal Lock CS-1, the Seneca River is joined by the Clyde River.

The Clyde River has no appreciable storage capacity and the Seneca River, once released from Cayuga Seneca-Canal Lock CS-1, has minimal storage at Cross Lake. The Seneca River flows east from the junction with the Clyde River adding additional tributary flows from Crusoe Creek, Cold Spring Brook, Owasco Lake Outlet, and Skaneateles Lake Outlet before flowing through Cross Lake to Erie Canal Lock E-24 (Baldwinsville). The Seneca River continues flowing east, where it confluences with Onondaga Lake Outlet 5.5 miles downstream of Erie Canal Lock E-24. Another 6.7 miles downstream the Seneca River joins the Oneida River at Three Rivers Junction forming the Oswego River and the Oswego Canal. The Oneida River and Erie Canal are collocated between Three Rivers Junction and Oneida Lake. East of Oneida Lake to the summit section at Rome, the Erie Canal is not collocated with any river system but intercepts Fish Creek and Wood Creek. The drainage area contribution of the Oneida River system at Three Rivers Junction is 27% of the Oswego Basin's drainage area. The Oswego River is canalized between Three Rivers Junction and Lake Ontario by the Oswego Canal consisting of a series of seven locks (O-1, O-2, O-3, O-5, O-6, O-7 and O-8) that lower the water level 118 feet from Three Rivers Junction to Lake Ontario.

Except for Cayuga Lake that is regulated by NYSCC, the Finger Lakes are operated by a combination of private and public entities with the overall operation of each lake, including Cayuga Lake, governed by a 'Rule Curve'. Rule curves have been developed to maintain a summer water level 1 to 3 feet above the winter water level for recreational uses. The lowered winter water levels are meant to reduce flood and ice damage along the lake shorelines. In general, each rule curve includes an upper and lower target lake elevation for different times of the year, and some include an initiation of flooding level above the upper summer target level. Rule curves for all the Finger Lakes and Oneida Lake are presented in Appendix C. While the lake operators can normally follow the rule curves by operating gates at the lake outlets, the rule curves do not consider the downstream impacts of releases made during a flooding event to keep the lake within the rule curve target elevation range. From what can be

observed from lake level records, Cayuga and Oneida Lakes (both operated by NYSCC) are the only lakes that are regulated, when possible, to reduce downstream flooding without causing significant flooding on the lake.

The NYSCC operates 20 locks on three canals (the Erie, the Oswego, and the Cayuga Seneca Canals) within the Basin. At 17 locks, NYSCC has limited operational capability. However, five locations where NYSCC has operational control include:

- Erie Canal Lock E-27 and Tainter gated dam
- Erie Canal Lock E-26 and Tainter gated dam
- Erie Canal Lock E-25 and Movable Dam MD 18 at Mays Point
- Cayuga Seneca Canal Lock CS-1 (Mud Lock) and Tainter gated dam, Outlet of Cayuga Lake that becomes the Seneca River
- Erie Canal Lock E-23 and Caughdenoy Tainter gated dam, that controls Oneida Lake outflow

Locations where NYSCC has partial control, and other entities are involved, include:

- Erie Canal Lock E-24 (Baldwinsville): Seneca and Baldwinsville hydropower facilities - privately owned and operated.
- Oswego Canal Lock O-1 (Phoenix): Phoenix hydroelectric project which is privately owned and operated.

Locations where NYSCC has no control include:

- Oswego Canal Locks O-2 through O-8
- Canandaigua Lake Outlet
- Keuka Lake Outlet
- Seneca Lake Outlet
- Owasco Lake Outlet
- Skaneateles Lake Outlet
- Otisco Lake Outlet

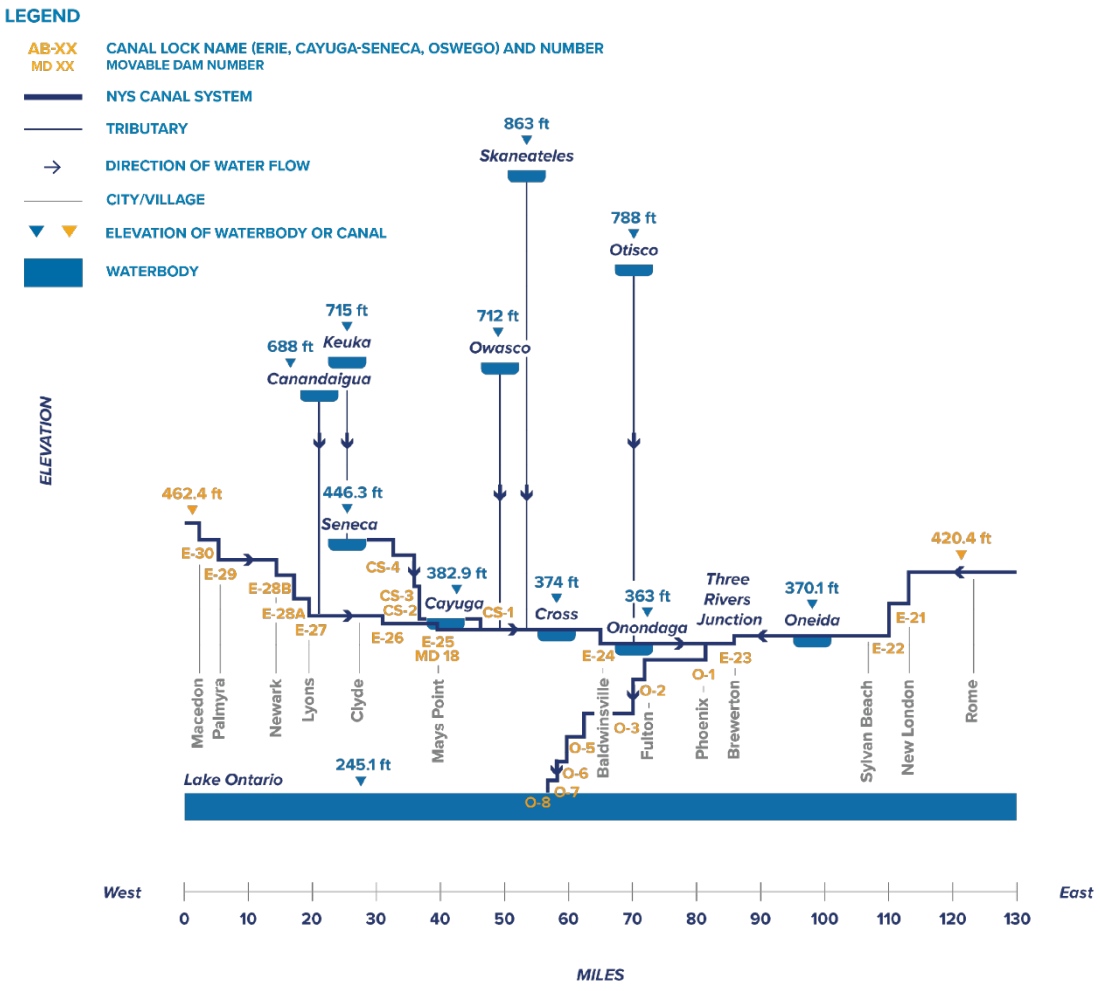


Figure 4: Schematic Diagram, Oswego River Basin

1.4.3. Mohawk River Basin Characterization of Flooding

In the Mohawk River Basin, peak daily flows range from five (5) to 890 times the monthly average discharge in a subbasin. Seasonality is a key contributor toward variations in discharge and flow events. High flows often occur in the springtime, coinciding with snowmelt and precipitation. Mohawk River storm events produce fast-rising and fast-receding events lasting one to three days. This is due to the Mohawk River Basin containing little off-channel storage and most tributaries as well as the Mohawk River itself having a steep gradient. Refer to Figure 5 for a depiction of monthly average and daily peak flows for the Mohawk River Basin. The data collected and displayed in this figure contains both recent and historic information and includes the years 1927 to 2022 at Little Falls, 1939 to 2022 at Burtonsville, and 1925 to 2022 at Cohoes.

In Figure 5, there are entries for peak daily flow and monthly average flow at each river location, for each month. The three locations (Mohawk River at Little Falls, Schoharie Creek at Burtonsville, and Mohawk River at Cohoes) are color coded. Peak daily flow is the upper horizontal line, and monthly average flow is the lower horizontal line. The thin vertical line connecting them is a graphic representation of how much higher peak daily flow is compared to monthly average flow. At the bottom of the graph shaded bands show the range between maximum and minimum

monthly flows, with monthly average flow in between. In summary, the graph shows that monthly average flows are generally higher in the springtime, and significant peak daily flows can occur throughout the year.

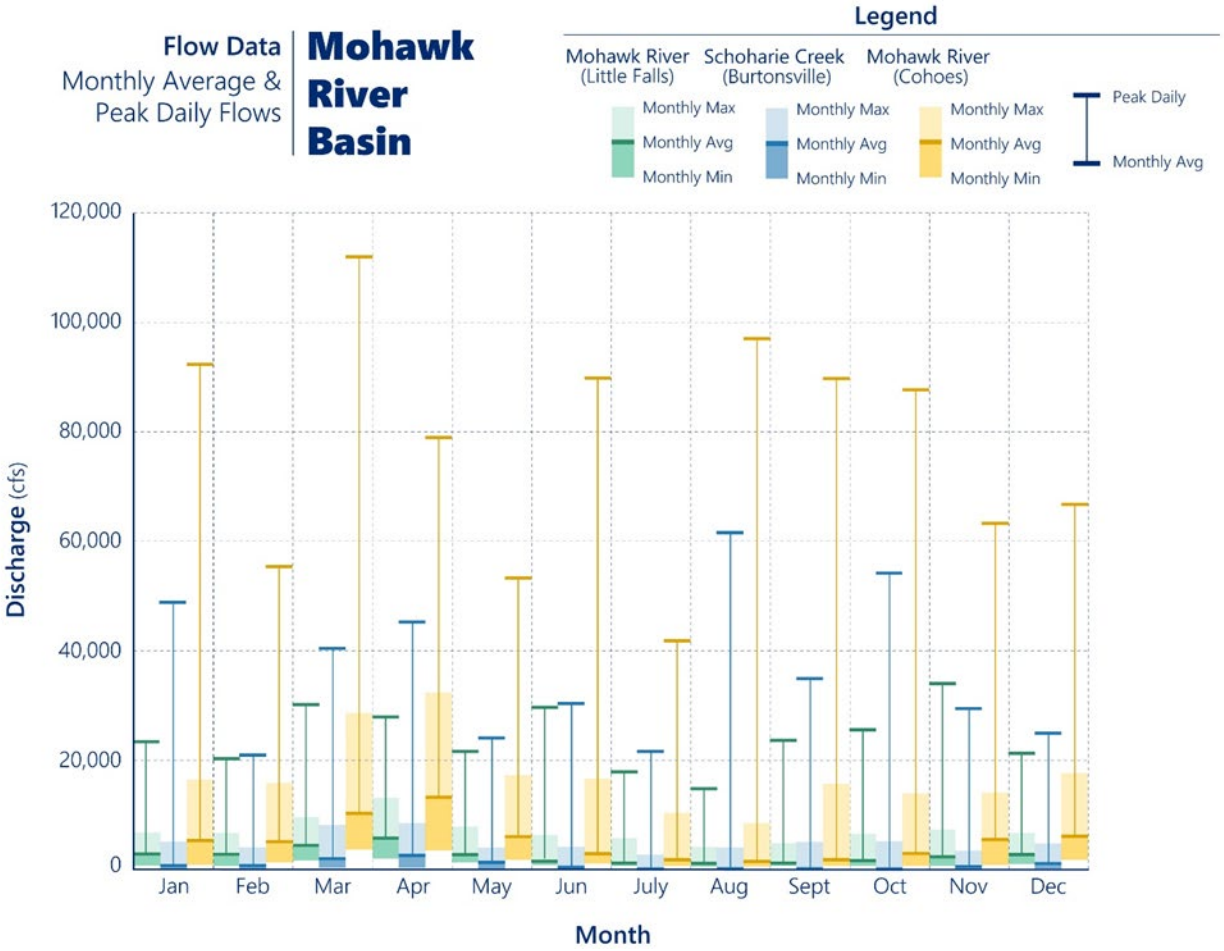


Figure 5: Characterization of Flooding Mohawk River Basin

1.4.4. Oswego River Basin Characterization of Flooding

In the Oswego River Basin, peak daily flows can range from two (2) to ten (10) times the monthly average discharge in the subbasins. Seasonality is a key contributor toward variations in discharge and flow events. High flows often occur in the springtime, coinciding with snowmelt and precipitation. Oswego River Basin storm events generally produce slow-rising and slow-receding flood events lasting several days to weeks in the subbasins. This is attributable to the significant off-channel storage and low channel gradients upstream of Erie Canal Lock E-24 (Baldwinsville). Refer to Figure 6 for a depiction of monthly average and daily peak flows within the Oswego River Basin. The data collected and displayed in this figure is more limited to recent years than in the Mohawk River Basin, and includes years 1949 to 2022 at Baldwinsville, 1996 to 2022 at Euclid (Oneida River), and 2007 to 2022 at Phoenix (Oswego River/Canal).

In Figure 6, there are entries for peak daily flow and monthly average flow for each river location, for every month. The three river locations (Seneca River at Baldwinsville, Oneida River at Euclid, and Oswego River at Phoenix) are color coded. Peak daily flow is the upper horizontal line, and monthly average flow is the lower horizontal line. The

thin vertical line connecting them is a graphic representation of how much higher peak daily flow is compared to monthly average flow. At the bottom of the graph shaded bands show the range between maximum and minimum monthly flows, with monthly average flow in between. In summary, the graph shows that monthly average flows are generally higher in the springtime, and significant peak daily flows can occur throughout the year.

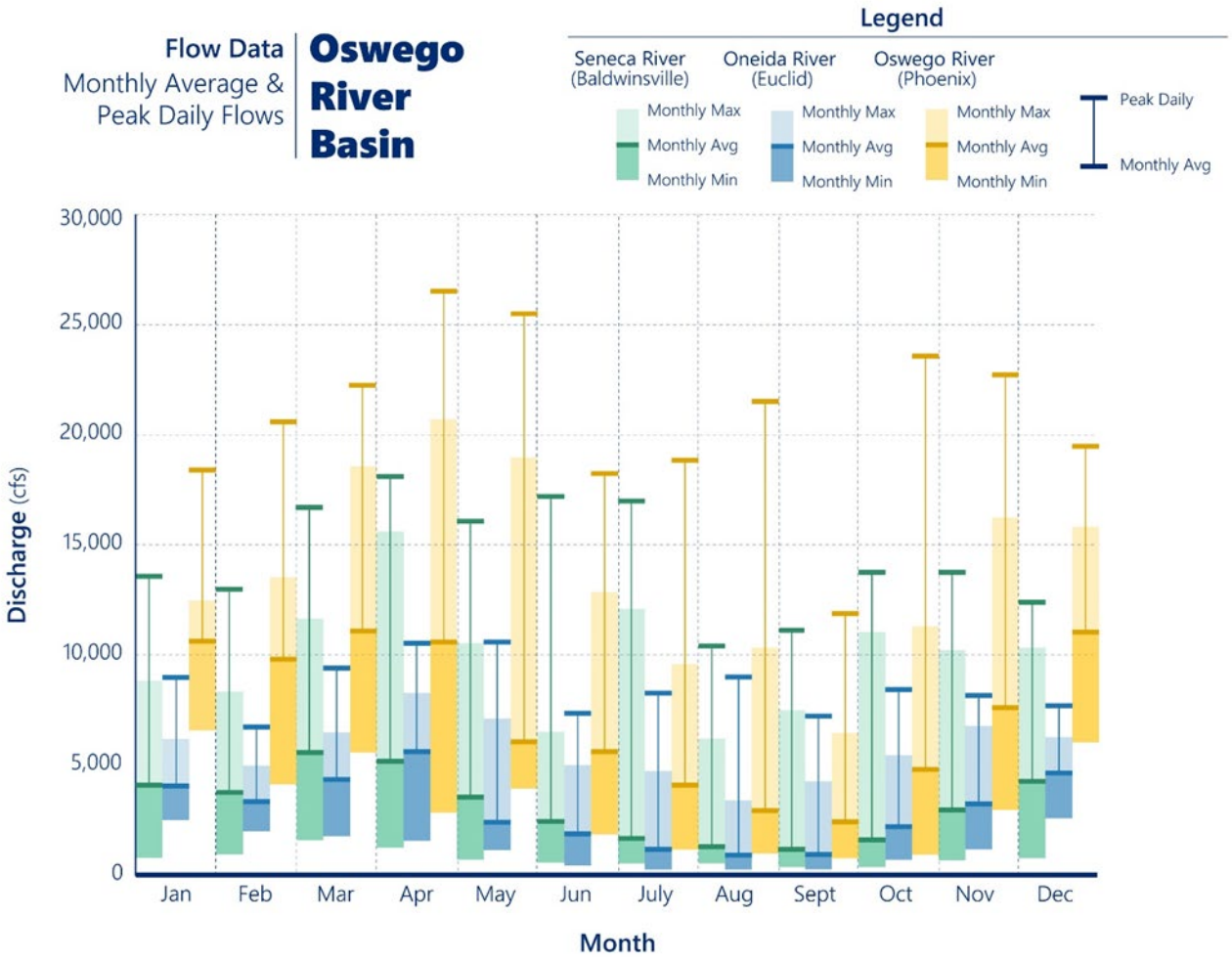


Figure 6: Characterization of Flooding, Oswego River Basin

1.4.5. Mohawk River Recent Flood History

From 2017 – 2022, there were two significant flood events within the Mohawk River Basin. A peak flow event occurred on October 31-November 1, 2019, with significant flows from West Canada Creek (Halloween Storm). A second event occurred on August 18, 2021, with significant flows from the Upper Mohawk Subbasin tributary to Delta Reservoir. These events are compared to other historic flood events at three locations within the watershed in Figure 7.

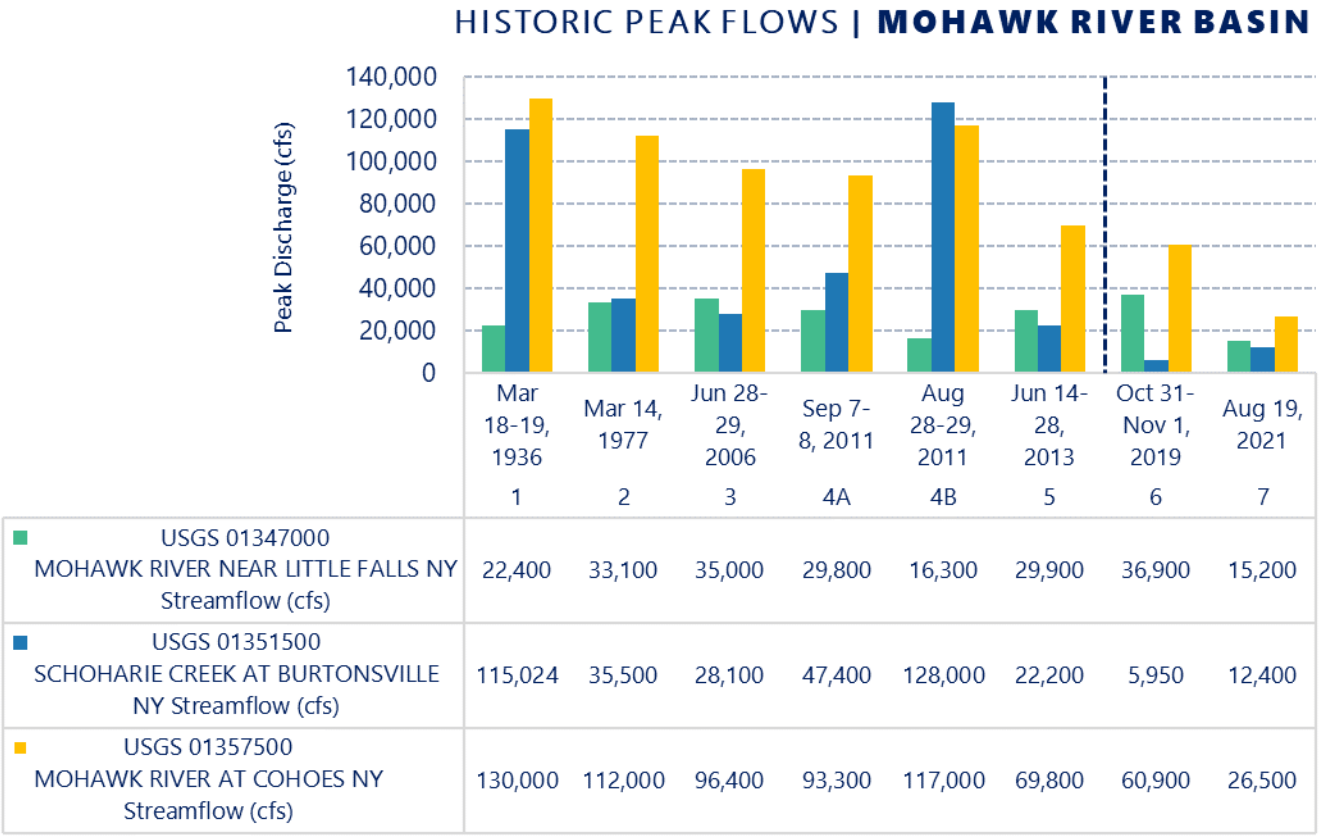


Figure 7: Historic Peak Flows, Mohawk River Basin

The Halloween storm event (October 31- November 1, 2019), occurred due to heavy rainfall over the West Canada Creek Subbasin. The storm caused the flood of record at USGS Gage 01346000, West Canada Creek at Kast Bridge (27,500 cfs), and at USGS Gage 01347000, Mohawk River at Little Falls (36,900 cfs). In contrast the mean daily flow for this date is less than 900 cfs at West Canada Creek and 1800 cfs at Little Falls. These peak flows were equivalent to a 500-year (0.2% annual probability) recurrence interval at both locations. Yet, the peak flow on Schoharie Creek (USGS 01351500) was only 50% of a 1.25-year (80%) recurrence event and the peak flow on the Mohawk River at Cohoes (USGS 01357500) was a 2-year (50%) recurrence event. The movable dams at Erie Canal Locks E-15 through E-8 were raised in anticipation of the flooding, which prevented flooding of the New York State Thruway and parts of Canajoharie and Fort Plain. However, there was a delay in removing some of the movable dams. At Erie Canal Lock E-12, the delay in raising the movable dam gates caused an estimated $1 million in damage and debris cleanup. Additionally, at Hinckley Reservoir, NYPA deviated from the rule curve and reduced outflow to zero to reduce downstream flooding which raised the reservoir water surface to elevation 1230.8 which is almost 6 feet above the spillway crest elevation. By allowing water to accumulate within the reservoir, downstream flooding impacts were reduced.

The storm event of August 18, 2021 was concentrated in the Upper Mohawk Subbasin, upstream of Delta Reservoir. Peak flow at USGS Gage 01336000 Mohawk River below Delta Dam was 8,100 cfs. In contrast the mean daily flow for this date is 250 cfs below Delta Reservoir. The August 18 event was the flood of record, comparable to a 100-year (1%) recurrence interval event. In contrast, the flood peaks at West Canada Creek at Kast Bridge (USGS 01346000) and the Mohawk River at Little Falls (USGS 01347000) were less than 2-year (50%) recurrence interval events. All movable dams were removed for this flood event with no delay in accordance with NYSCC movable dam policy and no damage to Canal infrastructure was sustained.

1.4.6. Oswego River Basin Recent Flooding History

From 2017 – 2022, there have been two basin-wide flood events in areas specifically influenced by NYSCC operations. The first event occurred in the spring of 2017 and is indicative of the long duration flooding exemplified during spring thaw (snow melt) periods. The second event occurred in August 2021 due to Tropical Storms Henri and Fred and covered significant portions of the Oswego River Basin, and is indicative of the sporadic major storm events, the second type of significant storm that can occur in the Oswego River Basin. Other events have occurred in the basin such as the Seneca River[2] experienced a peak flow of 13,500cfs on April 8, 2017, which is the 5-year (20%) recurrence interval storm event. Cayuga Lake experienced three separate instances when the lake elevation rose to above the lake's reported damage initiation elevation. At Cross Lake there were thirteen separate instances of the water surface elevation rising above the reported damage initiation elevation. The Oneida River[3] experienced a peak flow of 9,840 cfs in May 2011 which is approximately the 3-year (33%) recurrence interval storm. Oneida Lake had two instances when the lake elevation rose above the reported damage elevation. On the Oswego River[4] there was a peak flow of 25,300 cfs in April 2011 which is approximately the 5-year recurrence interval storm. Table 1 summarizes the historic discharges on the Seneca, Oneida, and Oswego Rivers respectively, and Table 2 summarizes the occurrences and durations of high lake elevations on Cayuga, Cross, and Oneida Lakes, respectively during the past five years. Seneca Lake had no reported exceedances of the reported damage elevation during the past five years. Canandaigua, Keuka, Owasco, Skaneateles, and Otisco Lake rule curves do not report an initiation of damage elevation.

Table 1: Peak Flow Events, Oswego River Basin

BASIN	USGS GAGE	PERIOD OF RECORD (YRS)	HISTORIC PEAK FLOW (CFS)	DATE	ESTIMATED 100-YEAR EVENT (CFS)	RECENT PEAK FLOW (CFS)
Seneca River	04237496	73	22,100	March, 1936	20,450	13,500
Oneida River	04247000	17	10,600	May, 2011	14,304	9,840
Oswego River	04247055	15	26,500	April, 2011	36,050	25,300

[2] USGS 04237496 Seneca River at Baldwinsville, NY
[3] USGS 04247000 Oneida River at Euclid, NY
[4] USGS 04247055 Oswego River at Phoenix, NY

Table 2: High Lake Elevations, Oswego River Basin

LAKE	DATES WHEN LAKE LEVEL WAS ABOVE THE DAMAGE INITIATION ELEVATION
Cayuga	4/10/2017 - 4/12/2017
Cayuga	8/22/2021
Cayuga	10/30/2021-11/8/2021
Oneida	4/8/2017 - 4/16/2017
Oneida	8/20/2021 - 8/27/2021
Cross Lake	3/29/2017 - 5/16/2017
Cross Lake	5/21/2019
Cross Lake	12/16/2019 - 12/18/2019
Cross Lake	1/1/2020 - 1/3/2020
Cross Lake	1/12/2020 - 1/14/2020
Cross Lake	3/4/2020 - 3/8/2020
Cross Lake	5/2/2020 - 5/13/2020
Cross Lake	5/11/2021 - 5/13/2021
Cross Lake	7/18/2021 - 7/21/2021
Cross Lake	8/20/2021 - 9/1/2021
Cross Lake	10/27/2021 - 11/23/2021
Cross Lake	2/20/2022 - 3/28/2022
Cross Lake	8/9/2022

2.0 Impacts of Flooding over the Past Five Years

The Mohawk and Oswego River Basins have a long record of flooding. The Mohawk River Basin experienced one of its most significant storms in 2011, due to Hurricane Irene and Tropical Storm Lee, resulting in $85 million in damage to Canal infrastructure. Statewide, over $1 billion in damages occurred, with 600 homes destroyed, six towns inundated, 150 major highways damaged, and 22 state bridges closed. Comparing the historic events and flooding events in the last five years, the Mohawk Basin has experienced two peak flow events (November 2019 and August 2021), but the level of impact was less than the 2011 event. For example, peak flow at the Mohawk River at Cohoes exceeded 100,000 cfs in the record storms of 1936 and 2011. In contrast, the peak flow at Cohoes was 60,000 cfs in 2019 and 23,000 cfs in 2021.

The Oswego River Basin experienced devastating, wide-spreading flood events in the spring of 1993 (snowmelt and precipitation event), and June 1972 (remnants of Hurricane Agnes). Hurricane Agnes resulted in over $50.5 million in damage in the sectors of residential, commercial, public, and agricultural infrastructure. In comparison to the historic record of flooding, there have been no major basin-wide storm events in the last five years, resulting in a lower level of impact basin-wide, and localized to specific portions of the watershed.

This section details the quantitative and qualitative impacts of flooding over the last five years (2017-2022) in the Mohawk and Oswego River Basins, both in general and relative to the Canal System operations, in the sectors of insurance, land use, agriculture, infrastructure, in the sectors of economic development, including recreation, tourism, and hydropower generation. Quantitative information is derived from the NYS GIS Clearinghouse and FEMA open data sources. Qualitative information is derived from multiple articles, studies, and resources.

Please note the data presented herein was obtained from third parties and does not fully account for losses at uninsured properties or other losses which are not reimbursed by those third parties. Damage to on-site domestic facilities (wells and septic systems, in particular) created by soil saturation and/or standing water remaining after a flood event are generally not accounted for in the data analyzed but are a known issue in certain areas of the basins studied.

2.1. FLOOD PROTECTION & DISASTER DAMAGE

2.1.1. Overview

Flooding causes millions of dollars of damage in the Mohawk and Oswego River Basins and poses a risk to individuals, communities, and the surrounding environment. The Federal Emergency Management Agency (FEMA) is, "the federal agency responsible for leading the Nation's efforts to prepare for, protect and mitigate against, respond to, and recover from the impacts of natural disasters and man-made incidents or terrorist events." FEMA determines the level of risk, the quantitative impacts of flooding on the economy, and flood insurance purchase requirements by delineating the Special Flood Hazard Areas (SFHAs), the Base Flood Elevations (BFEs), and the flood zones used nation-wide for building and development standards.

One way to measure the impacts of flooding on communities within the Mohawk and Oswego River Basin is through repetitive loss data developed by FEMA and provided by NYSDEC. Repetitive loss is defined as an NFIP-insured structure having at least two paid flood losses of more than $1,000 each in any 10-year period since 1978. There are a total of 215 repetitive loss properties identified in the two river basins, as shown in Figure 8 below.

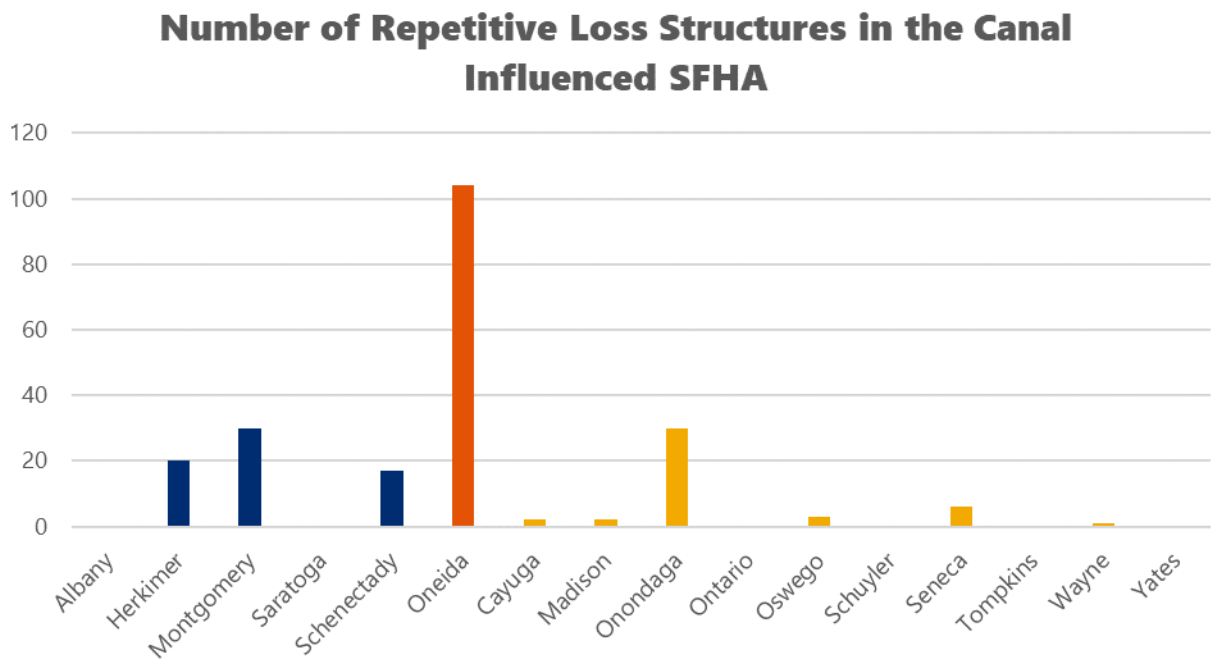


Figure 8: Expected Number of Losses, Mohawk and Oswego River Basins

Another method to estimate the potential impact of weather-related events is through the National Risk Index (NRI), developed by FEMA, which calculates a community's risk related to people, buildings, and agriculture by comparing exposure, annualized frequency of a hazard, and the historic loss ratio. The resulting information can be used as a basis to measure the expected annual loss (EAL) to the community. The cumulative EAL in the combined Mohawk and Oswego River Basins amounts to nearly $22.9 million, which is relatively low in comparison to other flood-prone regions nationally. The EAL from riverine flooding is depicted by flood mitigation region, below. As shown in Figure 9, Oneida, Saratoga, and Herkimer flood mitigation counties are expected to experience the highest annual loss in the Mohawk River Basin. Oneida, Onondaga, and Madison flood mitigation counties are expected to experience the highest annual loss in the Oswego River Basin.

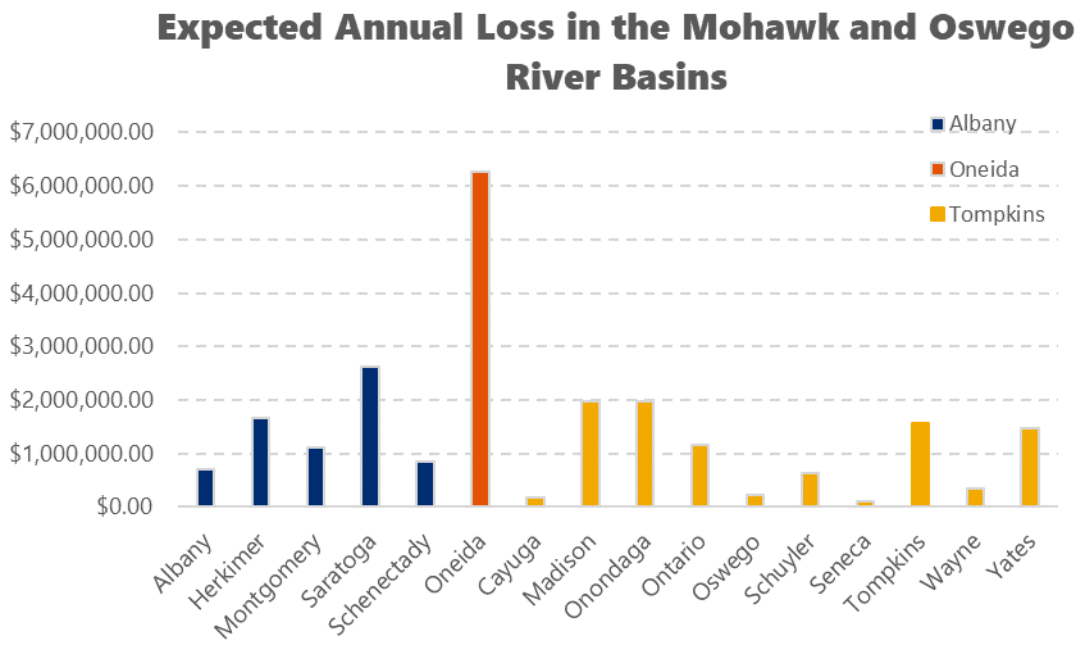


Figure 9: Expected Dollar Value, Mohawk and Oswego River Basins

FEMA provides flood insurance through the National Flood Insurance Program (NFIP) and, in the event of a federally declared disaster, supports post-storm recovery needs for municipalities through the Public Assistance (PA) Program and, in certain cases, homeowners through the Individuals and Households Program (IHP). Following a federally declared disaster, NYS DHSES' Disaster Recovery team works directly with impacted communities throughout the State to maximize federal assistance. Through FEMA's PA program, supplemental grant assistance is provided to State, Local, Tribal, and Territorial (SLTT) governments, and certain types of private nonprofit (PNP) organizations for debris removal, emergency protective measures, and the restoration of disaster-damaged, public or non-profit owned facilities. PA Program claims can be categorized as either emergency or permanent work. Emergency work is performed immediately following an incident, including debris removal and emergency protective measures. Permanent work is the restoration of disaster-damaged infrastructure, including roads and bridges, water control facilities, public buildings, public utilities, recreation, or other facilities. The State management category covers all fees related to the administration and oversight of projects (under the PA program). FEMA's IHP provides financial and direct services to eligible individuals and households affected by a disaster. PA and IHP are not declared for every flood event. Disaster damage must meet certain thresholds both state-wide and county-wide to obtain a federal disaster declaration. Most declarations do not include IHP funds, and even when they do, funding for individual grantees is limited, and not designed to fully repair damaged structures. Therefore, the flood event damage data collected for this report does not reflect the full cost of event flooding damage because this damage data is based on claims paid under several FEMA programs. However, the flood event damage data can be used to approximate the magnitude of the total flood damage experienced in each river basin. The claims through the IHP indicate that the flood mitigation counties in the Mohawk and Oswego River Basins experienced approximately $19.4 million in impacts from flooding events from 2017-2022.

Open-source data was collected from PA Program and IHP claims to estimate the damage value sustained by the communities and individuals in the Mohawk and Oswego River Basins related to flooding in the past five years. Data from the flood mitigation counties, being the counties where the Canal runs through or along, from hurricanes, severe storms, and floods were included to ensure all impacts related to flooding events along the Canal were included. The following sections connect this quantitative analysis to an inventory of the features associated with

these sectors and the qualitative impacts flooding has on each river basin. To draw the connection between the quantitative and qualitative analysis, FIRM maps were collected from FEMA open-source data. Where more recent preliminary FIRMs were available, or where there were not digitized maps, digitized layers (Q3) received from the NYSDEC were applied. For the inventory of existing features, geospatial data was able to be calculated within the flood mitigation regions, being the area of the county within the basin, and within the operational influence of the Canal System. The approximate limits of Canal operational influence were established through a desktop visual assessment of the floodplain by estimating where backwater effects appear to end (typically where the floodplain narrows in tributaries flowing into the Canal System). Hydraulic analysis would be needed to confirm the exact extent to which Canal operations influences the SFHA.

2.1.2. Mohawk River Basin

There are 2,248 individual NFIP policies in the Mohawk River Basin. The total annual policy premiums and federal policy fees are approximately $2.7 million and the total property coverage is over $505 million. As shown in Figure 10, here are eight municipalities along the Canal System in the Mohawk River Basin where there are no active homeowner policies, but the community does participate in the NFIP program. There is one community in the Mohawk River Basin Flood Mitigation Regions that does not participate in the NFIP program, which is the Village of Nelliston, in Montgomery County. The Village is located along the Canal System.

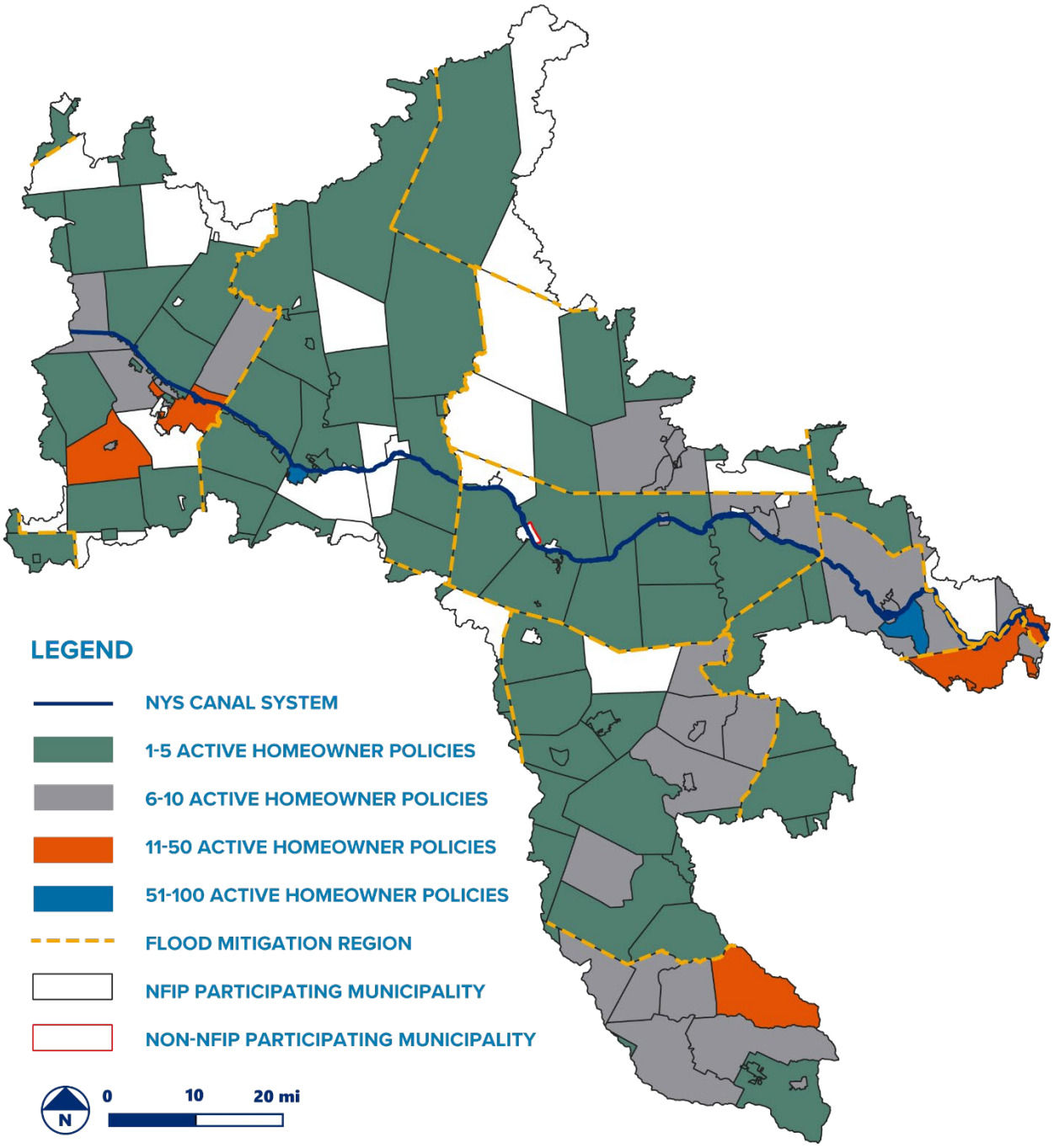


Figure 10: Active Homeowner Policies Participating in the National Flood Insurance Policies (NFIP) Program, Mohawk River Basin

Within the Mohawk River Basin, there are 60,832 acres of SFHA. Approximately 30,298 acres (50%) of this SFHA are influenced by the Erie Canal System. 269 public assistance claims were made by the flood mitigation counties of Herkimer, Montgomery, Oneida, and Saratoga due to hurricanes, severe storms, and floods between 2017-2022. The flood mitigation counties of Albany and Schenectady did not have a public assistance claim during this time period. The storm event damages sustained in these regions resulted in FEMA funding nearly $34.6 million in projects broken down into the FEMA work categories as shown in Figure 11. Roads and bridges received a significant

amount of funding basin-wide to restore disaster-damaged infrastructure. In addition to PA Program claims, a total of 107 individual NFIP claims were filed in the Mohawk River Basin flood mitigation counties in the past five years, resulting in $12.4 million of individual claims. In addition to PA Program claims, a total of 107 individual NFIP claims were filed through FEMA in the past five years (2017-2022), inclusive of all the Mohawk River Basin flood mitigation counties, resulting in $12.4 million of individual claims.

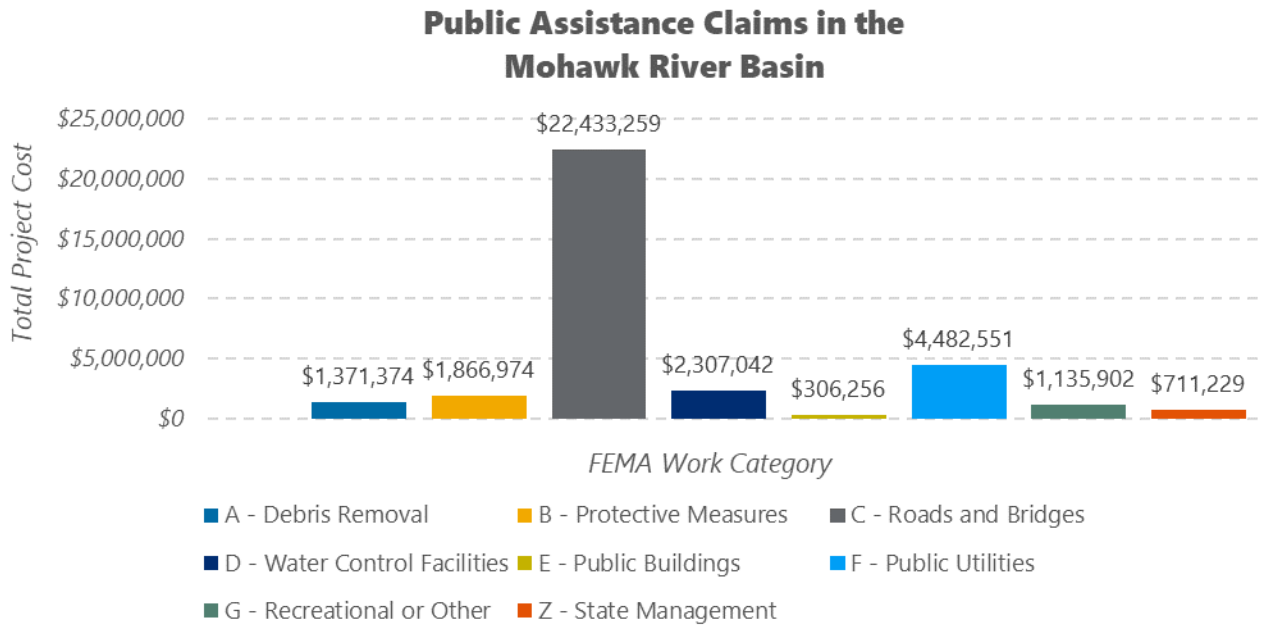


Figure 11: Public Assistance Claims and Project Cost, Mohawk River Basin

2.1.3 Oswego River Basin

There are 248 individual NFIP policies in the Oswego River Basin. The total annual policy premiums and federal policy fees are approximately $3.3 million, and the total property coverage is over $701 million. As shown in Figure 12, there are four municipalities along the Canal System in the Oswego River Basin where there are no active homeowner policies, but the community does participate in the NFIP program. There are two communities in the Oswego River Basin Flood Mitigation Regions that do not participate in the NFIP program, which include the Town of Williamstown and the Town of Palermo, both located in Oswego County.

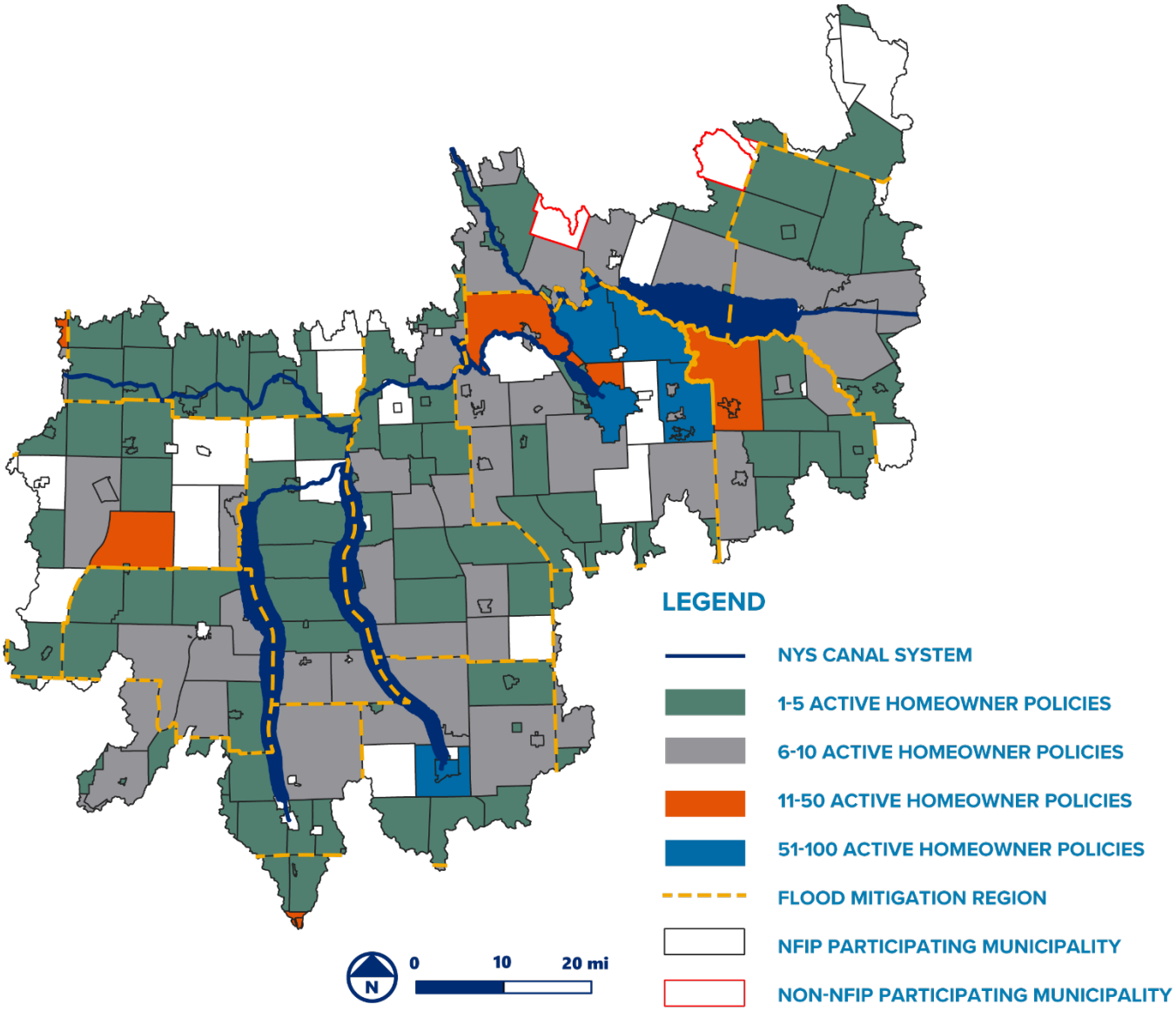


Figure 12: Active Homeowner Policies Participating in the National Flood Insurance Policies (NFIP) Program, Oswego River Basin

Within the Oswego River Basin, there are 397,529 acres of SFHA. Approximately 226,895 acres (57%) of this SFHA are influenced by the operations of the Canal System. 340 public assistance claims were filed in the flood mitigation counties of Cayuga, Madison, Oneida, Onondaga, Oswego, Schuyler, Seneca, Wayne, and Yates Counties due to hurricanes, severe storms, and floods between 2017-2022. Tompkins and Ontario counties did not file a public assistance claim during this time period. Damages sustained in these regions resulted in FEMA funding for over $40.9 million in public projects which is broken down into FEMA work categories as shown in Figure 13. The recreation and roads and bridges sections received the highest amount of public assistance project funding in the Oswego River Basin. In addition to PA Program claims, a total of 186 IHP claims were filed through FEMA in the Oswego River Basin flood mitigation counties in the past five years, resulting in $7 million of individual claims. In addition to PA Program claims, a total of 186 IHP claims were filed through FEMA in the past five years (2017-2022), inclusive of all of the Oswego River Basin flood mitigation counties, resulting in $7 million of individual claims.

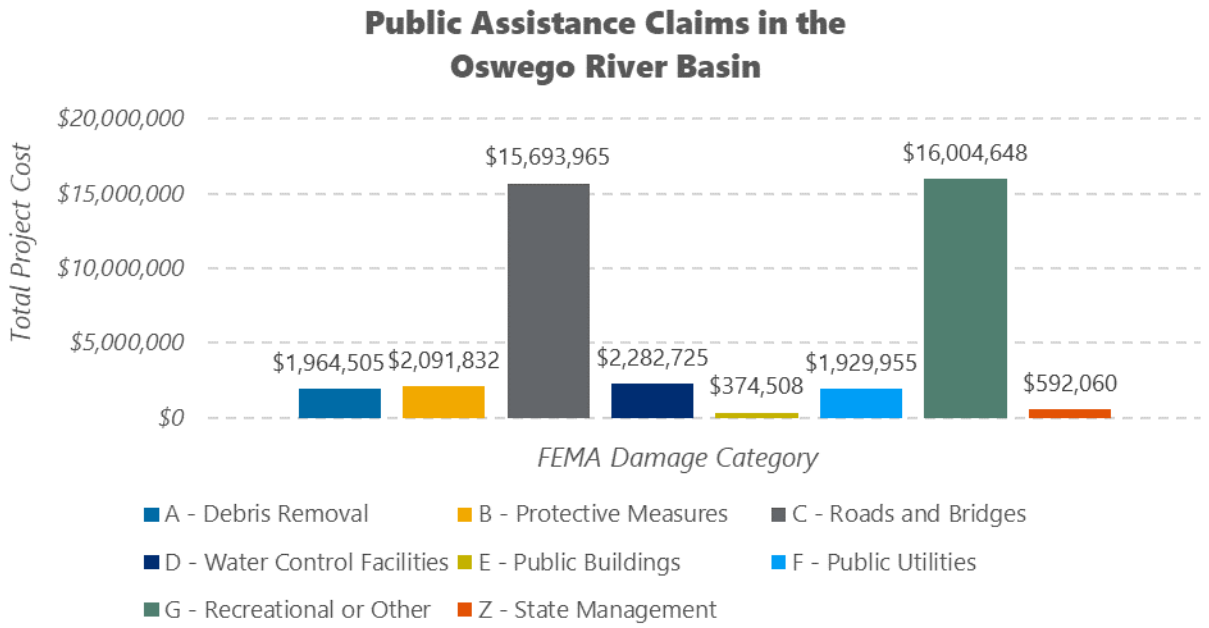


Figure 13: FEMA PA Program Claims and Project Cost, Oswego River Basin

2.2 LAND USE

The Mohawk and Oswego River Basins consist primarily of agricultural, forested, and wetland areas. The Mohawk River Basin passes through areas of higher density development in Rome, Utica, and Little Falls in the western section and Schenectady in the eastern portion of the River Basin. The most prevalent land cover is forest (58% of total land cover) and agriculture (23%). The Oswego River Basin passes through higher density development in the Syracuse area in the center of the River Basin and Phoenix and Oswego on the Oswego River, with the remainder of the basin consisting of low to medium density development along the Canal System with agriculture (38% of total land cover) and forest (34% of total land cover) accounting for the majority of the Basin land coverage. See Figure 14 for a comparison of land cover between the two river basins.

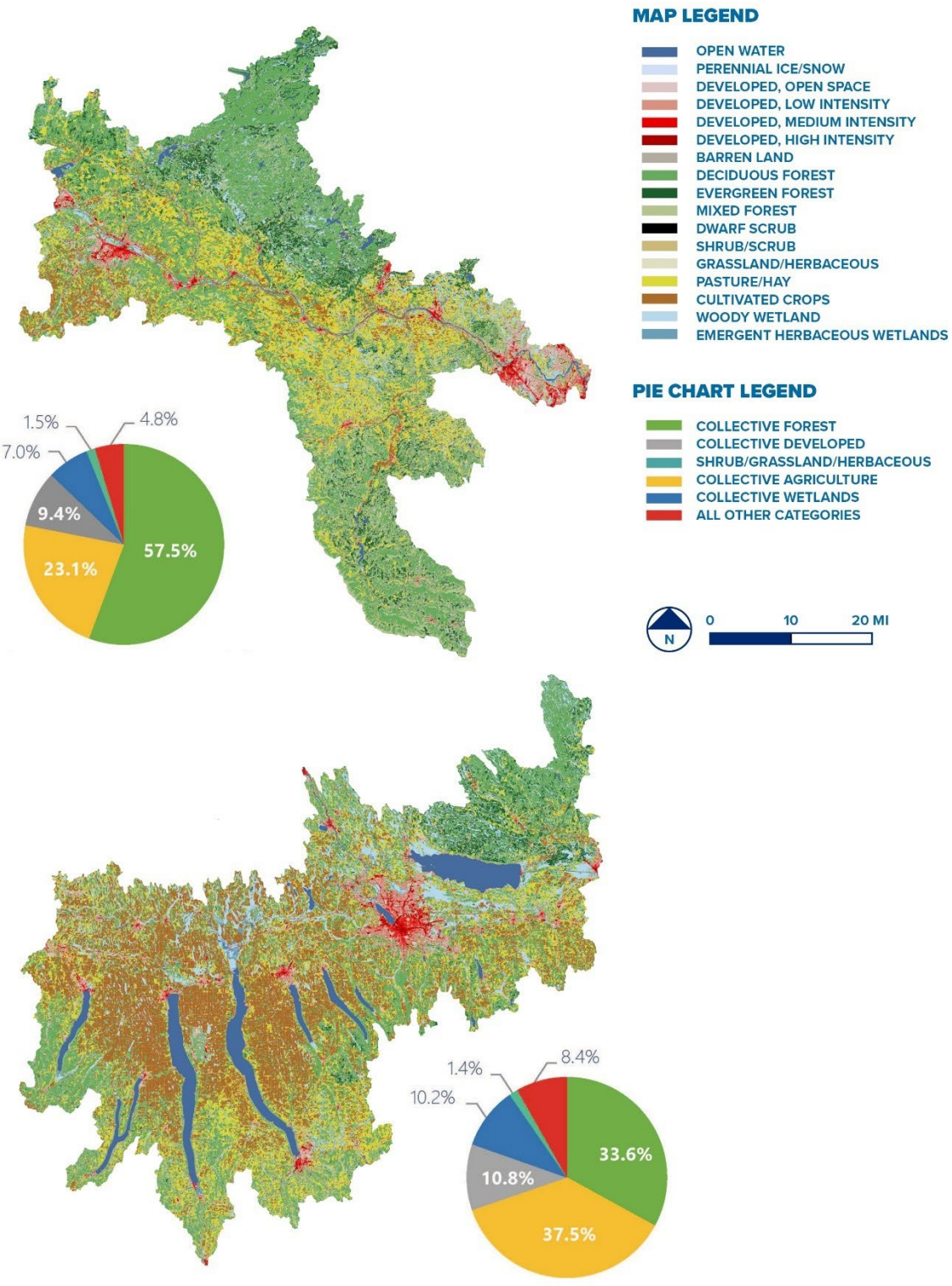


Figure 14: Comparison of Land Cover, Mohawk (top) and Oswego (bottom) River Basins

New York State is a 'Home Rule' state and as such most planning, zoning and land use enforcement matters are made on a local level and so can vary considerably from municipality to municipality. Land use policies and regulations are described in Section 4. Floodplain regulations both in FEMA's regulations and in state building code do not prohibit development in floodplains but do regulate how such development takes place. However, there are a significant number of structures that were constructed prior to the 1980s, when most of the first local and state floodplain standards were enacted. Therefore, across both basins, there are a significant number of structures that are still located within the current designated SFHA.

2.2.1. Mohawk River Basin

Within the Mohawk River Basin, there are 404,468 buildings located in the flood mitigation counties, and 180,569 buildings located in the flood mitigation regions. Six percent of the buildings in the flood mitigation counties are within the Canal operation influenced SFHA (about 10,835 structures). As shown in Table 3, the buildings within the flood mitigation counties have a total estimated value of $203.1 billion. The EAL due to riverine flooding is about $31.7 million, meaning that each year, the EAL is equal to approximately 0.02% of the total structure value within the flood mitigation counties.

Table 3: Building Value and Annual Loss, Mohawk River Basin

County	2023 Building Value	Riverine Flooding - Expected Annual Loss - Building Value
Albany	$62,620,319,000	$8,693,000
Herkimer	$13,389,809,000	$2,454,000
Montgomery	$9,790,764,000	$1,810,000
Oneida	$44,669,326,000	$8,378,000
Saratoga	$47,650,133,000	$6,913,000
Schenectady	$24,998,475,000.00	$3,467,000
Total	**$203,118,826,000**	**$31,715,000**

2.2.2. Oswego River Basin

Within the Oswego River Basin, there are 670,733 buildings located in the flood mitigation counties, and 535,239 buildings located in flood mitigation regions. Two percent of the buildings in the flood mitigation counties are located in the Canal operation influenced SFHA (about 10,705 structures). As shown in Table 4, the estimated total building value within the flood mitigation counties is $406.6 billion. The EAL in the flood mitigation counties is about $13.6 million, meaning that each year, the EAL is equal to approximately 0.003% of the total structure value within the flood mitigation counties.

Table 4: Building Value and Annual Loss, Oswego River Basin

County	2023 Building Value	Riverine Flooding - Expected Annual Loss - Building Value
Cayuga	$15,990,406,000	$112,000
Madison	$13,873,759,000	$1,683,000
Monroe	$136,996,466,000	$162,000
Oneida	$44,669,326,000	$5,349,000
Onondaga	$90,744,546,000	$1,483,000
Ontario	$26,114,336,000	$1,098,000
Oswego	$23,112,426,000	$71,000
Schuyler	$4,143,048,000	$623,000
Seneca	$7,518,603,000	$82,000
Tompkins	$20,211,050,000	$1,425,000
Wayne	$17,687,533,000	$170,000
Yates	$5,548,822,000	$1,386,000
Total	**$406,610,321,000**	**$13,644,000**

2.3 AGRICULTURE

2.3.1. Overview

With a need for irrigation and high-organic content soils, agricultural lands are often concentrated along tributaries, major waterways, and wetlands, including SFHAs and the Canal System. Storm events and flooding have both a localized and regional impact on agriculture and water quality. During storm events, precipitation can destabilize and oversaturate soils, leading to impacts on both farm production and water quality of adjacent waterbodies that receive nutrients, chemicals, and organic material from the stormwater runoff. These pollutants can lead to growth in algae and bacteria, impairing fish and aquatic ecosystems.

Agriculture is a dominant land use throughout the Mohawk and Oswego River Basins. Agricultural products include dairy, beef, livestock, field crops, vegetables, and fruit orchards (primarily grape and apple). Agricultural activities are overseen at the county level through Soil and Water Conservation Districts, at the state level by the NYS Department of Agriculture and Markets, and at the federal level by the United States Department of Agriculture (USDA). The farmland and agricultural products produced in both River Basins are essential to the regional and state economy. Flood mitigation regions in the Oswego River Basin and Mohawk River Basin rank in the top 10 in New York State for producing the highest market value of agricultural products. For example, according to the 2017 Census of Agriculture, Cayuga County is ranked 2nd in the State in dollar value of products sold, Wayne County is ranked 5th, Ontario is ranked 6th, and Onondaga is ranked 10th.

2.3.2. Mohawk River Basin

Agricultural districts in the flood mitigation counties of the Mohawk River Basin contain 617,051 acres with 398,145 acres of those acres within the flood mitigation regions. A total of 3,824 acres (1% of the agricultural district land in the flood mitigation counties) lie in agricultural districts located within the SFHA influenced by Canal System operations (Figure 15).

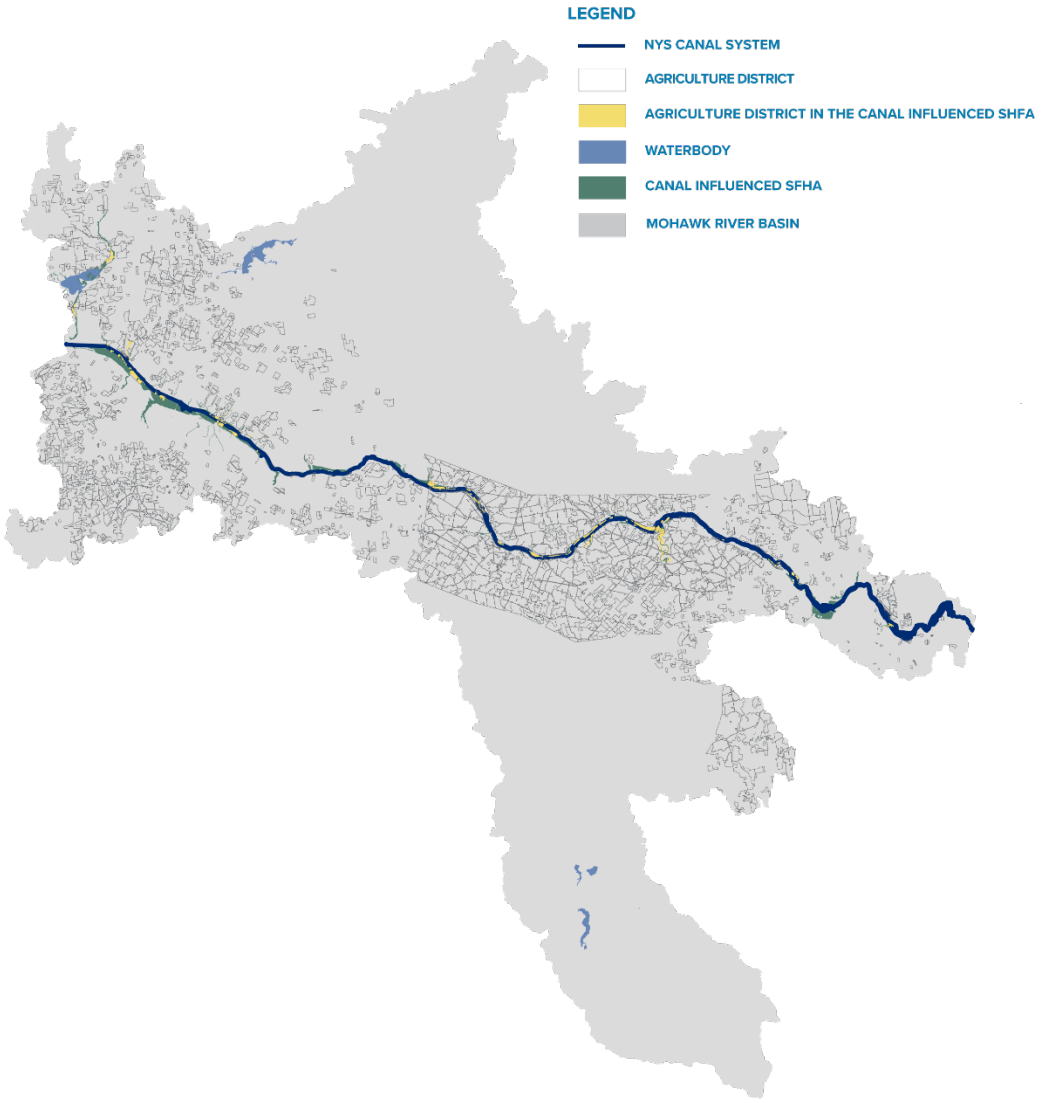


Figure 15: Agriculture District, Mohawk River Basin

Based on the value of agricultural lands, as documented in the 2017 USDA National Agriculture Statistics Services, the value of the agricultural lands and structures in the flood mitigation counties of the Mohawk River Basin total over $416 million (Table 5). However, due to riverine flooding, the agricultural EAL has a value of $660,000. It should be noted that after land used for human consumption crops is flooded, it cannot be used again for human consumption crops for at least two years. Therefore, there may be some increased value of loss experienced in the lands that are continually flooded.

Table 5: Agriculture Value and Annual Loss, Mohawk River Basin

County	2023 Agriculture Value	Riverine Flooding - Expected Annual Loss - Agriculture Value
Albany	$54,276,000	$205,000
Herkimer	$66,476,000	$47,000
Montgomery	$85,975,000	$139,000
Oneida	$115,215,000	$102,000
Saratoga	$88,094,000	$151,000
Schenectady	$6,268,000	$16,000
Total	$416,304,000	$660,000

2.3.3. Oswego River Basin

Agricultural districts in the flood mitigation counties within the Oswego River Basin contain approximately 1,837,450 acres and 1,538,465 acres are located within the flood mitigation regions. A total of 33,459 acres (about 2% of the land in agricultural districts in the flood mitigation counties) are contained in agricultural districts located within the Canal operation influenced SFHA (Figure 16).

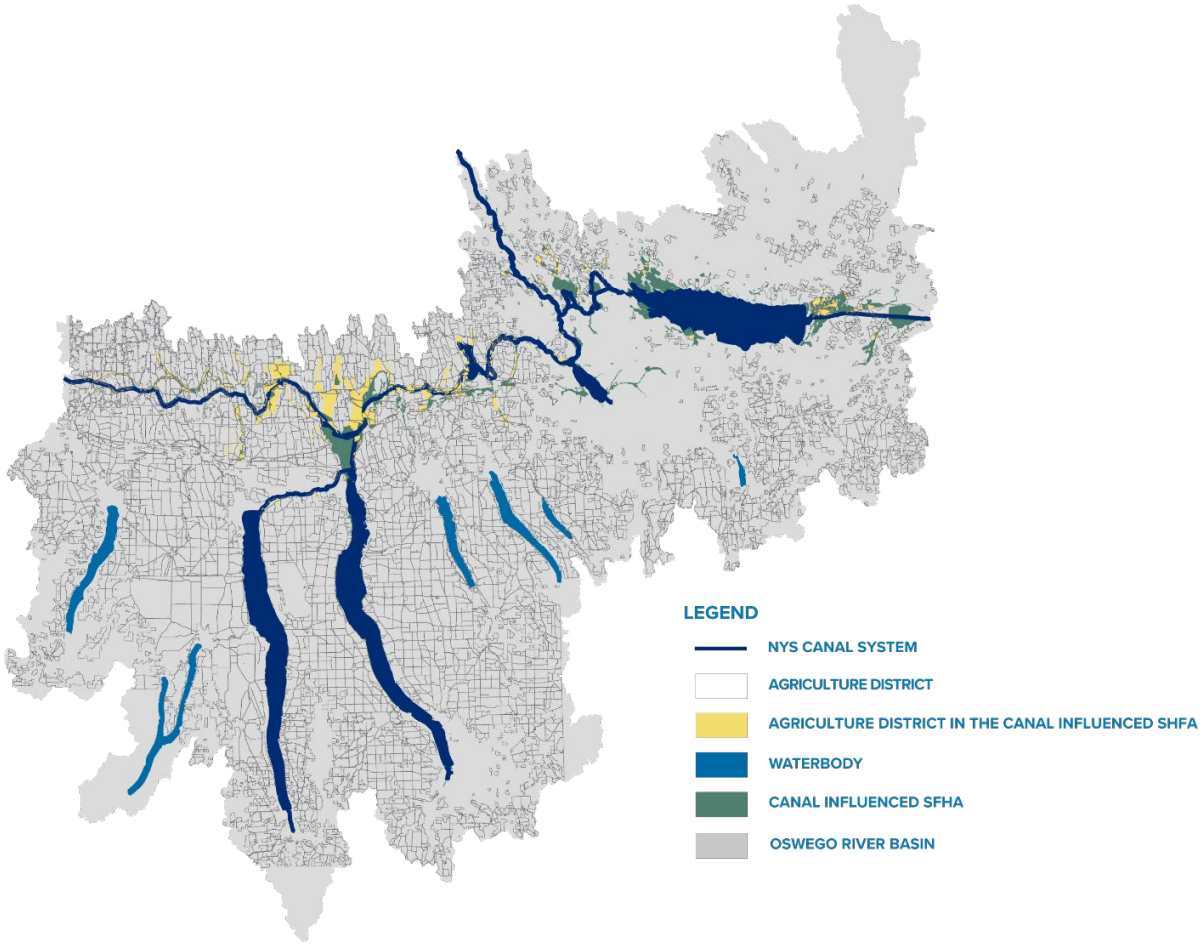


Figure 16: Agriculture District, Oswego River Basin

Based on the values documented in the 2017 USDA National Agriculture Statistics Services, the value of the agricultural lands and structures in the flood mitigation counties of the Oswego River Basin total over $1.7 billion. However, due to riverine flooding, the total agricultural EAL has a value of $160,000 (Table 6).

Table 6: Agriculture Value and Annual Loss, Oswego River Basin

County	Agricultural Value	Riverine Flooding – Expected Annual Loss – Agriculture Value
Cayuga	$330,182,000	$3,000
Madison	$130,335,000	$16,000
Monroe	$87,910,000	$36,000
Oneida	$115,215,000	$38,000
Onondaga	$204,637,000	$25,000
Ontario	$235,294,000	$24,000
Oswego	$47,296,000	$7,000
Schuyler	$52,466,000	$1,000
Seneca	$104,207,000	$2,000
Tompkins	$74,206,000	$2,000
Wayne	$253,833,000	$2,000
Yates	$131,502,000	$6,000
Total	**$1,767,083,000**	**$162,000**

2.4 TOURISM & RECREATION

2.4.1. Overview

The New York State Canal System offers an abundance of land-based and water-based recreational activities for hikers, bikers, campers, kayakers, fishing enthusiasts, and boaters in and along the Canal System revolving around the historical significance, structures, ecology, and character of the communities that border it.

Serving as the spine of land-based recreation, a portion of the 365-mile segment of the Empire State Trail, of which the Erie Canalway Trail is part of, traverses the Mohawk and Oswego River Basins following the Canal System, passing through more than 200 communities that offer accommodations, entertainment, seasonal events, and dining to support local business and attract tourists. The trail primarily attracts local bicyclists, walkers, dog walkers, bird watchers, and cross-country skiers, offering both on-road and off-road trails. Trail amenities include benches and picnic areas and 10 Canal amenity centers. The trail also enables access to several parks for passive and active recreation, including sports fields, playgrounds, open lawn areas, and 15 State and National Parks. Canal-centric communities depend on the approximately 3.3 million annual visits to the Erie Canalway Trail, which generate over $55.8 million each year in spending and over 731 jobs (*Who's on the Trail, The Economic Impact of the Erie Canalway Trail*[5]). Also, according to this economic impact study, 61% of respondents use the trail at least once per week. Three percent of visitors are non-local but generate most of the total spending on the Canal, averaging $531.47 per trip. Only 18% of visitors stay overnight but generate 84% of all spending[6]. During a flooding event, where the embankments are overtopped, the Erie Canalway Trail alongside the Canal is also overtopped and damaged.

[5] Scipione, P. 2014. The Economic Impact of the Erie Canalway Trail: An Assessment and User Profile of New York's Longest Multi-Use Trail. Albany, NY: Parks & Trails New York.

Significant storm events can damage park amenities, trail surfaces, cause downed trees, riverbank erosion, and/or damage to Canal infrastructure that may require closure or re-routing of the trail for extended periods of time.

On the subject of water-based recreation and tourism, discussions with NYPA staff note that over 40,000 motorized recreational vessels use the Canal System each year, and there are thousands of other non-motorized watercraft users for fishing opportunities, water-based recreational opportunities, and water cruises. The Canal provides access to the highly productive fisheries of Oneida, Seneca, and Cayuga Lakes which, combined with the river segments and tributaries that feed into the Canal, provide a diversity of deep and shallow-water habitats for various fish species. The Oswego River is stocked with chinook salmon and rainbow trout (steelhead) annually in addition to the naturally reproducing populations of brown trout, pumpkinseed, sunfish, perch, bass, walleye and other species. According to the NYSDEC website, fishing accounts for over $35 million in revenues and supports over 1,000 jobs in and around Oswego River and Oswego County. There are also 70 variety of fish species in the Mohawk River Basin, with smallmouth bass and walleye drawing the highest number of anglers.

Flooding impacts water-based recreation and tourism through Canal closures impeding overall navigation and recreation opportunities and potentially creating unsafe conditions. Significant storm events can damage storage facilities impacting rental equipment and seasonal docks, limiting on watercraft usage all together by low wake or no wake zones due to high water conditions, and high-water levels can make boat ramps and launches unusable or inaccessible. Impacts from nonpoint source and point source pollution especially following a major precipitation event can cause harmful algal blooms, impacting Canal usage and degrading fish habitat through sediment accumulation, turbidity, loss of food sources, and lowered dissolved oxygen levels.

2.4.2 Mohawk River Basin

Approximately 99 miles of the Erie Canalway Trail is within the Mohawk River Basin (Figure 17). The Trail intersects the State Bicycle Route 9 traveling south to New York City and North to Quebec. About 7.0 miles of the trail is located within the Canal operation influenced SFHA. There are 22 marinas, 34 boat launches, and 5 boat rental businesses along the Canal System. There are 22 Canal themed tourist cruises and 24 lodging accommodations. Lodging includes hotels, motels, bed & breakfast inns and RV campsites that either have their own direct access to the Canal System or are within a half-mile walk to a public dock. The levels of amenities and service vary by establishment. There are also 39 heritage sites serving as tourist attractions, such as the American Revolutionary War Museum, historic Champlain Canal locks and New York's first Historic District in and around the Canal System. From 2017 to 2022, there were 12 FEMA PA Program claims made to FEMA classified as "G – Recreational or Other" in the Mohawk River Basin, totaling $1.1 million in repair, restoration, and replacement projects including, but not limited to, embankments, boat ramps, and sports fields. Herkimer County had received the most amount of funding for the damages sustained, but Oneida and Montgomery flood mitigation counties also received some funding.

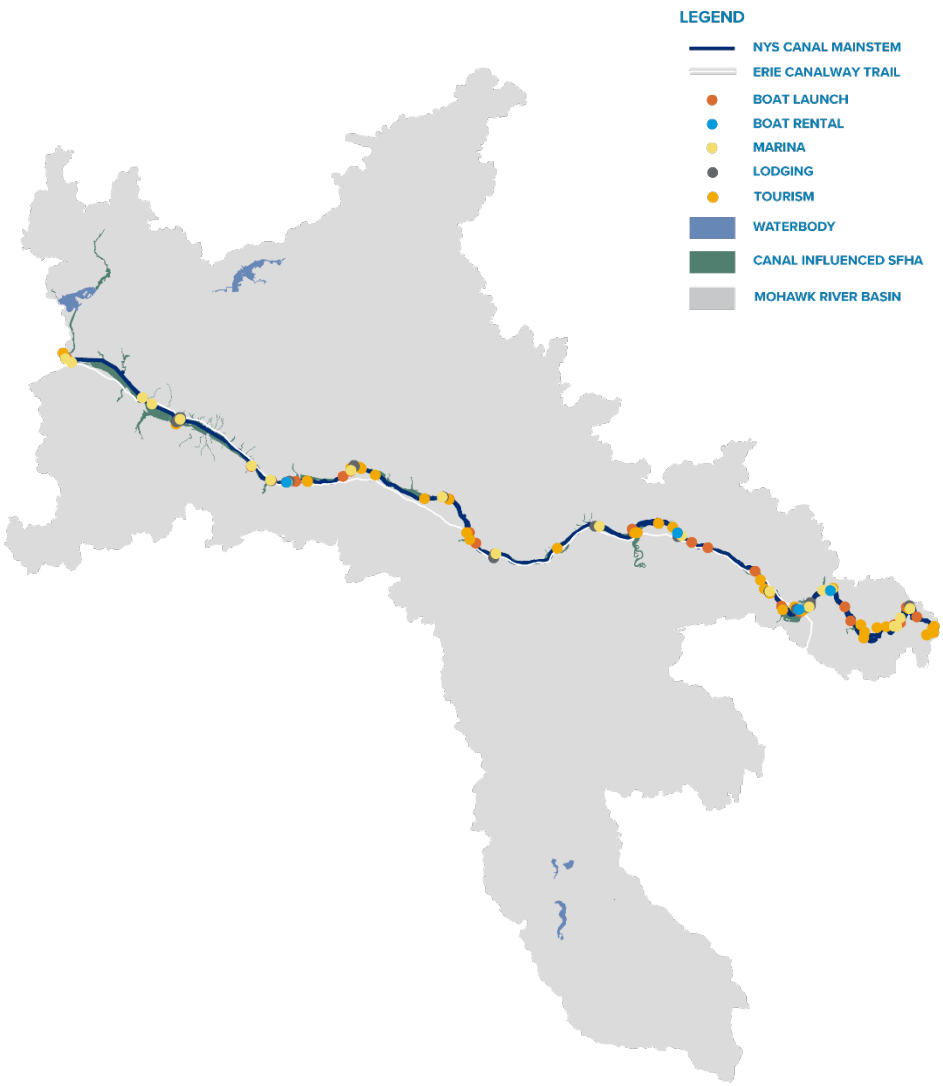


Figure 17: Land and Water-Based Recreation, Mohawk River Basin

2.4.3. Oswego River Basin

There are approximately 123 miles of the Erie Canalway Trail within the Oswego River Basin, intersecting the Genesee Riverway Trail in Rochester and the Loop the Lake Trail in Syracuse (Figure 18). Approximately 10.5 miles of Canalway Trail are within the Canal operation influenced SFHA. Along the Canal System, there are 22 boat launches, including 14 boat ramps and eight car-top launches. There are also 28 boat launches on Seneca, Cayuga, and Oneida Lakes, collectively. There are two boat rental locations which paddle boats, fishing boats, and motorized watercraft, along the Canals, and 20 locations on Seneca, Cayuga, and Oneida Lakes collectively. 55 tourist cruises are offered along the Canals, and 80 lodging opportunities. Lodging includes hotels, motels, bed & breakfast inns and RV campsites that either have their own direct access to the Canal System or are within a half-mile walk to a public dock. The levels of amenities and service vary by establishment. There are also 63 heritage sites serving as tourist attractions, such as museums representing historic life in the towns and villages, the site of the Women's Rights Convention, and the Enlarged Canal-era infrastructure in and around the Canal System. From 2017 to 2022, there were 26 FEMA PA Program claims made to FEMA classified as "G – Recreational or Other" in the Oswego River Basin, totaling $16

million in recreational features in need of repair, reconstruction, or replacement, including, but not limited to, embankments, boat ramps, and sports fields. These impacts largely effected Oswego, Oneida, and Wayne counties, but also Schuyler, Cayuga, and Yates Counties.

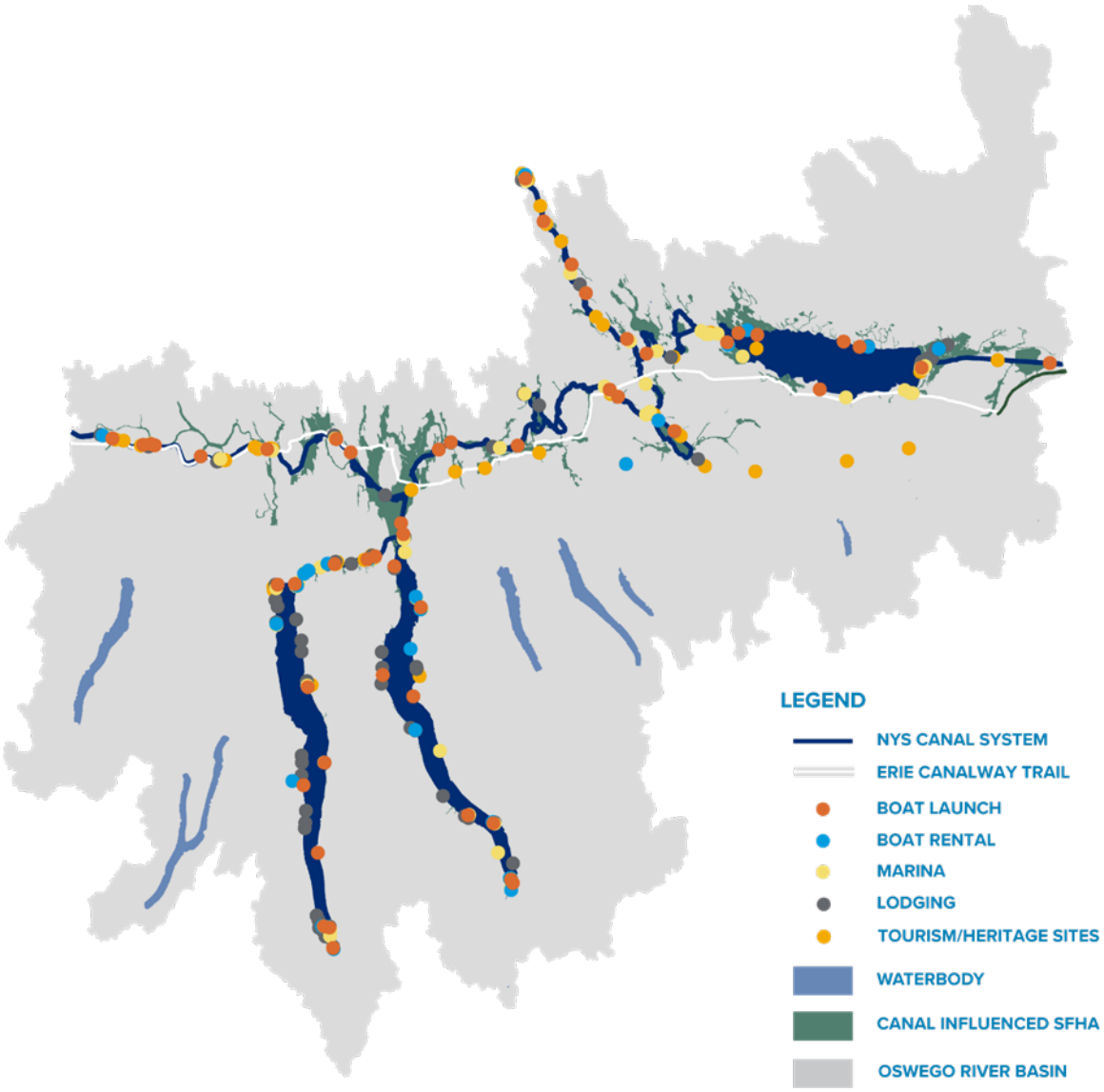


Figure 18: Land and Water-Based Recreation, Oswego River Basin

2.5 PUBLIC INFRASTRUCTURE & TRANSPORTATION

2.5.1 Overview

The flooding events in the past five years have impacted both Canal infrastructure and transportation infrastructure. Based on discussion with NYSCC staff, it was determined the 2019 Halloween event caused $1 million in damage at Erie Canal Lock E-12. This was due to the inconclusive and changing AHPS forecasts for the Mohawk River at Little

Falls resulting in delayed implementation of the movable dam lifting procedure. As part of another discussion, it was also noted that in May 2021, there was a failure of the Canal embankment dam adjacent to Erie Canal Lock E-29 from high water levels on the Ganargua Creek side of the aqueduct, in conjunction with heavy equipment located at the site causing a surcharge load. This section of Canal was closed for an extended period and the Erie Canal Lock E-29 pool was operated at a lower navigation pool level for a significant portion of the 2021 navigation season. The following sub-sections identify key infrastructure components, the number of components within each basin, and the infrastructure within the SFHA.

2.5.2. Canal Infrastructure

The New York State Canal System utilizes many infrastructure components to provide water for navigation purposes. Primary infrastructure generally consists of lock and dam structures, but there are many other structures associated with the Canal System. During flooding events, Canal infrastructure is subject to damage from flood water, debris, debris accumulation, and, potentially, wind as nearly all Canal infrastructure is located within the Canal operation influenced SFHA.

2.5.2.1. Mohawk River Basin

There are 571 Canal System infrastructure components in the Mohawk River Basin (Figure 19) which include, but are not limited to, locks, movable dams, Tainter gates, sluice gates, fixed crest dams, retention dams, waste weirs, spillways, guard gates, bridges, terminals, access roads, docks, guide structures, and culverts:

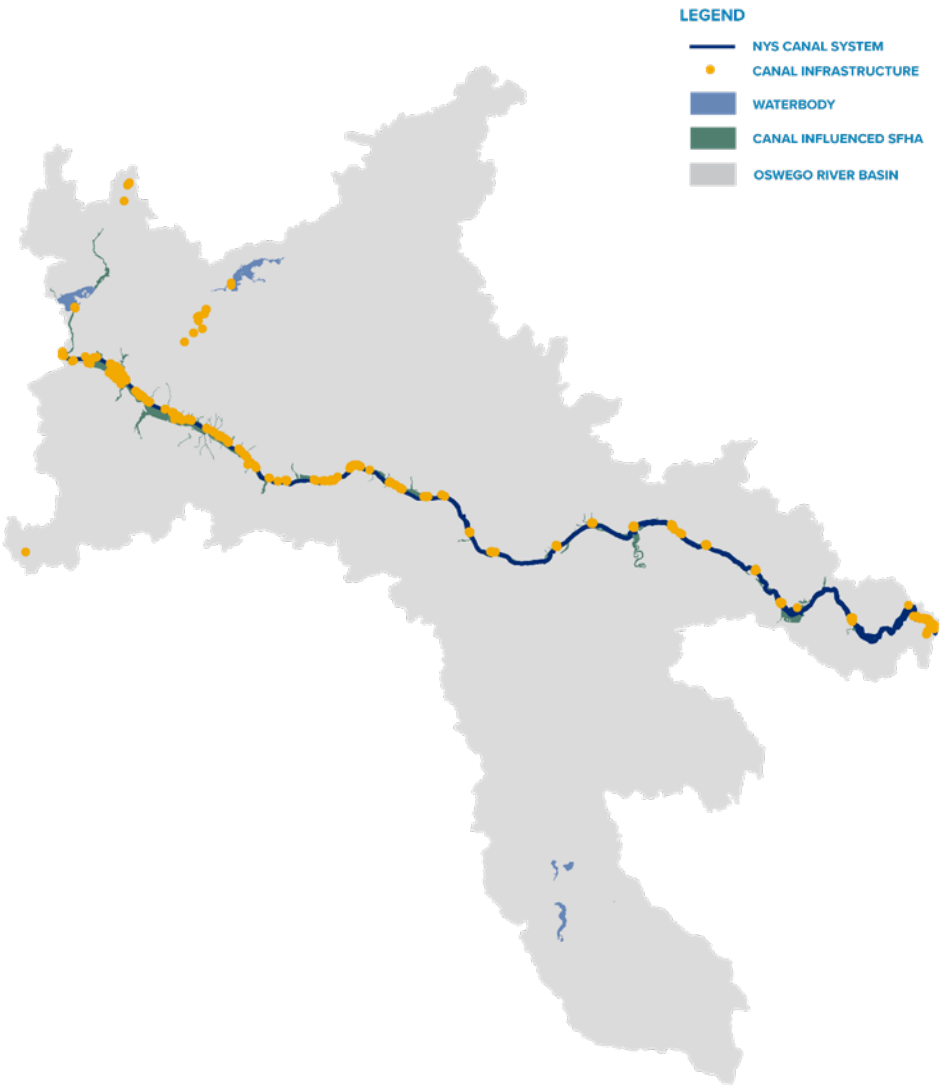


Figure 19: Canal Infrastructure, Mohawk River Basin

2.5.2.2 Oswego River Basin

There are 626 Canal System infrastructure components in the Oswego River Basin (Figure 20), which include, but are not limited to, locks, movable dams, Tainter gates, sluice gates, fixed crest dams, retention dams, waste weirs, spillways, guard gates, bridges, terminals, access roads, docks, guide structures, and culverts:

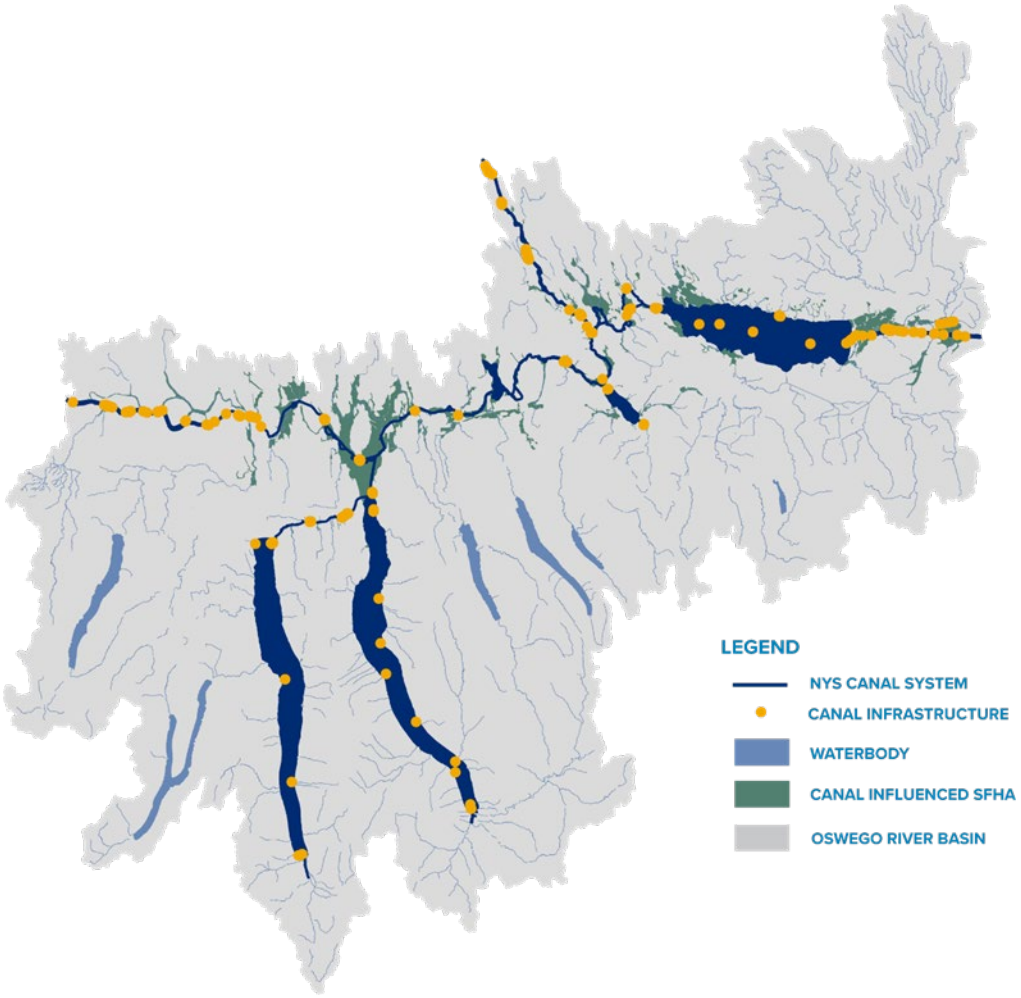


Figure 20: Canal Infrastructure, Oswego River Basin

2.5.3. Vehicular Infrastructure

Vehicular infrastructure located within the SFHA influenced by Canal System operations includes streets, bridges, and culverts, all of which are subject to inundation and flooding. The NYSDOT and Federal Highway Administration (FHWA) have several monitoring programs, plan of actions, and scour critical bridge coding to guide actions during flood events.

2.5.3.1. Mohawk River Basin

There are 9,327 miles of roads in the Mohawk River Basin with 102.4 miles located within the Canal operation influenced SFHA (1%). The roads are broken down into road types in Table 7 below. The 102.4 miles of roadway within the Canal operation influenced SFHA includes 160 NYSDOT bridges and 7 NYSTA bridges (Figure 21). Between 2017-2022, there were 120 FEMA PA Program claims basin-wide associated with hurricanes, floods, and severe storms, totaling nearly $22.4 million in projects classified as "C – Roads and Bridges." These projects range from the repair, reconstruction, or replacement of infrastructure, including, but not limited to, culverts, roads, bridges, and embankments, that experienced damage. All flood mitigation counties within the Canal operation influenced SFHA had claims during this period with Oneida and Herkimer Counties most significantly impacted (highest claims value).

Table 7: Roadways in the Canal Operation Influenced SFHA, Mohawk River Basin

Road Type	Miles in Canal operation influenced SFHA
Interstate	8.9
US Route	0
State Route	9.6
County Road	0
Local Roads	83.9
Total	102.4

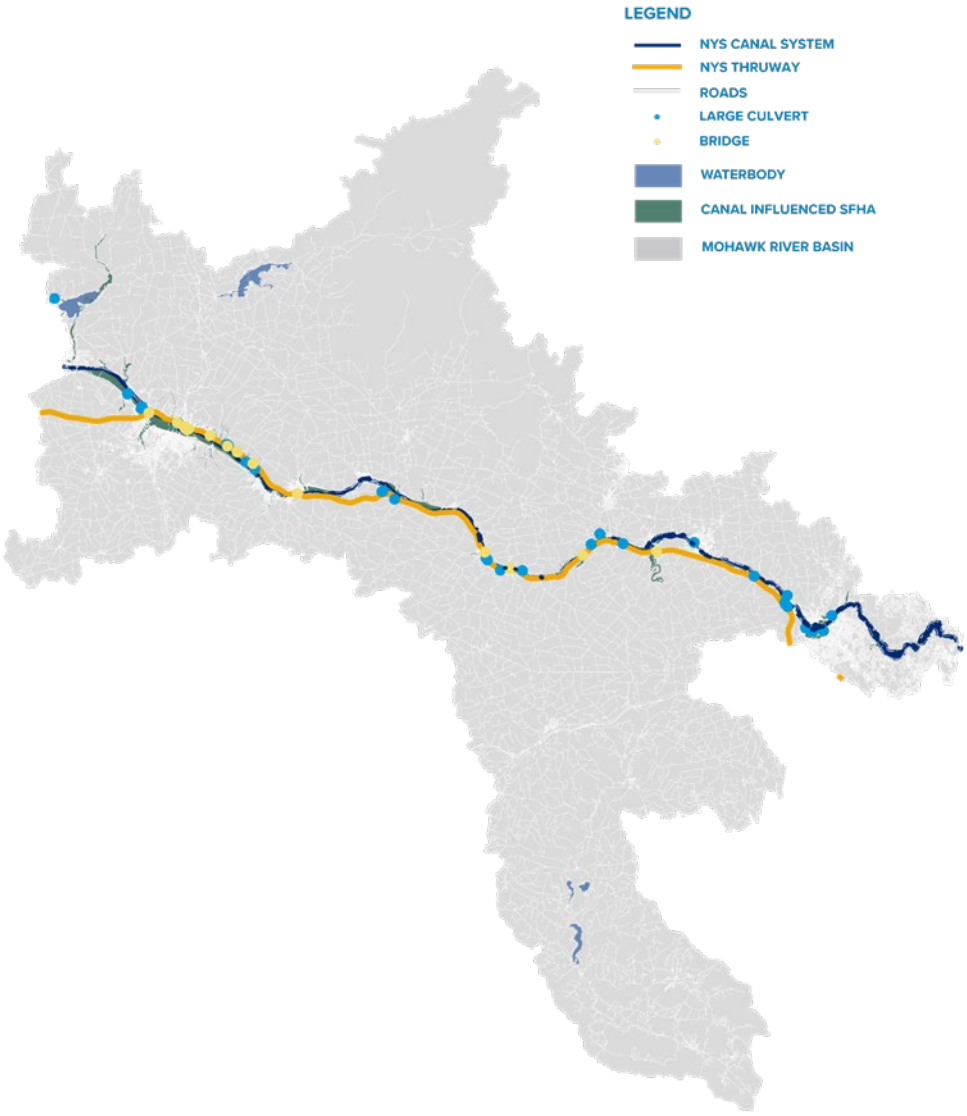


Figure 21: Vehicular Infrastructure, Mohawk River Basin

2.5.3.2 Oswego River Basin

There are 15,740 miles of roads in the Oswego River Basin with 261.4 miles of roadway located within the Canal operation influenced SFHA (2%). The mileage is broken down into the road types in Table 8 below. A total of 256 bridges are located within the SFHA influenced by Canal System operations, and 56 large culverts pass under the 261.4 miles of roadway (Figure 22). Between 2017-2022 there have been 158 FEMA PA program claims basin-wide associated with hurricanes, floods, and severe storms totaling about $15.7 million in projects classified as "C – Roads and Bridges." These projects range from the repair, reconstruction, or replacement of infrastructure, including, but not limited to, culverts, roads, bridges, and embankments, that experienced damage. All flood mitigation regions within the Canal operation influenced SFHA had claims during this period with Oneida and Seneca Counties most significantly impacted (highest claims value).

Table 8: Roadways in the Canal Operation Influenced SFHA, Oswego River Basin

Road Type	Miles in Canal operation influenced SFHA
Interstate	16.9
US Route	1.6
State Route	10.5
County Road	3.8
Local Roads	228.6
Total	261.4

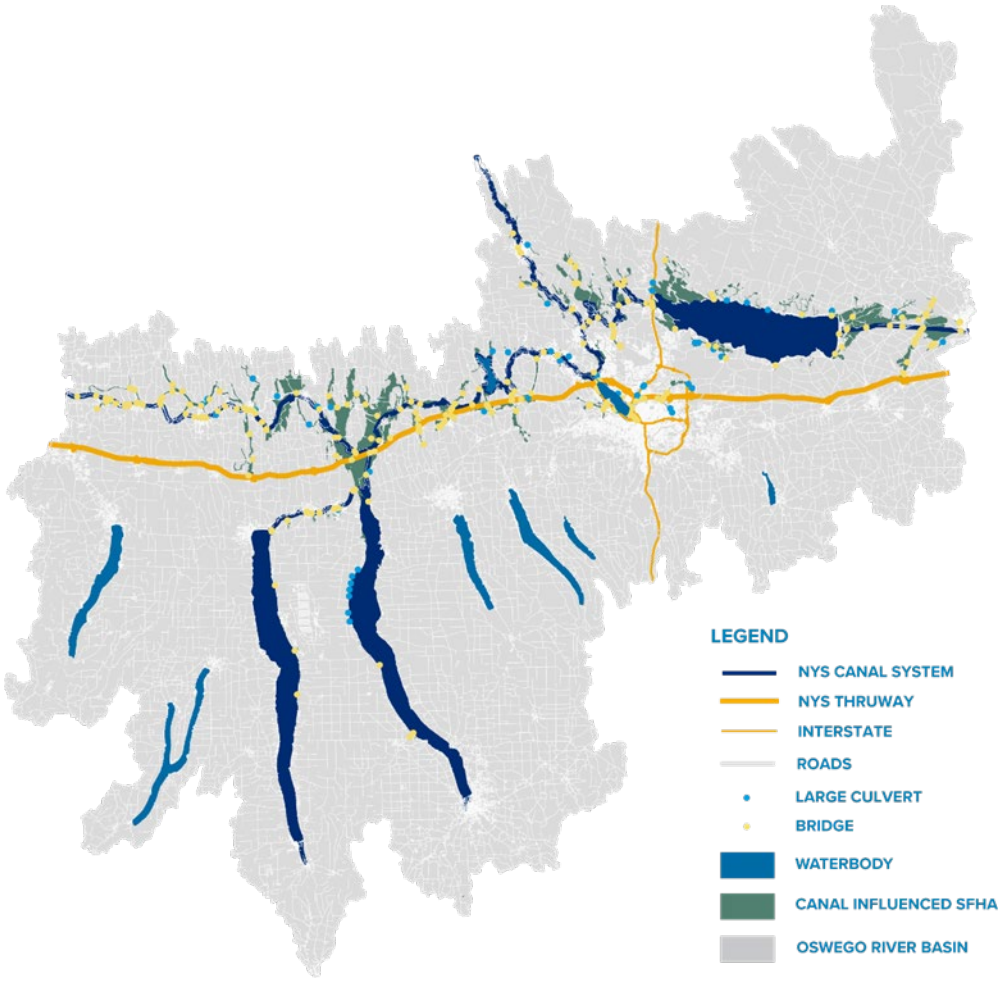


Figure 22: Vehicular Infrastructure, Oswego River Basin

2.5.4. Railroad Infrastructure

Railroad infrastructure located within the Canal operation influenced SFHA includes railroads, passenger stations, freight stations, and rail places all of which are subject to inundation and flooding. Each railroad is privately owned and operated.

2.5.4.1. Mohawk River Basin

There are 406.5 miles of railroad in the Mohawk River Basin, 61.6 miles of which are in the Canal operation influenced SFHA (Figure 23). The railroads belong to the Mohawk, Adirondack, and Northern Railroad Corporation (MHWA), the New York, Susquehanna and Western Railway Corporation (NYSW), the Oneida County IDA, Pan Am Southern LLC, Amtrak, Delaware and Hudson Railroad (DHR), General Electric Company, and CSX Transportation. Two CSX passenger stations and six freight stations (CSX – 3, Amtrak – 1, NYSW – 1, MHWA – 1) are within the Canal operation influenced SFHA.

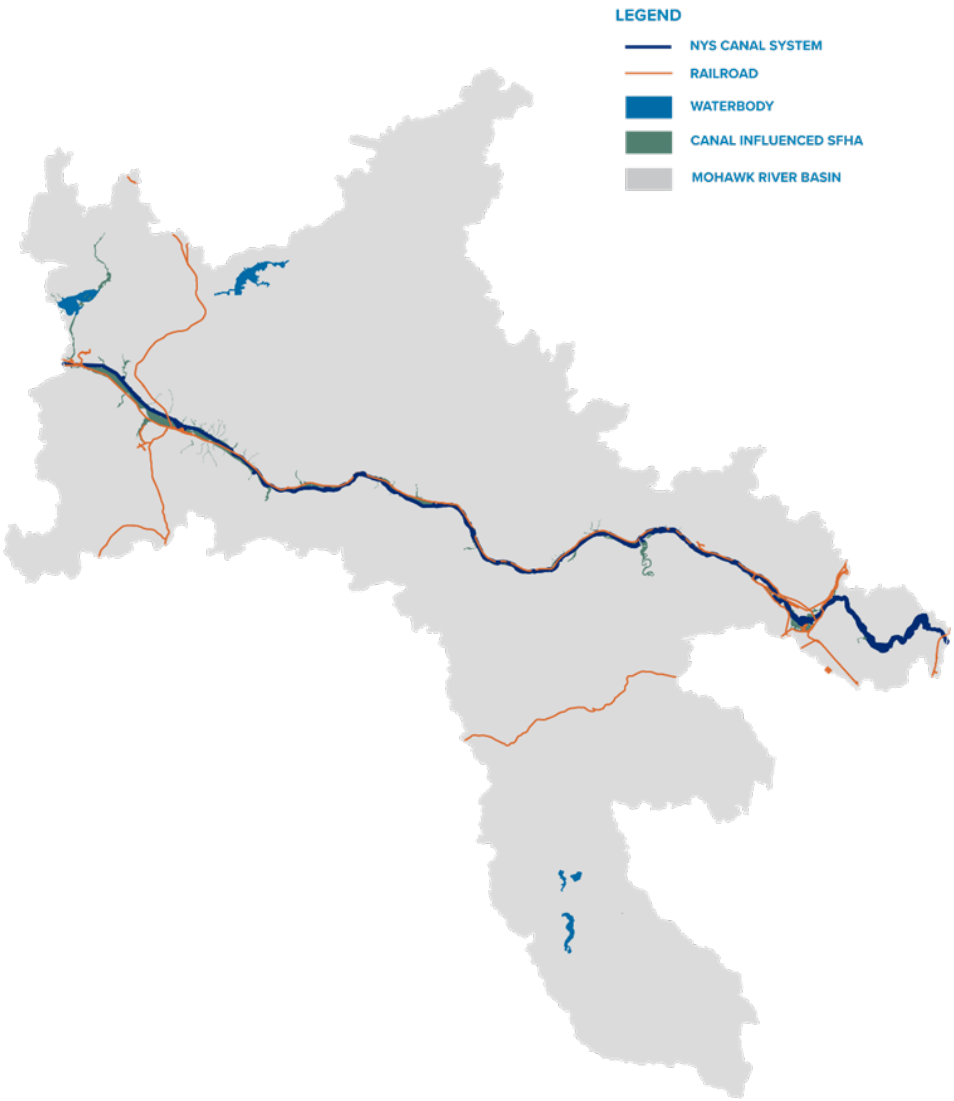


Figure 23: Railroad Infrastructure, Mohawk River Basin

2.5.4.2 Oswego River Basin

There are about 800 miles of railroad within the Oswego River Basin, of which approximately 92 miles are in the Canal operation influenced SFHA (Figure 24). The CSX Rochester Subdivision and Mohawk Subdivision railroads each run east-west running parallel to the Canal. There are three locations where the Rochester Subdivision railroad passes over the Canal. The CSX Baldwinsville Subdivision railroad runs to the west of the Oswego Canal, and the Fulton Subdivision railroad is east of the Oswego Canal, both running north-south and each with a bridge over the Oswego Canal at one location. The St Lawrence Subdivision railroad runs from Syracuse north, passing west of Oneida Lake over the Canal System. The CSX Auburn railroad line (Finger Lakes Railway) runs along the Cayuga Seneca (C&S) Canal and passes over the Canal once. There are also two railroad junctions in the Canal operation influenced SFHA, including the Chenango Junction and the Cayuga Junction.

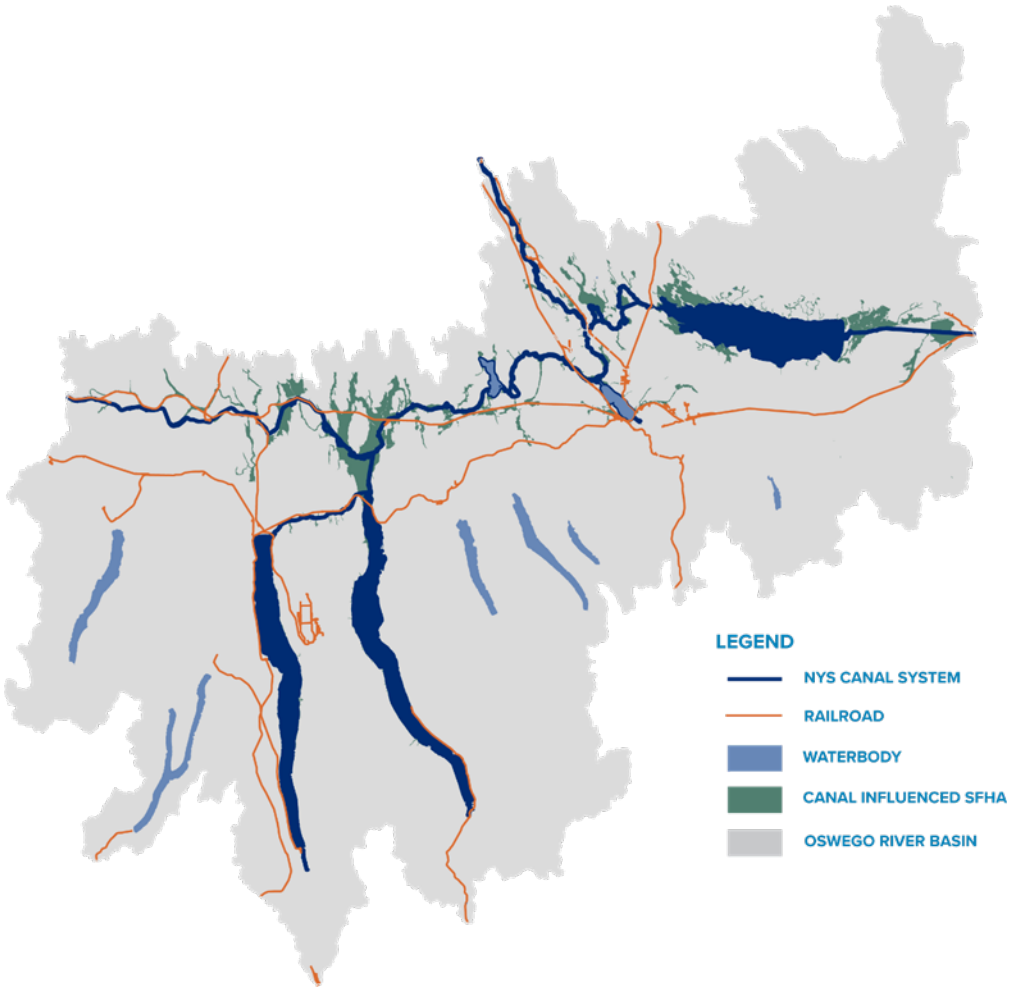


Figure 24: Railroad Infrastructure, Oswego River Basin

2.6. POWER GENERATION

2.6.1. Overview

The New York Canal System supports a significant amount of hydroelectric production. Generally, hydroelectric facilities are designed to withstand a major flooding/storm event due to their location adjacent to or within the river/canal channel so no significant loss due to storm events is anticipated. Additionally, hydroelectric facilities operate using the head differential between the upstream (intake) or impoundment to the downstream (discharge) or tailrace. During a major storm event, the head differential between upstream and downstream can be significantly reduced due to the increased flows over the adjacent dams causing the facilities to 'go off-line' and cease power generation. This is a known condition in the hydropower industry and is accounted for when new facilities are constructed, or existing facilities are transferred to new owners. The difference in lost hydroelectric generation would not be impacted appreciably by reasonable changes in Canal System operations or the modifications contemplated by this report.

2.6.2. Mohawk River Basin

Hydroelectric facilities are located on all sections of the Canal and immediately downstream a navigation support reservoir (Hinckley) within the Mohawk River Basin. Three are located on the Erie Canal, one on the Mohawk River, four on West Canada Creek, three on East Canada Creek, and one on Schoharie Creek. Table 9 provides a list of the known hydroelectric facilities and maximum output, and Figure 25 shows their location within the Mohawk River Basin.

Table 9: Hydropower Facilities in Mohawk River Basin

Lock, Reservoir, or Stream	FERC Project Number	Project Name	Licensee	Parent Company	Authorized Capacity (kilowatts)
West Canada Creek	P-3211	Hinckley (Gregory B. Jarvis)	New York Power Authority	NYPA	9,000
West Canada Creek	P-10445	Utica Water Line[1]	Utica	City of Utica	450
West Canada Creek	P-2701	West Canada Creek	Erie Boulevard Hydropower, L.P.	Brookfield	39,750
West Canada Creek	P-5196	Newport	Newport Hydro Associates	Eagle Creek	1,960
West Canada Creek	P-9709	Herkimer	Ecosponsible, LLC.	Ecosponsible	1,710
East Canada Creek	P-4008	Dolgeville	Eony Generation Limited	Eony	5,000
East Canada Creek	N/A[2]	Inghams	Erie Boulevard Hydropower, L.P.	Brookfield	6,000
East Canada Creek	N/A[2]	Beardslee	Erie Boulevard Hydropower, L.P.	Brookfield	20,000
E-17 (Mohawk River/ Erie Canal)	P-3509	Little Falls	Little Falls Hydroelectric Assoc	Eagle Creek	13,600
Schoharie Creek	P-2685	Blenheim Gilboa Pumped Storage	New York Power Authority	NYPA	1,160,000
E-7 (Mohawk River/ Erie Canal)	P-4679	Vischer Ferry	New York Power Authority	NYPA	11,800
E-6 (Mohawk River/ Erie Canal)	P-4678	Crescent	New York Power Authority	NYPA	11,800
D/S of E-6 (Mohawk River)	P-2539	School Street[3]	Erie Boulevard Hydropower, L.P.	Brookfield	38,800
D/S of E-6 (Mohawk River)	P-3605	Mohawk Paper Mills Inc [4]	Adirondack Hydro-Fourth Branch, LLC.	Albany Engineering Corporation	3,350
D/S of E-6 (Mohawk River)	P-7481	New York State Dam [4]	Nysd Ltd Partnership	Boralex	10,830

Notes:
1. Domestic Raw Water Line
2. NYSDEC Regulated
3. At Cohoes Falls
4. Downstream of Cohoes Falls

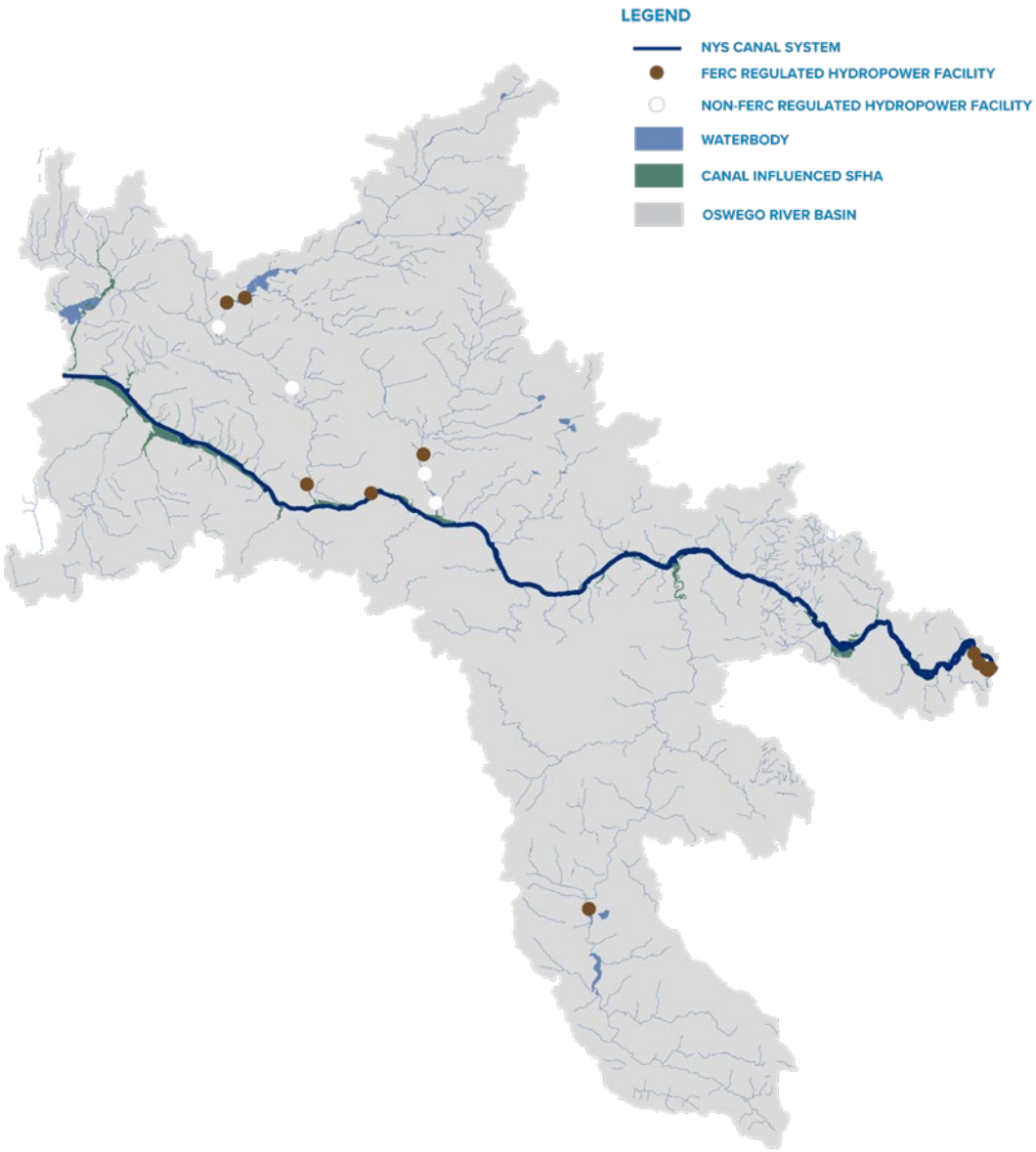


Figure 25: Hydropower Facilities, Mohawk River Basin

2.6.3. Oswego River Basin

The Oswego River Basin contains several hydroelectric facilities with two located on the Cayuga Seneca Canal, two on the Erie Canal/Seneca River, and seven on the Oswego Canal/Oswego River. Table 10 provides a list of the known hydroelectric facilities and maximum output and Figure 26 shows their location within the Oswego River Basin.

Table 10: Hydropower Facilities in Oswego River Basin

Lock, Reservoir, or Stream	FERC Project Number	Project Name	Licensee	Parent Company	Authorized Capacity (kilowatt
CS-2 and CS-3 & 4 (C-S Canal/Seneca River)	P-2438	Waterloo & Seneca Falls	C-S Canal Hydro, LLC.	Gravity Renewables	7,440
Owasco Lake Outlet	P-4372	Mill Street Dam	Auburn	City of Auburn	410
Owasco Lake Outlet	P-8949	North Division Street	Auburn	City of Auburn	750
E-24 (Erie Canal/Seneca River)	P-4296	Seneca	Northline Energy, LLC.	Northline	950
E-24 (Erie Canal/Seneca River)	P-5217	Baldwinsville	Erie Boulevard Hydropower, L.p.	Brookfield	640
O-1 (Oswego Canal/River)	P-4113	Phoenix	Oswego Hydro Partners L P	Eagle Creek	3,180
O-2 (Oswego Canal/River)	P-5984	Oswego Falls	Erie Boulevard Hydropower, L.p.	Brookfield	7,360
O-3 (Oswego Canal/River)	P-2837	Granby	Erie Boulevard Hydropower, L.p.	Brookfield	10,080
O-3, 5, 7 (Oswego Canal/River)	P-2474	Oswego River	Erie Boulevard Hydropower, L.p.	Brookfield	17,368
O-6 (Oswego Canal/River)	P-10551	High Dam	City of Oswego	City of Oswego	10,192

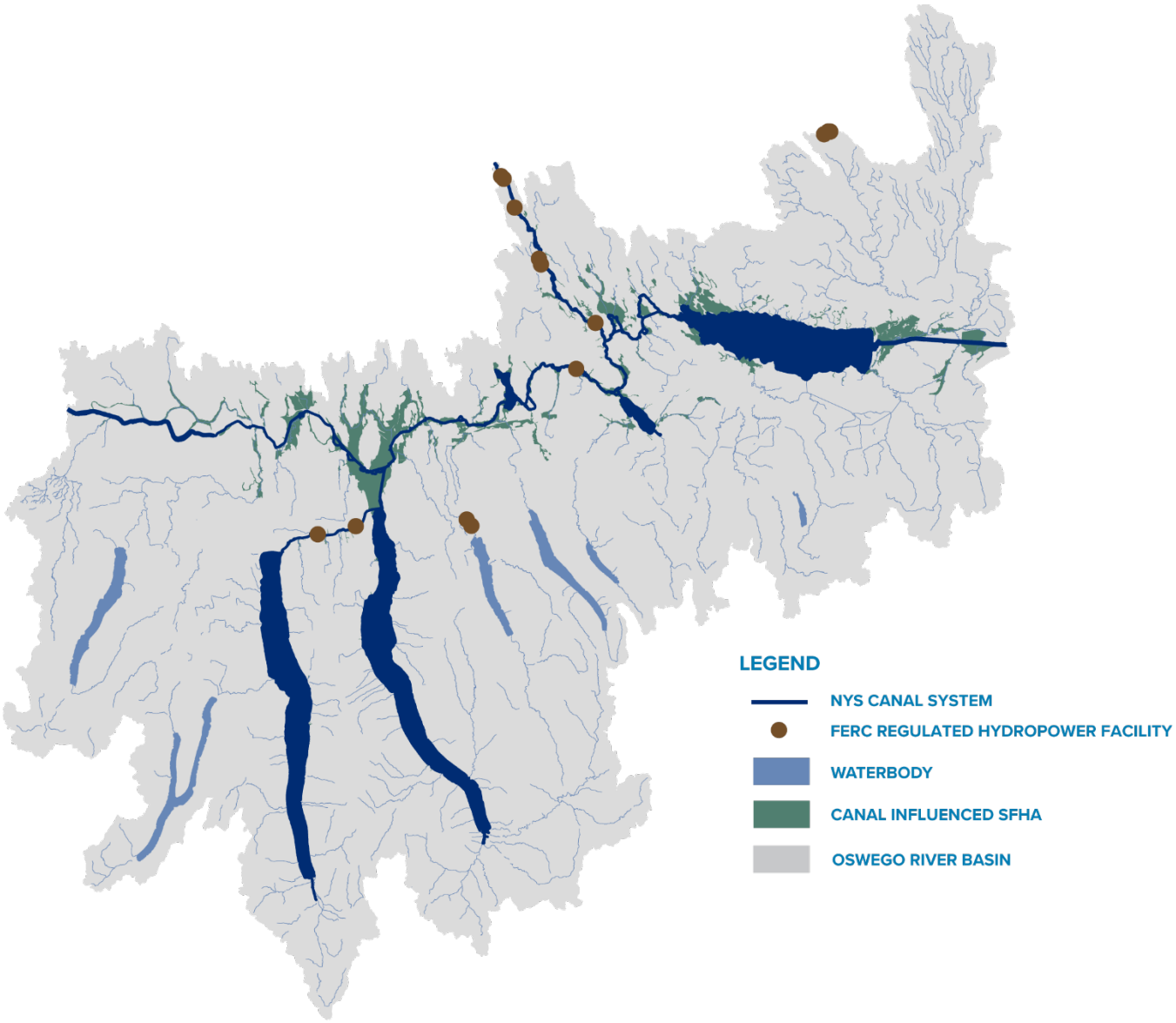


Figure 26: Hydropower Facilities, Oswego River Basin

2.7. PUBLIC HEALTH AND CRITICAL FACILITIES

2.7.1 Overview

Diminished water quality impacts the riverine, lake, and bifurcated Canal portions of the Oswego and Mohawk River Basins. Point and nonpoint source pollution generally arise from municipal, residential, industrial and agricultural sources. Point-sources of pollution are regulated by state and federal agencies. Stormwater outfalls in larger population communities are included in the Municipal Separate Storm Sewer System (MS4) program and are managed by municipalities with the overall program regulated and administered by NYSDEC. Both municipal and industrial facilities require permitting from NYSDEC under the State Pollution Discharge Elimination System (SPDES)

program. The SPDES permits have regulatory limits; typically including maximum pollutant load and/or concentrations of Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), nitrogen and phosphorus.

MS4 operators are required to implement a stormwater management program (SWMP), which includes control measures ("Six Minimum Control Measures") and utilizes Best Management Practices (BMPs). They are also required to develop and implement a Long-Term Control Plan (LTCP) that identifies solutions to reduce CSO impacts or eliminate CSO. Combined storm/sanitary sewers (CSO's) carry industrial and sanitary wastewater and stormwater in a single system. Characteristic of older cities, the combined sewers include relief points, CSOs, to direct the discharge into waterways when the pipe capacity is exceeded; generally caused by precipitation events. This mixture of untreated wastewater and stormwater often contains elevated concentrations of bacteria, nutrients, and solids. As required by the SPDES permits, each CSO community must submit a CSO Annual Report to DEC and comply with fifteen CSO Best Management Practices (BMPs).

Grants may be available to offset the costs of CSO improvements, such as the Water Quality Improvement Project (WQIP) program, NYS DEC/EFC Wastewater Infrastructure Engineering Planning Grant (EPG), and the NYS Water Infrastructure Improvement Act (WIIA) grant program.

Pollution can impact public health if discharges exceed regulatory limits of the SPDES permits for industrial and municipal wastewater treatment plants. In addition, sources such as Combined Sewer Overflows (CSOs) affect public health due to increased pollution levels and public perception of water quality and suitability for recreational use, especially after rainfall events. High water levels and runoff from contaminated sites can also lead to water quality and volume impacts on water wells, and further, affect access to clean water.

2.7.1.1 Mohawk River Basin

The NYSDEC *Mohawk River Basin Action Agenda 2021-2026* noted many pollutants have decreased in the Mohawk River Basin over the past 30 years, but the trend has plateaued in recent years. Since 2015, Riverkeeper, SUNY Cobleskill, SUNY Polytechnic Institute and Union College have collaborated on a water quality monitoring project at 40 sites in the Mohawk River Basin. The data indicate that water quality is often worse after rain events, as direct runoff from the watershed and overflows from combined sewers or other infrastructure degrade water quality. From 2017-2022, a total of six public assistance claims through FEMA (five in Oneida County and one in Herkimer County) were filed under, "D – Water Control Facilities," resulting in about $2.3 million in projects to repair damages.

NYSDEC records show that there are 72 industrial wastewater treatment plants and 43 municipal wastewater treatment plants operating with NYS SPDES permits in the Mohawk River Basin. NYSDEC publishes a statewide map of CSOs which shows the highest numbers of CSO discharges within the Mohawk River Basin are in the City of Utica (47 CSOs). Other CSOs include three in Little Falls, three in Amsterdam, and two in Waterford. The majority of tributaries do not receive discharges from a CSO outside of Utica.

At the recent *Mohawk River Symposium*[6], March 17, 2023, several speakers noted the variations in water quality due to CSOs and other sources in the Mohawk River and tributaries. Law et al. have conducted sampling during navigation season since 2015 for Fecal Indicator Bacteria (FIB) at 40 sites along the Mohawk River and found most sites would not meet EPA-recommended safe swimming criteria on occasion. Potential FIB sources include CSOs, wastewater discharges without disinfection, septic system failures, surface water and agricultural runoff.

According to the *Mohawk River Symposium*, March 17, 2023, Rodak et al., sampled for FIB in the Mohawk River near Rome and Utica and found Mohawk River near Utica are not currently appropriate for in-water recreation due to elevated FIB concentrations. As part of the *Mohawk River Symposium* Garver et al., sampled for FIB in a small urban

[6] Garver, J.I., Smith, J.A., and Rodak, C. 2023. Proceedings of the 2023 Mohawk Watershed Symposium, Union College, Schenectady, NY, March 17, 2023, Volume 13, 82 pages.

creek in Schenectady and found 100% of samples exceeded EPA recommendations for recreational contact. Additionally, they found FIB concentrations increased dramatically after rainfall events, possibly indicating overflows from aging and deteriorated sanitary sewer systems/piping. A total of eight public assistance claims were filed with FEMA under, "F – Public Utilities," resulting in approximately $4.5 million in projects for sewer lines, pump stations, sewer plants, and utility repairs between 2017-2022. All eight projects were in Herkimer and Oneida flood mitigation counties.

Out of 4,142 wells in the Mohawk River Basin, there are a total of 24 water wells in the Canal Influenced SFHA. The water level of the Canal System can impact the water levels within the well systems during the navigation season, and runoff from precipitation events can cause contaminated materials to enter well systems, impacting water quality and individual access to clean water.

2.7.1.2 Oswego River Basin

Water quality concerns in the Oswego River Basin include legacy Industrial discharges in Syracuse/Onondaga Lake area, municipal wastewater and CSOs in Syracuse and other urban areas, agricultural and other nonpoint sources, as well as protection of drinking water sources. From 2017-2022, a total of six FEMA PA Program claims were filed under, "D – Water Control Facilities," resulting in approximately $2.2 million in projects to repair damages.

NYSDEC records identify 122 industrial wastewater treatment plants and 71 municipal wastewater treatment plants with NYS SPDES permits in the Oswego River Basin. NYSDEC CSO mapping for the Oswego River Basin consists of 10 in Auburn, 46 in and around Syracuse, and one in Canastota. A total of 13 FEMA PA Program claims were filed with FEMA under, "F – Public Utilities," resulting in $1.9 million in projects for sewer lines, pump stations, sewer plants, and utility repairs between 2017-2022. These projects took place in Cayuga, Oneida, Oswego, Schuyler, and Seneca flood mitigation regions.

Out of 12,124 wells in the Oswego River Basin, there are a total of 167 wells in the Canal Influenced SFHA. The water level of the Canal System can impact the water levels within the well systems during the navigation season, and runoff from precipitation events can cause contaminated materials to enter well systems, impacting water quality and individual access to clean water.

2.7.2 Critical Facilities & Emergency Response

According to the New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act (CRRA) of August 2020, critical facilities include the following:

- Facilities designed for bulk storage of chemicals, petrochemicals, hazardous or toxic substances or floatable materials
- Hospitals, rest homes, correctional facilities, dormitories, patient care facilities
- Major power generation, transmission or substation facilities, except for hydroelectric facilities
- Major communications centers, such as civil defense centers
- Major emergency service facilities, such as central fire and police stations

The Management Guidance and Implementation report recommends that in order to prevent potential flood damage to certain facilities that would result in serious danger to life and health, or widespread social or economic dislocation, no new projects to install critical facilities shall be undertaken within any flood hazard area. However, there are several critical facilities that exist within the Canal operation influenced SFHA, and some have experienced damage in the last five years. There are 2,417 critical facilities in the Mohawk River Basin and 4,107 critical facilities in the Oswego River Basin (Table 11). Approximately 40% of the critical facilities in the Mohawk River Basin flood mitigation regions are in the Canal operation influenced SFHA, and approximately 20% of the critical facilities in the Oswego River Basin flood mitigation regions are in the Canal operation influenced SFHA.

Table 11: Critical Facilities, Both River Basins

Basin	Critical Facilities Basin-wide	Critical Facilities in the FMRs	Critical Facilities in the Canal operation influenced SFHA
Mohawk	2,417	872	339
Oswego	4,107	3,800	793
Total	6,524	4,672	1,132

FEMA Category B, Emergency Protective Measures, claims can be used to estimate the potential damages sustained in emergency work by each flood mitigation region, including those to critical facilities. Emergency protective measures are described by FEMA as, "before, during, and after a disaster to save lives, protect public health and safety, and prevent damage to improved public health and safety, and prevent damage to improved public and private property. Generally, those prudent actions taken by a community to warn residents, reduce the disaster damages, ensure the continuation of essential public services, and protect lives and public health or safety."

2.7.2.1 Mohawk River Basin

A total of 47 FEMA PA Program claims were made to FEMA under "B – Protective Measures," totaling approximately $1.9 million between 2017-2022. Oneida County had the highest number of claims, but Herkimer, Montgomery, and Saratoga counties also received project assistance for damages sustained. Please refer to Public Health and Critical Facilities (Figure 27).

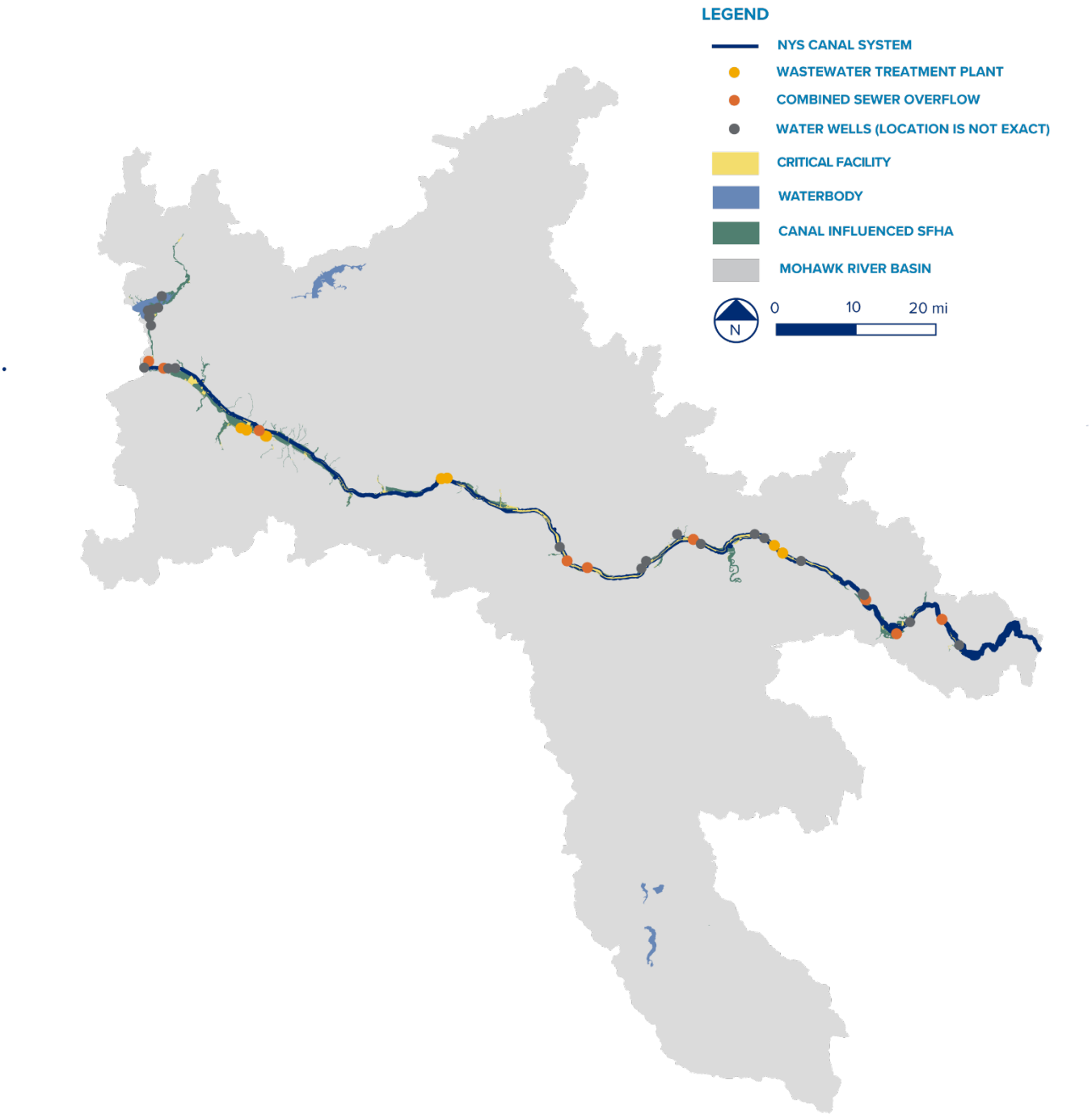


Figure 27: Public Health and Critical Facilities, Mohawk River Basin

2.7.2.2 Oswego River Basin

A total of 60 FEMA PA Program claims were made to FEMA under "B – Protective Measures," totaling nearly $2.1 million between 2017-2021. Oneida County received the highest values in claims, but all other flood mitigation counties received project assistance for damages sustained. Please refer to Public Health and Critical Facilities (Figure 28).

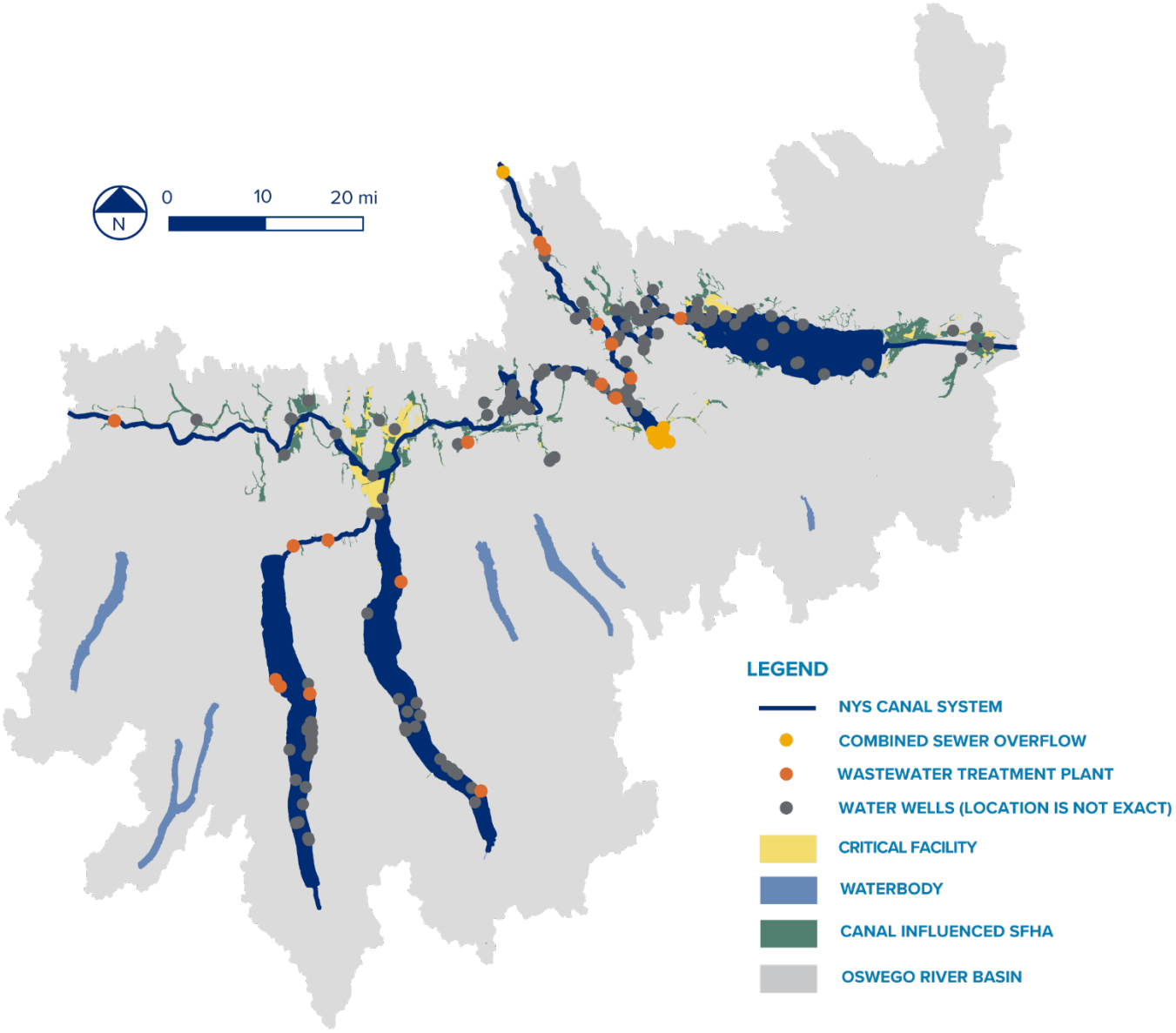


Figure 28: Public Health and Critical Facilities, Oswego River Basin

3.0 Assessment of Erie Canal Operations and Flood Management

3.1. MOHAWK RIVER BASIN CHARACTERISTICS

The Mohawk River Basin drainage area covers approximately 3,460 square miles from Central New York to the Capital Region. The total length of the Mohawk River from its headwaters in the Adirondack Foothills to its confluence with the Hudson River is 155 miles. The Erie Canal is collocated with or runs parallel to the Mohawk River, beginning 6.5 miles downstream from Delta Dam, where the Mohawk River joins the Erie Canal at Rome to Erie Canal Lock E-6 (Crescent Dam) at the upper end of the Waterford flight of locks. This section of the Mohawk River flows 130 miles southeast through the cities of Rome, Utica, Little Falls, Amsterdam, and Schenectady, experiencing a 300-foot elevation change, with an average gradient of 2.3 feet per mile. The dominant land covers are forest (58%), agriculture (23%), wetlands (7%), and developed open space, which is less than 20% impervious area. Figure 29 is a schematic diagram of the Mohawk River Basin.

The Erie Canal and Mohawk River between Rome and Erie Canal Lock E-6 at Crescent Dam stretches a distance of 130 miles along the Canal and alternates between being bifurcated and collocated eight times. The Mohawk River and Erie Canal are bifurcated for a total of 32 miles and collocated for a total of 98 miles. From Rome to Frankfort Harbor, 3.5 miles downstream of Erie Canal Lock E-19, the Canal and Mohawk River are bifurcated, with the Mohawk River occupying the south side of the valley. From Frankfort Harbor to Movable Dam MD 14 (Herkimer) the Canal and Mohawk River are collocated. From Movable Dam MD 14 to Erie Canal Lock E-18 (Jacksonburg) they are bifurcated, with the Mohawk River occupying the north side of the valley with West Canada Creek entering the Mohawk River in this reach. Between Erie Canal Lock E-18 and immediately upstream of Little Falls they are collocated, before bifurcating again before re-joining at the lower end of Erie Canal Lock E-17 (Little Falls). Between the lower end of Erie Canal Lock E-17 and Movable Dam MD 12 (Rocky Rift) they are collocated. Between Movable Dam MD 12 (Rocky Rift) and Erie Canal Lock-E-16 (St. Johnsville) the Canal and Mohawk River are bifurcated with the Mohawk River occupying the north side of the valley. East Canada Creek enters the Mohawk River and Nowadaga Creek enters the Canal in this reach. The Canal and Mohawk River rejoin immediately downstream of Erie Canal Lock E-16 (St. Johnsville) and remain collocated to Guard Gate 2 upstream of Erie Canal Lock E-6 (Crescent Dam). Downstream of Crescent Dam, the Mohawk River steepens and is non-navigable, requiring vessels navigating the Erie Canal to or from the Hudson River to travel through the Waterford flight of locks that raise or lower the navigation pool 169 feet in 1.5 miles between Erie Canal Locks E-6 and E-2 (Hudson River), upstream of the Troy Federal Lock.

The Mohawk River has a significant number of tributaries (over 70) with the majority having significant gradients well in excess of the 2.3 feet per mile on the Mohawk River from Rome to Erie Canal Lock E-6 (Crescent). Please refer to the Basin Schematic Diagram (Figure 26) for the approximate locations of the major and minor tributaries and reservoirs discussed. There are four major tributaries that individually contribute 4% or more, and collectively contribute 55% of the Mohawk River watershed area. From upstream to downstream, they include Oriskany, West Canada, East Canada, and Schoharie Creeks. There are 11 minor tributaries (shown on Figure 29) that individually contribute 1 to 3%, and collectively contribute 14% of the Mohawk River watershed area, from upstream to downstream, include Nine Mile, Sauquoit, Moyer, Steele, Fulmer, Nowadaga, Caroga, Otsquago, Canajoharie, and North Chuctununda Creeks and the Alplaus Kill. It should also be noted there are approximately 55 additional Mohawk River tributaries not individually listed or shown in Figure 29. Four significant reservoirs are located within the Mohawk River Basin, including Delta Reservoir (Mohawk River), Hinkley Reservoir (West Canada Creek), Schoharie Reservoir (Schoharie Creek), and Blenheim-Gilboa Lower Reservoir (Schoharie Creek).

Tributary flows into the Mohawk River are generally uncontrolled with no reservoir in the watershed designed for flood control. The upper reaches of the Mohawk River flow into Delta Reservoir, north of Rome, which was designed and constructed to provide supplemental base flow to the Canal during navigation season. To ensure the flow is available, the reservoir is kept full (at spillway crest) as inflows allow during navigation season to provide the in-

stream minimum flow to the Mohawk River and the Canal's Summit Section and to support fisheries. This prevents use of the reservoir for flood mitigation/storage during the navigation season. The reservoir is lowered after navigation season to provide some flood storage for the spring freshet/snow melt. Hinckley Reservoir is located on West Canada Creek, roughly 25 miles upstream of its confluence with the Mohawk. Hinkley Reservoir was also designed and constructed to provide supplemental flow to the Canal. It serves as the City of Utica's main domestic water supply and five Federal Energy Regulatory Commission (FERC) licensed hydroelectric facilities are located on West Canada Creek between Hinkley Reservoir and the Mohawk River. The remaining two reservoirs, Schoharie and Blenheim-Gilboa Lower, are located on Schoharie Creek approximately 40 miles upstream of the Mohawk River. Schoharie Reservoir was constructed as a water supply reservoir for New York City and the Blenheim-Gilboa Lower Reservoir was constructed as the lower/source reservoir for the Blenheim-Gilboa Pumped Storage Hydroelectric Project currently licensed to NYPA by FERC. Neither reservoir has significant flood storage capacity, and neither was designed for flood mitigation.

The remaining Mohawk River tributaries do not have significant reservoirs other than East Canada Creek which supports three hydroelectric facilities. Some tributaries have small dams near their confluence with the Mohawk River which contain no appreciable water storage capacity.

Schematic Diagram

Mohawk River Basin

LEGEND

DRAINAGE AREA X (Y%) - drainage area in **X** square miles and Y% of Mohawk River Basin drainage area
DISCHARGE CAPACITY - spillway capacity in **Z** cfs
RIVER - flows from lake to canal, see legend above
CANAL - numbers indicate the elevations of canal segments, in feet
(E-#, MD #) - numbers indicate the Erie Canal lock number and movable dam number

Note: Mohawk River Basin drainage area at the Hudson River is 3,460 square miles.

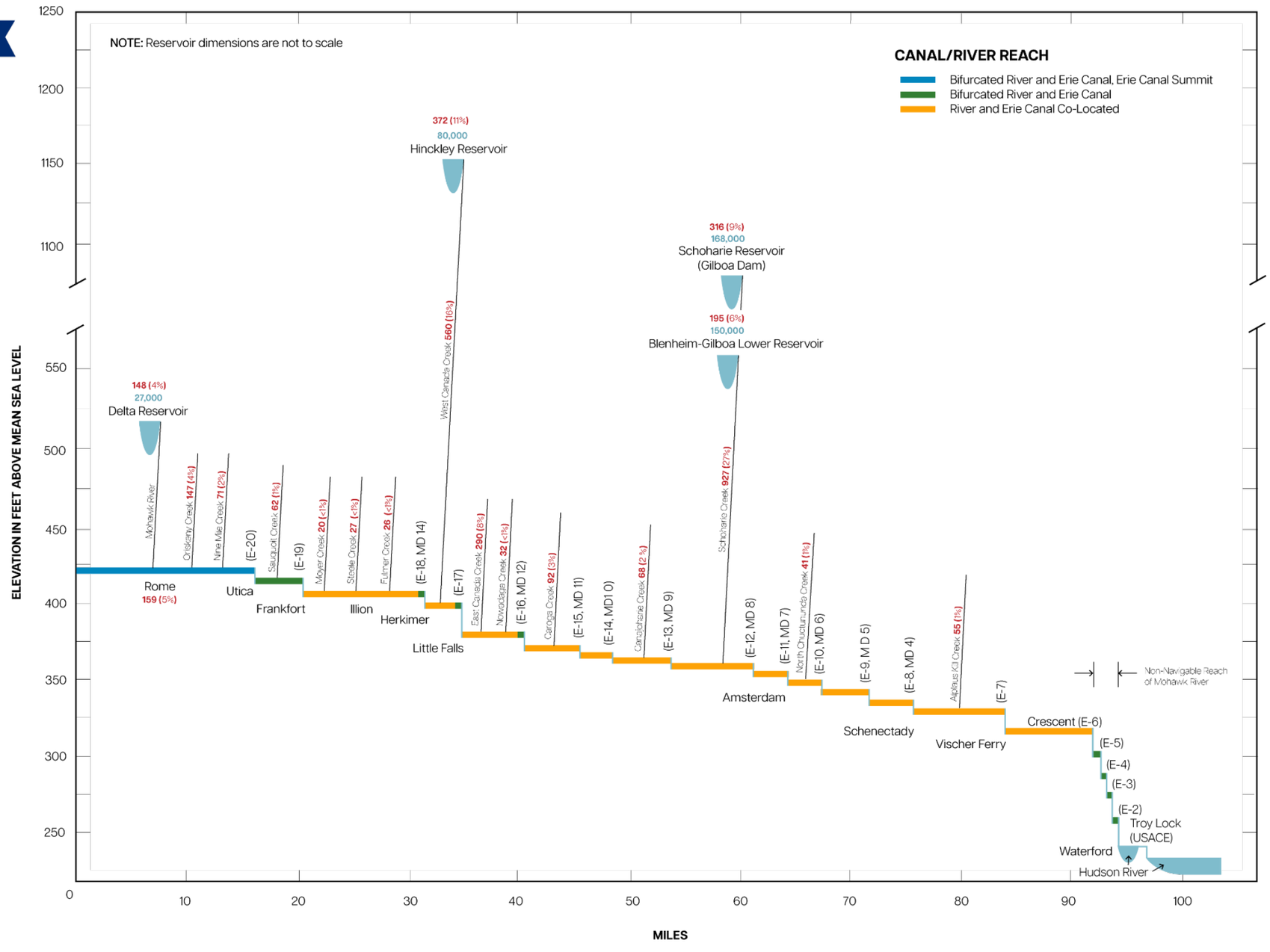


Figure 29: Mohawk River Basin Schematic Profile

3.2 CHARACTERIZATION OF MOHAWK RIVER BASIN FLOODING

In the Mohawk River Basin, peak daily flows range from five (5) to 890 times the monthly average discharge in a subbasin. Seasonality is a key contributor toward variations in discharge and flow events. High flows often occur in the springtime, coinciding with snowmelt and precipitation. Mohawk River storm events produce fast rising and fast receding events lasting one to three days. This is due to the Mohawk River Basin containing little off-channel storage and most tributaries as well as the Mohawk River itself having a steep gradient. Refer to Figure 30 for a depiction of monthly average and daily peak flows for the Mohawk River Basin. The data collected and displayed in this figure contains both recent and historic information and includes the years 1927 to 2022 at Little Falls, 1939 to 2022 at Burtonsville, and 1925 to 2022 at Cohoes.

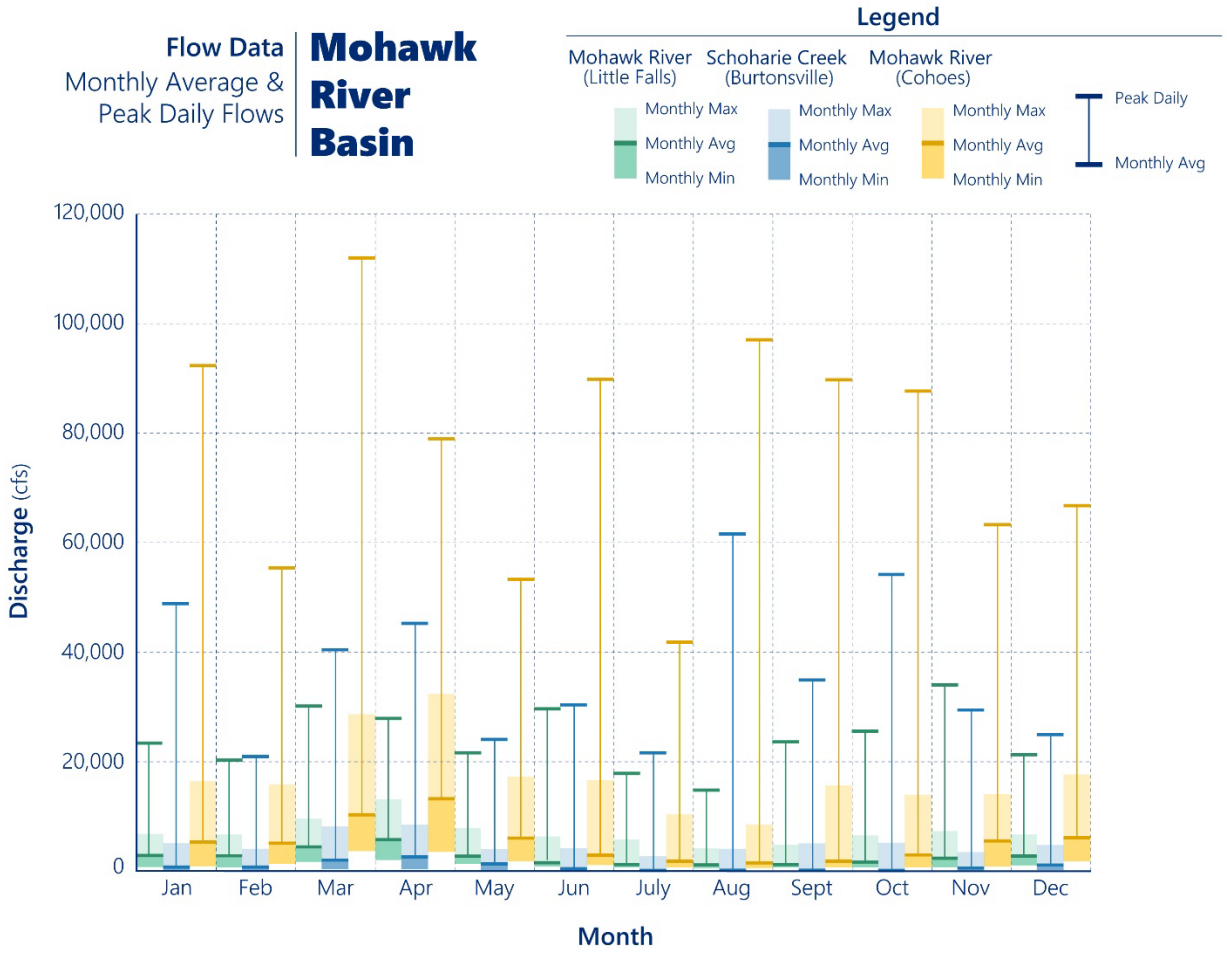
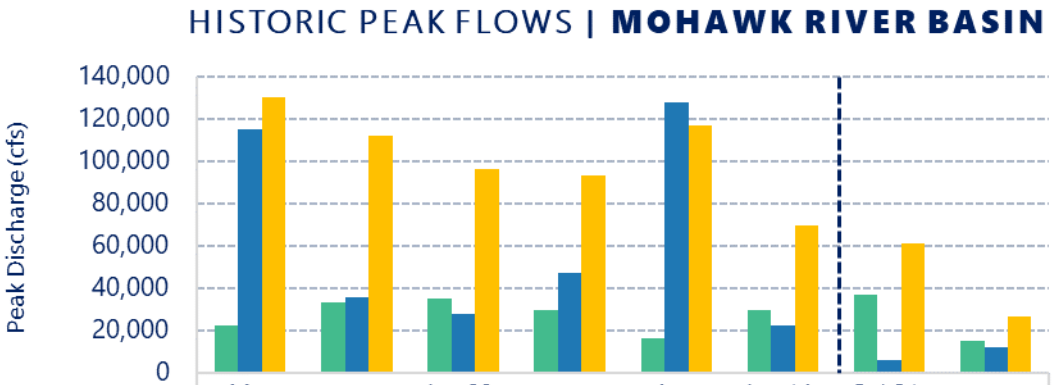


Figure 30: Monthly Flow Data, Mohawk River Basin

3.3 MOHAWK RIVER BASIN RECENT FLOOD HISTORY

From 2017 – 2022, there were two significant flow events within the Mohawk River Basin. A peak flow event occurred on October 31-November 1, 2019, with significant flows from West Canada Creek (Halloween Storm). A second event occurred on August 18, 2021, with significant flows from the Upper Mohawk Sub-Basin tributary to Delta Reservoir. These events are compared to other historic flood events at three locations within the watershed in Figure 31.



	1	2	3	4A	4B	5	6	7
USGS 01347000 MOHAWK RIVER NEAR LITTLE FALLS NY Streamflow (cfs)	22,400	33,100	35,000	29,800	16,300	29,900	36,900	15,200
USGS 01351500 SCHOHARIE CREEK AT BURTONSVILLE NY Streamflow (cfs)	115,024	35,500	28,100	47,400	128,000	22,200	5,950	12,400
USGS 01357500 MOHAWK RIVER AT COHOES NY Streamflow (cfs)	130,000	112,000	96,400	93,300	117,000	69,800	60,900	26,500

Figure 31: Historic Peak Flows, Mohawk River Basin

The 2019 Halloween storm event (October 31 - November 1, 2019), occurred due to heavy rainfall over the West Canada Creek Sub-Basin. The storm caused the flood of record at USGS Gage 01346000, West Canada Creek at Kast Bridge (27,500 cfs), and at USGS Gage 01347000, Mohawk River at Little Falls (36,900 cfs). In contrast the mean daily flow for this date is less than 900 cfs at West Canada Creek and 1800 cfs at Little Falls. These peak flows were equivalent to a 500-year recurrence interval (0.2% annual probability) at both locations. Yet, the peak flow on Schoharie Creek (USGS 01351500) was only half of a 1.25-year recurrence event (80% annual probability) and the peak flow on the Mohawk River at Cohoes (USGS 01357500) was a 2-year recurrence event (50% annual probability). The movable dams at Erie Canal Locks E-15 through E-8 were raised in anticipation of the flooding, which prevented flooding of the New York State Thruway and parts of Canajoharie and Fort Plain. However, there was a delay in removing some of the movable dams. At Erie Canal Lock E-12, the delay in raising the gates of Movable Dam MD 8 caused an estimated $1 million in Canal infrastructure damage and debris cleanup. Additionally, at Hinckley Reservoir, NYPA deviated from the rule curve and reduced outflow to zero to reduce downstream flooding which raised the reservoir water surface to elevation 1230.8 which is almost 6 feet above the spillway crest elevation. By allowing water to accumulate within the reservoir, downstream flooding impacts were reduced.

The storm event of August 18, 2021 was concentrated in the Upper Mohawk Sub-Basin, upstream of Delta Reservoir. Peak flow at USGS Gage 01336000 Mohawk River below Delta Dam was 8,100 cfs. In contrast the mean daily flow for this date is 250 cfs below Delta Reservoir. The August 18 event was the flood of record, comparable to a 100-year recurrence interval event (0.1% annual probability). The flood peaks at West Canada Creek at Kast Bridge (USGS 01346000) and the Mohawk River at Little Falls (USGS 01347000) were less than 2-year recurrence interval (50% annual probability) events. All movable dams were removed for this flood event with no delay in accordance with NYSCC movable dam lifting procedures and no damage to Canal infrastructure was sustained.

3.4 MOHAWK RIVER BASIN FLOOD MANAGEMENT OPERATIONS DURING RECENT FLOODS

3.4.1. Control Points

NYSCC is responsible for operating the Erie Canal in the Mohawk River Basin but does not have operational control of all water control structures that have the potential to reduce flooding. This document defines operational control as any operator's ability to regulate, start or stop water flow at a water control structure by means of adjustable gates, valves, hydroelectric turbines or spillway gates. The degree and timing of control is typically governed by operating procedures, FERC or NYSDEC requirements, or reservoir rule curves in the case of lakes and reservoirs. Locations where NYSCC has operational control of water control structures that have the potential to be operated to reduce flooding include:

- Movable dams MD 4 through MD 11, adjacent to Erie Canal Locks E-8 through E-15
- Movable Dam MD 12 at Rocky Rift
- Hinged crest gates and Movable Dam MD 14 associated with Erie Canal Lock E-18
- Nine Mile Feeder Dam
- Utica Harbor Dam
- Guard Gates 1 through 7
- Delta Dam

Water control structures owned and/or operated by other entities that the NYSCC consults with:

- Hinckley Reservoir and the Jarvis hydroelectric project in coordination with NYPA and Brookfield Power.
- Blenheim-Gilboa Lower Reservoir, owned and operated by NYPA (Note: The Blenheim-Gilboa Hydroelectric Facility also includes the off-stream Upper Reservoir.)
- Vischer Ferry Dam regulated through the NYPA Vischer Ferry Hydroelectric Project.
- Crescent Dam regulated through the NYPA Crescent Hydroelectric Project.

Water control structures owned and/or operated by other entities that do not currently consult with the NYSCC:

- Schoharie Reservoir, owned and operated by New York City Department of Environmental Protection (NYCDEP).
- Hydroelectric projects on West Canada Creek further downstream of the Jarvis project at Hinckley Reservoir Dam. These include: Prospect, Trenton Newport and Herkimer. These hydroelectric facilities are privately owned and operated and do not currently consult with NYSCC prior to water releases.
- Hydroelectric projects on East Canada Creek include Dolgeville in the Village of Dolgeville, Inghams, and Beardslee located downstream. All are privately owned and operated and not currently required to consult with NYSCC prior to water releases.

The NYSCC has retained remnants of former, historic canal systems from the Old Erie, Chenango and Black River Canals. These remnant systems have no potential to be operated to reduce flooding, thus they cannot be considered control points. They include:

- Northern Reservoir System – This system draws water from the upper reaches of the upper Black River Basin and diverts it to the Mohawk River Basin at Forestport, NY. NYSCC reservoirs include North Lake, South Lake, Alder Creek, Woodhull, and the Forestport Reservoir. Ownership of the Sand Lake Reservoir was transferred from NYSCC to NYSDEC in 2018. The Forestport Feeder Canal begins at Forestport Reservoir and discharges to the summit section of the former Black River Canal at Boonville, where it flows south into the Lansing Kill and then the Mohawk River at Hillside, NY, 4 miles upstream of Delta Reservoir.

- Southern (East) Reservoir System – This system includes remnants of the former Chenango Canal, several feeders and Leland Pond, Madison, and Eaton Brook Reservoirs. The Southern (East) Reservoir system conveys water to Oriskany Creek, which flows north to the Village of Oriskany where it joins the Mohawk River west of Erie Canal Lock E-20, where the river and Canal are bifurcated.

Control points where NYSCC has operational control of water control structures are shown in Figure 32.

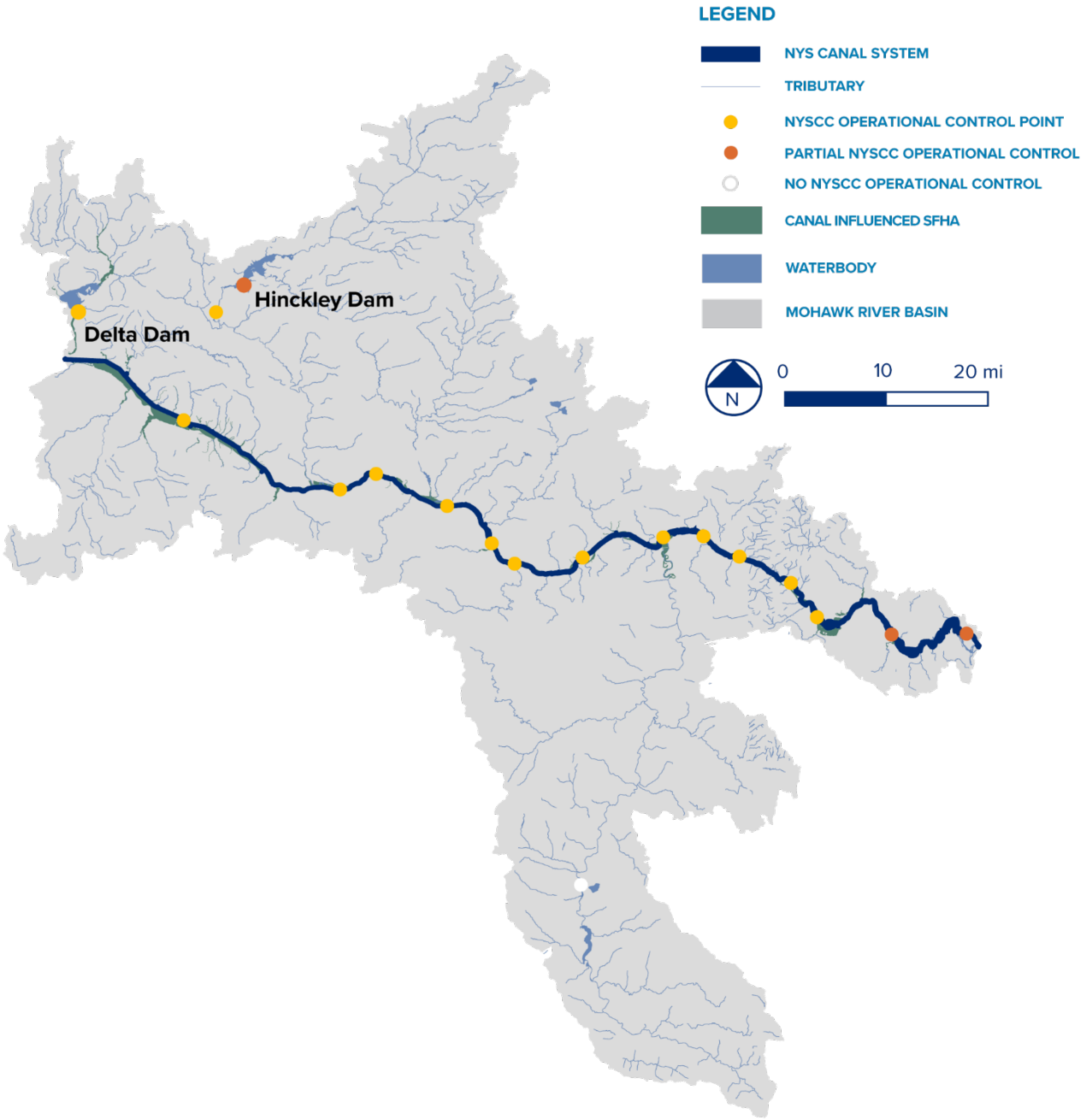


Figure 32: Control Points in the Mohawk River Basin

Each control point is discussed in further detail below.

- **Movable dams MD 4 through MD 11** are adjacent to navigation locks, beginning with Movable Dam MD 4 at Erie Canal Lock E-8 (Scotia) and extending west to Movable Dam MD 11 at Erie Canal Lock E-15 (Fort Plain). They were constructed as part of the Barge Canal expansion in 1918 to canalize the Mohawk River by creating level pools for navigation. They consist of upper and lower gate panels that can be lowered into the river along frames (uprights) which may also be raised and lowered from overhead steel bridge superstructures (trusses) during the navigation season. The lower and upper gates and uprights are operated by "mules" – traveling hoists – that move along rails supported on the truss floor beams. The structures at Movable dams 5 and 8 also support public roadways. Figure 33 depicts a typical section of a movable dam in both the lowered and fully raised position. During the navigation season when flood conditions are anticipated, upper and lower gates and uprights are to be fully raised as specified in *Movable Dam Lifting Procedure* (K118-EMP-0006). This procedure was implemented in 2018 and has resulted in significantly reduced flood levels upstream of these dams and significantly reduced damage to Canal infrastructure from collection of woody debris on the movable dam gates and uprights. When the movable dams are raised, the effect is to lower the upstream water level as these obstructions are removed from the river. During the non-navigation season, the lower and upper gates and uprights are fully raised.

- **Movable Dam MD 12 at Rocky Rift** is located 5 miles upstream of Erie Canal Lock E-16 (St. Johnsville). At Movable Dam MD 12 the Mohawk River and the Canal diverge, and this separate alignment continues until they rejoin downstream of Erie Canal Lock E-16. Like the other movable dams, Movable Dam MD 12 was constructed as part of the Barge Canal expansion in 1918.

- **Hinged Crest Gates and Movable Dam MD 14** are located at Herkimer, 4.5 miles upstream of Erie Canal Lock E-18 (Jacksonburg). At Movable Dam MD 14 and the crest gates, the Mohawk River and the Canal diverge, and this separate alignment continues until they rejoin downstream of Erie Canal Lock E-18. Like the other movable dams, Movable Dam MD 14 was constructed as part of the Barge Canal expansion in 1918. Where the river and Canal diverge, Movable Dam MD 14 is at the left (north) bank of the river. The adjacent 170 ft long Herkimer Dam with hinged crest gate continues south to an island. Guard Gate 5 extends south from the island across the Canal entrance to the right bank.

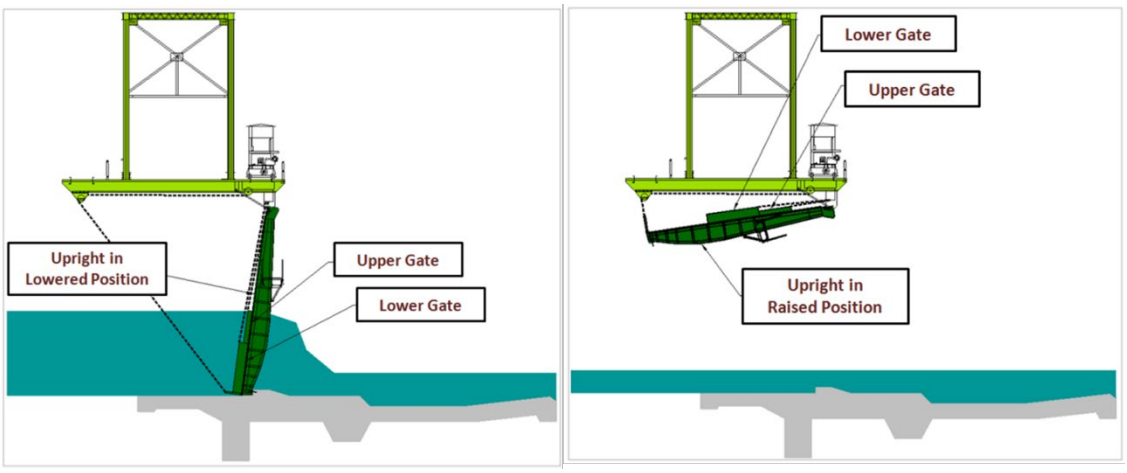


Figure 33: Movable Dam Typical Section – Gates Lowered (left) and Raised (right)

- **Nine Mile Feeder** connects West Canada Creek to Nine Mile Creek which flows into the summit section of the Canal near Erie Canal Lock E-20. During navigation season, a maximum 80 cfs was designed to be diverted at Trenton Falls from West Canada Creek into the Nine Mile Feeder. The present functional capacity is 10 cfs.
- **Utica Harbor Dam** is located approximately a mile downstream of the Utica Harbor on the Mohawk River northeast of the City of Utica. The upper pool of the dam forms the Utica Harbor, which is connected to the Erie Canal by the Utica Harbor Lock. The dam has two automated, 30-foot-wide steel Tainter gates on the south end and 100 feet of fixed crest at the north end.
- **Guard Gates 1 through 7** are used to close off sections of the Canal during flood conditions. Guard Gates 1 and 2 are located at the west end of the Waterford flight of locks – Erie Canal Locks E-2 (eastern) through E-6 (western). The flight of locks is the entry into the Erie Canal system, connecting the Hudson River and the Mohawk River for navigation, and forming the navigation route around Cohoes Falls. Other guard gate locations and numbers include Guard Gate 3 at Indian Castle, Guard Gate 4 at Little Falls, Guard Gate 5 at Herkimer, Guard Gate 6 at East Rome and Guard Gate 7 at West Rome. The *Movable Dam Lifting Procedure* specifies that prior to lifting the movable dams, Guard Gates 1, 2, 3, 4 and 5 shall be closed to create safe harbor conditions for vessels in the Waterford Flight, and the upper pools of Erie Canal Locks E-16, E-17 and E-18.
- **Delta Reservoir** was constructed in 1915 in the valley formed by the upper Mohawk River. Delta Reservoir has a drainage basin area of 145 sq mi. The dam is 1000 ft long, with a 300 ft long concrete overflow spillway. When full to the spillway crest at an elevation of 550, Barge Canal Datum (BCD), the reservoir has storage capacity of 63,100 acre-feet for navigation support (low flow supplementation) and recreation activities at Delta Lake State Park and through use of NYSCC lands and NYSCC permitted docks. An additional 25,000 acre-feet of active storage is available between the spillway crest elevation and the top of the dam embankment, el. 556.8 BCD. Delta Reservoir was designed to serve as the primary source of water for the summit section of the Canal, between Erie Canal Locks E-20 and E-21 and also provides the minimum base flow to the Upper Mohawk River supporting navigation on the eastern Canal and providing environmental benefit.

  Delta Reservoir provides limited flood protection benefits with the elevation kept at the spillway crest during navigation season and the reservoir level lowered a minimum of 6 feet during non-navigation season. The winter pool provides additional flood attenuation, particularly within the City of Rome between Delta Dam and the Canal's summit section. The NYSCC maintains ownership of all waterfront lands surrounding Delta Reservoir and, therefore, there are no private waterfront property owners. The Canal Corporation maintains a fee-based permit system to allow upland property owners to access the waterfront using NYSCC lands and for installation and use of private docks.
- **Hinkley Reservoir** was constructed in 1915 across the West Canada Creek valley. The dam is 3,700 feet long with two earthen sections and a 400-foot-long concrete section that forms the spillway and houses a hydropower facility. Hinckley Reservoir has a drainage basin area of 372 sq mi. When full to the spillway crest at an elevation of 1225 BCD, the reservoir has storage capacity of 92,000 acre-feet. An additional 62,000 acre-feet of active storage is available between the spillway crest elevation and the top of the dam embankment at el. 1240 BCD. In addition to the original purpose of supplying water for navigation, water from Hinckley Reservoir is used as a water supply to the Utica area via the Mohawk Valley Water Authority, for hydroelectric generation, recreation and downstream releases to support fisheries in West Canada Creek.

  Hinckley Reservoir is operated by NYPA pursuant to a 1982 FERC license and a 1984 Hydropower Easement and 1983 Operations and Maintenance Agreement between the NYSCC and NYPA (Jarvis Hydroelectric Facility). These agreements require NYPA to operate Hinckley Reservoir in accordance with the 1920 (now 2012) Hinckley Reservoir Operating Diagram. The Diagram allows reservoir levels to vary by about 51 feet

between a full reservoir level of 1225 feet BCD, to a low level of 1173.5 feet BCD. The prescribed downstream discharge reduces as the reservoir levels fall in order to maintain sufficient water in Hinckley Reservoir for canal navigation.

Any flood reduction benefits at Hinckley Reservoir are incidental to its main purpose of navigation with hydropower, and water supply additionally considered. The Operating Diagram (Figure 35) prioritizes these uses based on the pool elevation.

- **Vischer Ferry Dam**, located adjacent to Erie Canal Lock E-7, is a 1,900-foot long fixed crest ogee spillway dam. Flows are regulated on the northern side of the dam through the NYPA Vischer Ferry Hydroelectric Project. The combined hydraulic capacity of the four hydroelectric generation units and associated bypass gates is 21,000 cfs. Flows exceeding the hydraulic capacity of the generation facilities and associated bypass are conveyed over the fixed crest spillway. Per the FERC hydroelectric license, minimum water levels are required to be maintained at the top of the concrete spillway during the non-navigation season and at the top of 27-inch high flashboards that are installed on the spillway during the navigation season. The FERC hydroelectric license will expire May 31, 2024, and NYPA is pursuing relicensing at this time.
- **Crescent Dam** is located upstream of Cohoes Falls providing the navigation pool for Erie Canal Lock E-6 and was constructed in 1912. The dam and hydroelectric facilities are operated by NYPA. The upper pool of the Waterford flight of locks is located along the north shore of the Mohawk River just upstream of the dam. The dam consists of two independent concrete gravity overflow sections which link each bank to a rock island in the Mohawk River. Both sections are curved in plan. Water impounded by the dam maintains a pool extending upstream 10 miles to the Vischer Ferry Dam. Flashboards, 27 inches high, are installed on both spillways during navigation season. The powerhouse is located on the right bank and includes two 2.8 MW turbines and two 3 MW turbines. The FERC hydroelectric license will expire May 31, 2024, and NYPA is pursuing relicensing at this time.

3.4.2. Priorities for Control Point Operations

- **Delta Reservoir** is managed by NYSCC to provide sufficient water for Canal locking operations during the navigation season and environmental minimum flows. The reservoir is operated to maintain the water surface elevation at or near its spillway crest elevation during navigation season and lowered a minimum of 6 feet during non-navigation season. Seasonal water level variations are discussed further in Section 3.4.3.
- **Hinckley Reservoir** is managed by NYPA and coordinated with NYSCC and Brookfield Power to provide water for hydropower, Canal locking operations, and water supply. Reservoir operation is managed according to the 2012 Operating Diagram (Figure 35), which recognizes these uses. Flow releases are increased when the water level approaches the spillway crest elevation and reduced at lower elevations. The Operating Diagram is discussed further in Section 3.4.3.
- **Movable dams – Historic Operation**. The movable dam uprights, upper gates, and lower gates were lowered to impound water for navigation season. The upper gates were raised as necessary by NYSCC operations staff to adjust pool levels for navigation and completely raised out of the water during periods of high flow (generally greater than the 10-year recurrence interval (10% annual probability) storm. The lower gates were not adjusted during the navigation season, as they provided stability to the uprights against flowing water and debris. During the non-navigation season, the movable dam upper gates, lower gates and uprights were completely raised out of the water.
- **Movable dams – Current Operations**. After $85M in damages to Canal infrastructure caused by Hurricane Irene and Tropical Storm Lee in 2011, structural and machinery improvements were made to Movable dams MD 4 through MD 12, and a new operating procedure implemented in 2018. Movable dams MD 13 and

MD 14 have not yet been improved. During navigation season, when an NWS Northeast River Forecast Center forecast meets or exceeds the major flood incident criteria at the USGS stream gages at Little Falls or Cohoes on the Mohawk River, or Burtonsville on Schoharie Creek, the upper and lower gates and uprights are completely lifted out of water and folded up under the truss structure. Once the flood recedes to allow safe access and a visual inspection has been conducted, the movable dams are re-installed. The lifting procedure is further described in the following sections. Similar to historic operations, the movable dam upper gates, lower gates and uprights are completely raised out of the water during non-navigation season.

3.4.3. Rule Curves

At Delta Reservoir, the operating procedure has been to maintain the reservoir level at the spillway crest (Elevation 550 BCD) for the duration of navigation season, and to lower the reservoir level by a minimum of 6 feet during the non-navigation season. NYSCC strives to reach the target low level between December 15 and January 15, and begin refilling the reservoir during March. A diagram of the seasonal change in target water level is shown in Figure 34 below.

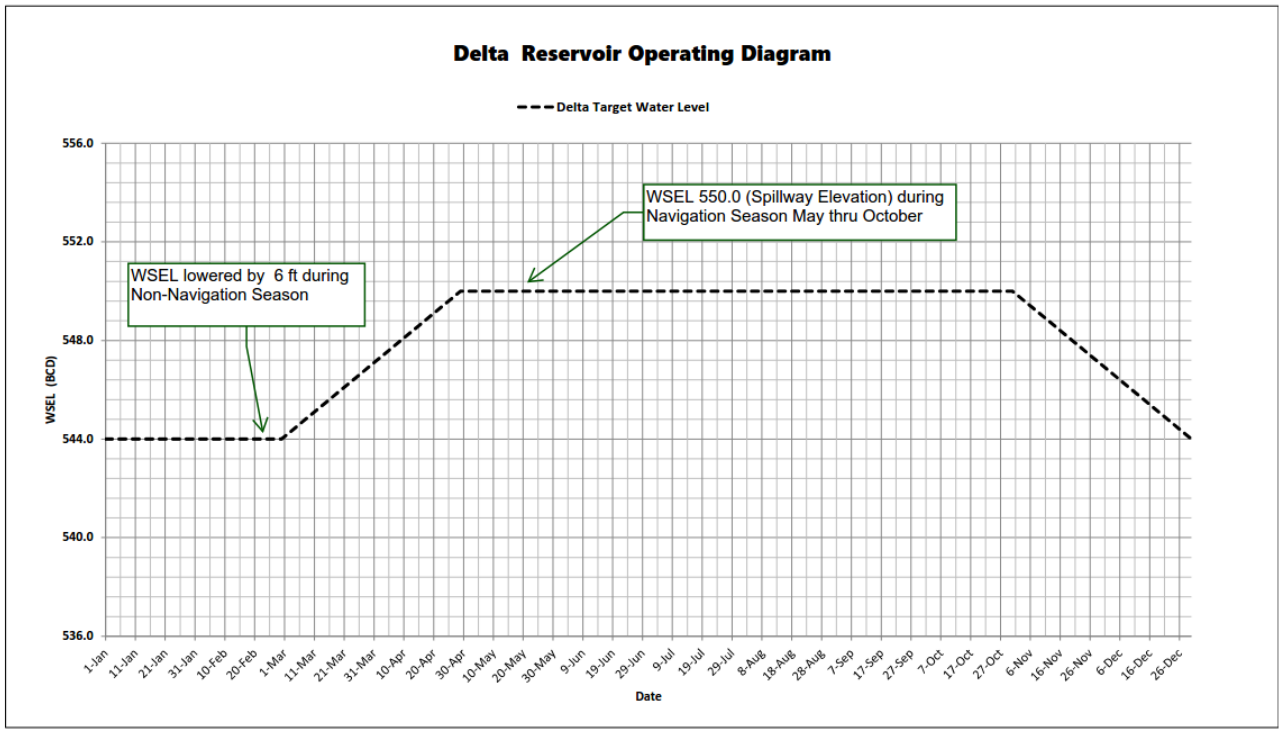


Figure 34: Delta Reservoir Operating Diagram

During navigation season, an inflow of 80 cfs is assumed from the Forestport Feeder (Black River). Minimum discharge to the Mohawk River downstream of Delta Dam to maintain aquatic habitat is 185 cfs. Another 30 cfs piped directly to the adjacent fish hatchery for total release of 215 cfs. When WSEL reaches four inches above the spillway crest, the dam's four 60-inch diameter low-level outlets are closed, and all flow goes over the spillway. Winter snowpack depth is monitored, and a deeper snowpack depth dictates a higher seasonal drawdown and the the non-navigation season drawdown may be increased up to 20 feet.

Hinckley Reservoir is operated according to the 2012 Hinckley Reservoir Operating Diagram, developed in coordination with Brookfield Power. The diagram is shown in Figure 35 below.

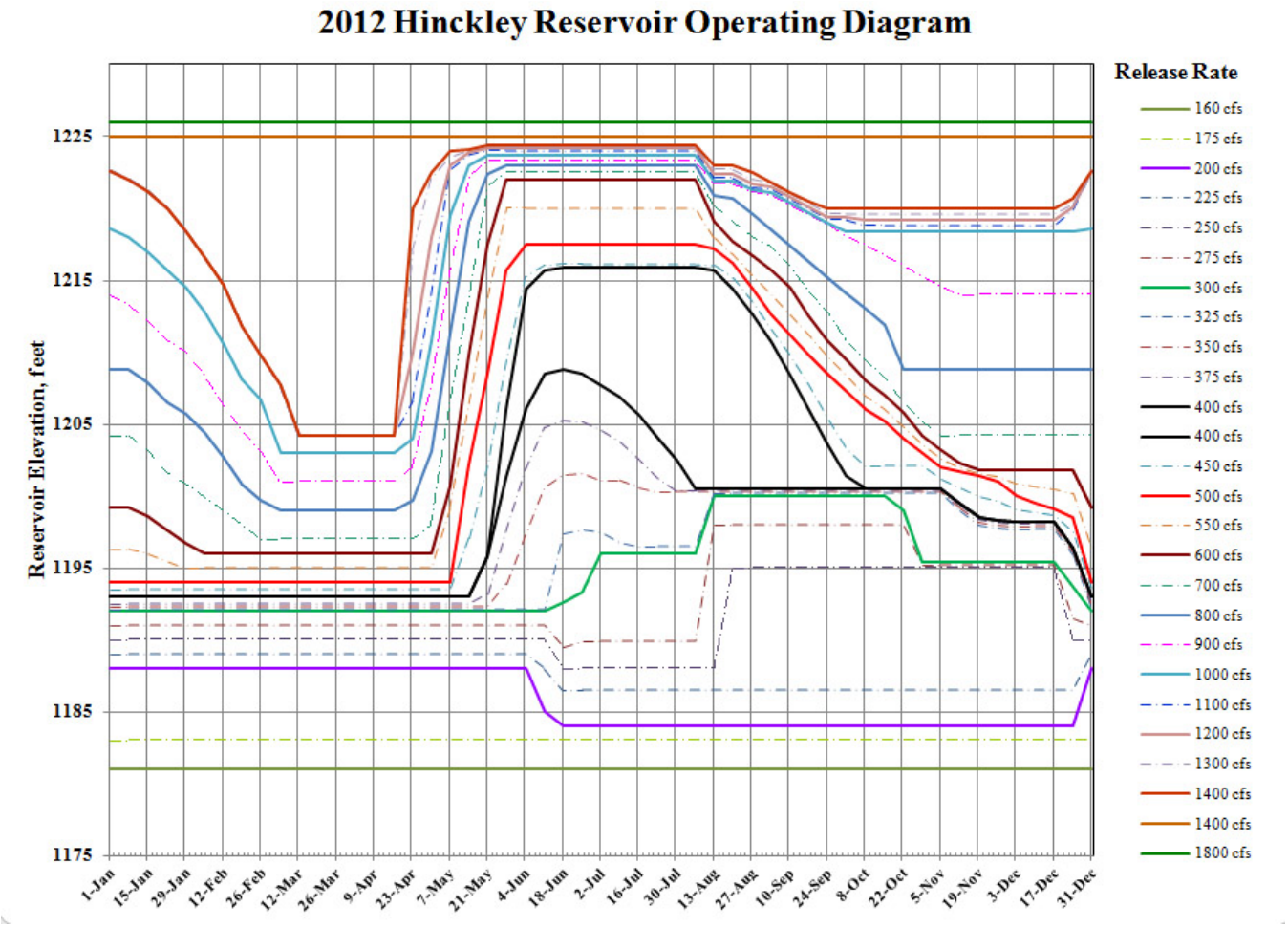


Figure 35: 2012 Hinckley Reservoir Operating Diagram

3.4.4. General Operational Guidelines

Operations of control points in the Mohawk River Basin follow a prescribed sequence based on the nature of the system where there is a main corridor for the Canal and the Mohawk River and the tendency for flood events is to peak and recede rapidly. The sequence during navigation season includes:

- Determine Present and Anticipated Hydrologic Conditions – stream gage and reservoir levels, seasonal snowpack depths, WS Northeast River Forecast System predictions and AHPS stream gage 72-hour forecasts for flow at Mohawk River at Little Falls and Cohoes and Schoharie Creek at Burtonsville.
- Recommend Action – close Guard Gates for flood protection within Canal sections, and removal of Movable dams.
- Monitor Results – to guide future actions, place Movable dams back into service, return guard gates to pre storm settings.

Guidelines for flood management are discussed in more detail below.

- **Delta Reservoir** During Canal navigation season, approximately 80 cfs is diverted to Delta Reservoir from the Black River via the Forestport Feeder. The original design capacity of the Forestport Feeder was 267 cfs. The minimum discharge from Delta Reservoir to meet aquatic habitat needs is 185 cfs. An additional 30 cfs is piped directly to the downstream fish hatchery. Delta Reservoir water levels are maintained at or near the spillway crest during the navigation season, which corresponds with summer recreational boating. In the fall, water levels are drawn down a minimum of 6 ft to provide flood retention storage.

- **Hinckley Reservoir** water levels vary over a range of 35 feet throughout the year based on water needs and runoff. Reservoir outflow is regulated by NYPA and NYCC in accordance with the 2012 Hinckley Reservoir Operating Diagram. Normal reservoir elevations at a given date reflect the average of 59 years of daily Hinckley Reservoir elevation data. Reservoir levels are highest during navigation season, and lowest in late winter. Releases are made from Hinckley Reservoir into West Canada Creek and reservoir management activities coordinated with downstream hydropower producers. Outflow is greater when reservoir level is higher, and vice versa.

  Hinckley Reservoir and the associated Jarvis hydroelectric project, along with the Prospect and Trenton Falls hydroelectric projects located further downstream on West Canada Creek, are required to maintain a minimum streamflow of 160 cfs for aquatic habitat needs. Hydropower releases range from 250 to 1800 cfs. In addition, the Mohawk Water Valley Authority may withdraw up to 40.2 cfs from Hinckley Reservoir for drinking water supply. Canal navigation releases range from 0 to 630 cfs, with 100 cfs typical.

- **Movable dams** After damages were incurred due to Hurricane Irene and Tropical Storm Lee in 2019, the movable dams were strengthened to allow the lower gates and the uprights to be raised with headwater elevations higher than 2.5 feet above the top of the lower gates. The new operating procedure was implemented in 2018. Movable Dam MD 12 at Rocky Rift and Movable Dam MD 14 at Herkimer have not yet received structural upgrades.

  Navigation Season

  The operating document *Movable Dam Lifting Procedure* (K118-EMP- 0006) established the framework for lifting the Canal Corporation's movable dams in advance of a forecasted storm. The operating procedure is summarized below.

  A. Appliable Movable dams and Gates: Included are Movable Dam MD 4 through MD 11 at Erie Canal Locks E-8 through E-15, and Movable Dam MD 12 at Rocky Rift and Movable Dam MD 14 at Herkimer. Also closing Guard Gates 1 and 2 at Waterford, 3 at Indian Castle, 4 at Little Falls and 5 at Herkimer and lowering Herkimer Crest Gates 1,2, and 3.

  B. Incident Criteria: The NWS Advanced Hydrologic Prediction Service (AHPS) provides a 2 to 3 day look ahead forecast which will be used to identify potential flooding events that are more than 24 hours ahead of current time to establish the Preliminary Dam Lifting Time (PDLT) for simultaneous movable dam lifting. Incident monitoring utilizes these USGS Gages:

     - Mohawk River at Little Falls (USGS Gage 01347000)
     - Mohawk River at Cohoes (USGS Gage 01357500)
     - Schoharie Creek at Burtonsville (USGS Gage 01351500)

     An AHPS forecasted flows that could result in lifting all movable dams are flows exceeding 82,500 cfs at Cohoes or exceeding 26,100 cfs at Little Falls. An AHPS forecasted flow that could result in lifting

the five movable dams, MD 4 through MD 8 downstream of Schoharie Creek are flows exceeding 82,500 cfs at Cohoes, flows in excess of 36,300 cfs at Burtonsville and less than 26,100 cfs at Little Falls. The extent of debris in the river or accumulating on the movable dam is considered in the decision to lift the movable dams.

C. Preparations and Planning: Preparations include activation of the NYCC Emergency Operations Center (EOC) in Albany. Section Superintendents and staff in Section 2 (Waterford), Section 3 (Fonda) and Section 4 (Utica) are notified. Upon notification that an incident is being monitored, Sections 2, 3, and 4 initiate a debris survey of all movable dams. Public notification is initiated, including issuing a Notice to Mariners (NTM) for the canal sections where movable dams will be lifted, and the list of dock permittees, railroads and marinas.

D. Incident Activation: When the AHPS forecast exceeds the major flood criteria, a final decision is made regarding lifting at least 24 hours in advance of when the forecasted flow criteria will occur. The section superintendents assign staff to the movable dams to ensure adequate staffing.

E. Movable Dam Lifting: Charts have been prepared for each movable dam showing safe lifting criteria, where the difference between headwater and tailwater elevation does not exceed certain values. The EOC staff compare the headwater and tailwater elevation data at each movable dam to the "Allowable Pools for Lower Gate Lifting" and "Allowable Pools for Upright Lifting" charts. EOC staff make a determination for each movable dam if conditions are either "safe for lifting" or "lifting is prohibited." If headwater/tailwater conditions indicate safe lifting is not possible, EOC staff, in coordination with site staff determine if steps can be implemented that will allow for safe lifting. The sequence is: close guard gates, lift upper gates in linear sequence, lift lower gates in prescribed sequence and lift uprights in linear sequence. The estimated lift time for lower gates and uprights ranges from 1.5 hours for Movable Dam MD 14 to 6 hours for Movable dams MD 4 and MD 5.

F. Movable Dam Re-Installation: Once water conditions allow safe access, a visual inspection will be conducted to assess the condition of the movable dams and their components. The movable dams are reinstalled as soon as they are cleared by the inspection.

Currently, the removal procedure for the movable dams is based on the 72-hour advance forecast as it requires a minimum of 24 hours to notify mariners to seek safe harbor and approximately 48 additional hours to open all movable dams.

Non-Navigation Season

Current procedures are unchanged from previous practice. During the non-navigation season, the movable dams are completely raised out of the water.

3.4.5. Limitations to the Operational Control Evidenced During Recent Floods

Delta and Hinckley Reservoirs were constructed in connection with the 1918 Barge Canal expansion to provide sufficient water supply for navigation. Additional water resources objectives: water supply, hydropower, and recreation were later added. Delta and Hinckley Reservoirs, therefore, were not planned as flood control reservoirs and have operational constraints that limit their ability to draw down their reservoir levels in advance of major storm events to provide flood storage volume. For example, see Figure 36 which shows seasonal water level changes for the past 5 years and the target water level at Delta Reservoir. Note that the November 2019 flood and August 2021 flood occurred during navigation season

when the Delta Reservoir water level was at the spillway crest elevation at the start of the flood event. The figure shows that the reservoir level rose 3 ft above the spillway elevation on August 19, 2021, and November 1, 2019. Thus, two floods in 5 years occurred during navigation season where there was no chance to attenuate flooding by drawing the water level below the spillway elevation to create additional storage.

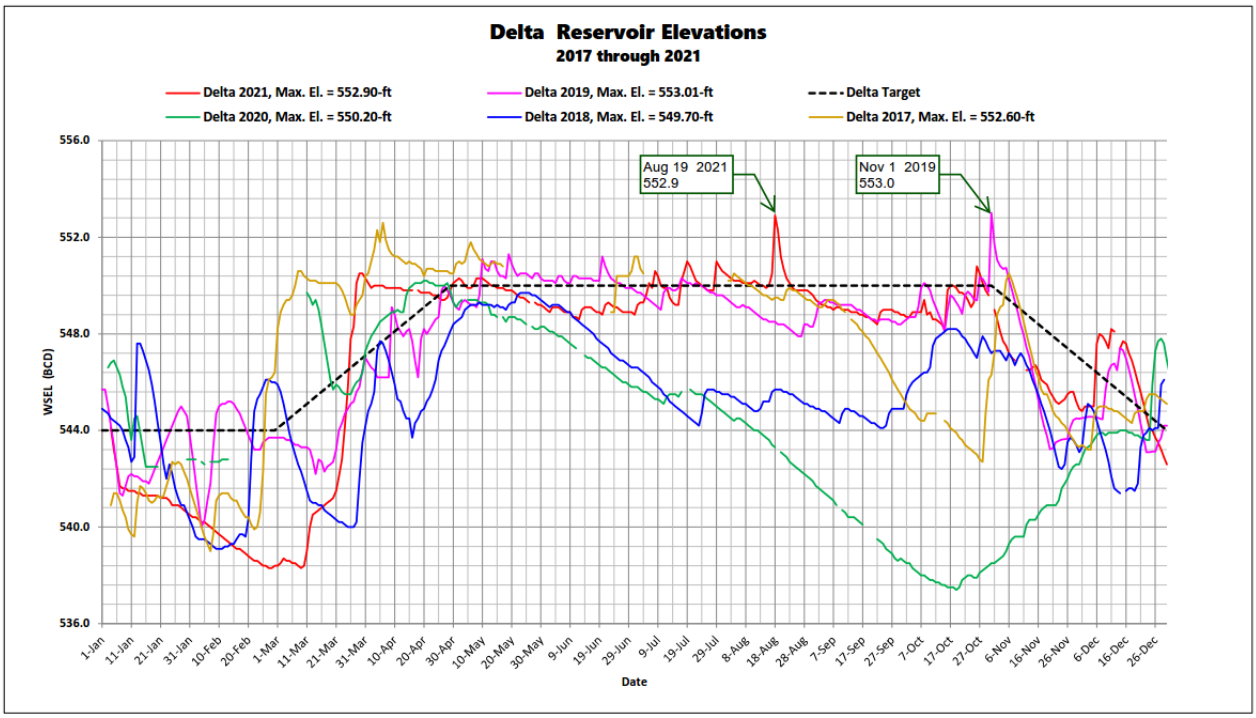


Figure 36: Delta Reservoir Water Surface Elevations 2017-2021

Additionally, the Erie Canal System which runs parallel to or is co-located with the Mohawk River was not originally designed to provide any flood mitigation benefits and could not be operated to do so.

Removing movable dams in anticipation of major storm events provides major flood reduction benefits immediately upstream of the movable dams and eliminates damage to the movable dams but cannot mitigate all flooding problems. Areas downstream of Movable Dam MD 4 in Scotia, including the City of Schenectady, are not affected by removing the movable dams.

There are limitations in the current flood forecasting models, including their inability to account for sudden changes in weather patterns. Given the length of time required to complete the Movable Dam Lifting Procedure and provide advance Notification to Mariners, rapid flooding and damage to NYSCC infrastructure can occur. These limitations can also result in significant staff effort to lift the movable dams for flooding that does not materialize.

November 2019 Flood - In this flood event (Halloween storm) peak flows at USGS gages and water levels upstream and downstream of selected movable dams on the Mohawk River are discussed. Showers across the southerly Adirondacks and Mohawk Valley became steadier and heavier during the evening of October 31, ahead of a strong cold front. An intense line of showers developed along the front, resulting in rainfall totaling 2-5 inches over this area. As a result, record flows were recorded for West Canada Creek at Kast Bridge, and the Mohawk River at Little Falls, equivalent to a 500-year recurrence interval. In contrast, the

Mohawk River downstream of Delta Reservoir recorded a 25-year flow, and Schoharie Creek contributed little more than a 1-year flow.

At Hinckley Reservoir, NYPA attempted to mitigate flooding by reducing outflow to zero during the peak of the flood event. As the reservoir water level increased by almost six feet to elevation 1230.8 BCD from October 31 to November 1, this action allowed more water to accumulate within the reservoir and reduced the magnitude of the flood peak downstream in West Canada Creek.

The movable dams at Erie Canal Lock E-15 through E-8 were raised in anticipation of the flooding, which prevented flooding of the New York State Thruway and parts of Canajoharie and Fort Plain. However, there was a delay in removing some of the movable dams downstream of the mouth of Schoharie Creek due to uncertainties in the forecasts. At Erie Canal Lock E-12, the delay in raising the gates of Movable Dam 8 caused an estimated $1 million in Canal infrastructure damage and debris cleanup.

Figure 37 and Figure 38 show the changes in upstream and downstream water levels at Movable Dam MD 9 at Erie Canal Lock E-13 and Movable Dam MD 4 at Erie Canal Lock E-8 as the movable dams were lifted out of the water during the November 2019 flood event. As the movable dams were lifted, the trend was for the upstream water level to drop and approach the downstream water levels, as shown at Erie Canal Locks E-13 and E-8 after all movable dams were lifted. The flood mitigation benefit allows the upstream water levels to drop as the movable dams are lifted. Also note that the upstream water levels continued to rise at Erie Canal Lock E-13 and E-8 after all movable dams were lifted by October 31 because the flood peak did not occur at Little Falls until approximately 3 AM on November 2nd. Although there was flood damage at Erie Canal Lock E-12, the benefits of the movable dam lifting included lowering the upstream water level 5 feet compared to conditions without lifting movable dams.

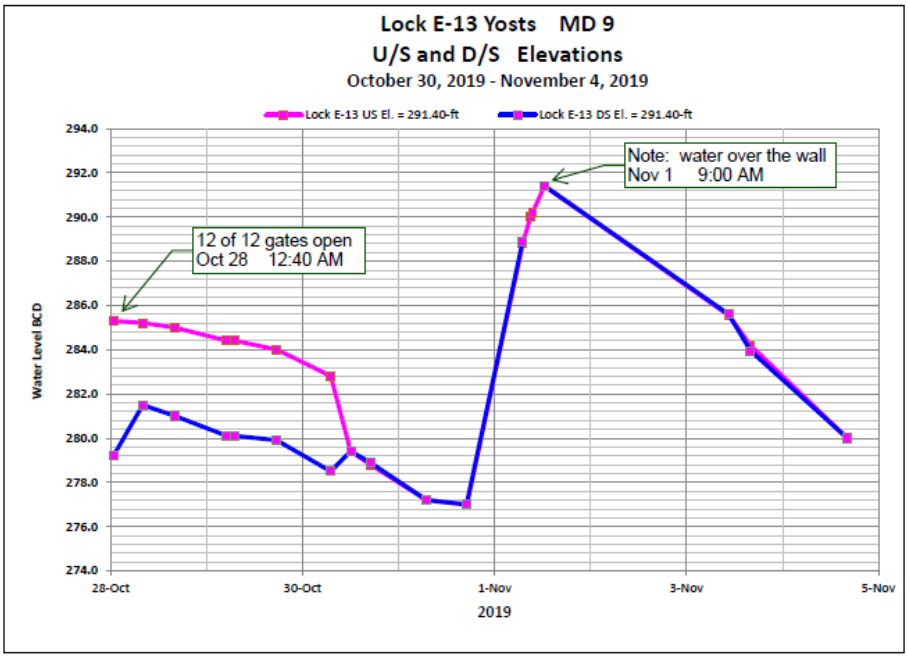


Figure 37: Movable Dam Operations Lock E-13 (MD 9) at November 2019 Flood

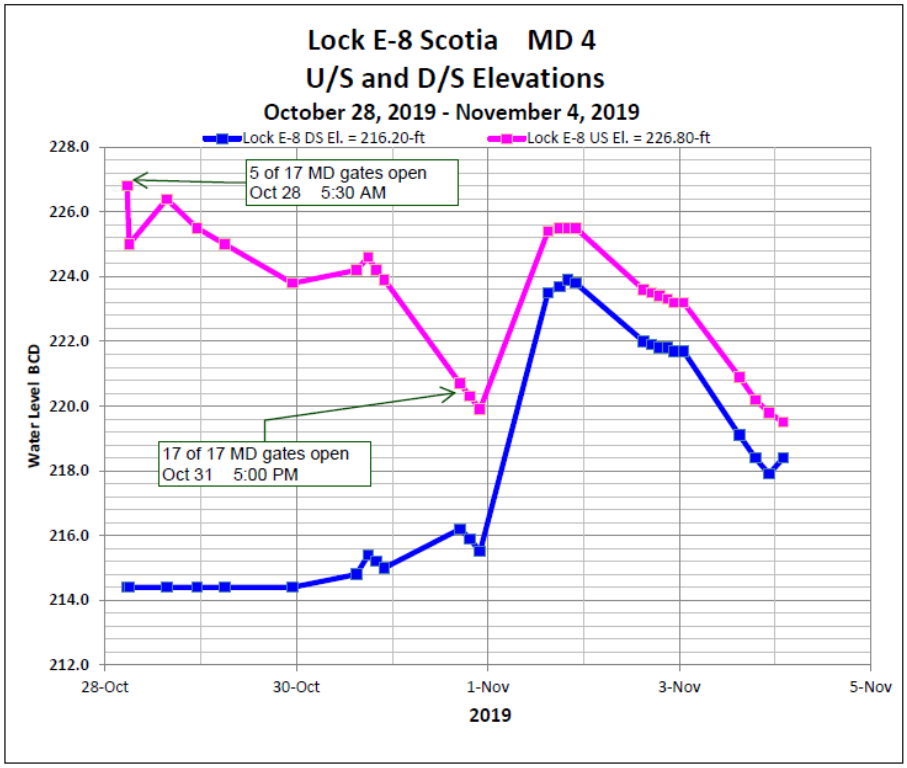


Figure 38: Movable Dam Operations Lock E-8 (MD 4) at November 2019 Flood

August 2021 Flood – During this flood event, peak flows at USGS gages and water levels upstream and downstream of selected movable dams on the Mohawk River are discussed. Moisture and remnants of Tropical Storm Fred moved across parts of the mid-Atlantic and northeast United States August 17 to 20, 2021. As this moved over the central parts of New York and northeast Pennsylvania it produced locally heavy rainfall. Flooding occurred in the River Street area of Rome, and some 50 families were displaced as a result of heavy rains totaling 2.5 inches on August 19.

The peak flow on the Mohawk River downstream of Delta Dam was 8,100 cfs, a 100-year flood. In contrast, peak flows for West Canada Creek at Kast Bridge, and the Mohawk River at Little Falls, were equivalent to a 1.25-year flood. Peak flow in Schoharie Creek was equivalent to a 1.25-year flood recurrence interval and occurred 2 days after the peak at Little Falls. This may be attributed to Tropical Storm Henri, which moved over central NY and eastern Pennsylvania a few days after Tropical Storm Fred along a more easterly track.

Figure 39 and Figure 40 show the changes in upstream and downstream water levels at Movable Dam MD 9 at Erie Canal Lock E-13 and Movable Dam MD 4 at Erie Canal Lock E-8 as the movable dams were lifted out of the water during the August 2021 flood event. All movable dams were removed in accordance with NYSCC movable dam policy with no delays. Flood mitigation benefits were due to the upstream water levels dropping as the movable dams were lifted. Similar to the November 2019 flood event, the trend was for the upstream water levels to drop and approach the downstream water levels, when all movable dams were lifted, as shown at Erie Canal Locks E-13 and E-8. After movable dams were re-installed August 25-26, upstream water levels were again higher than downstream water level. The peak flow at the Mohawk River gage at Little Falls occurred August 21 at 5 AM, and the peak flow at the Schoharie Creek gage at Burtonsville did not occur until August 23 at 5 PM. This meant that peak flow conditions at the movable dams were of longer duration for the August 2021 flood than for the November 2019 flood.

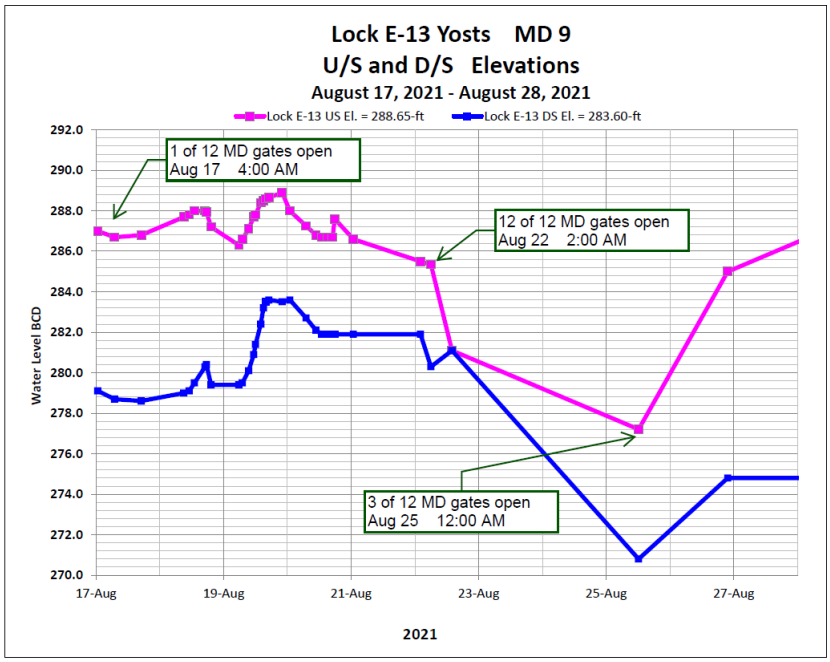


Figure 39: Movable Dam Operations Lock E-13 (MD 9) During August 2021 Flood

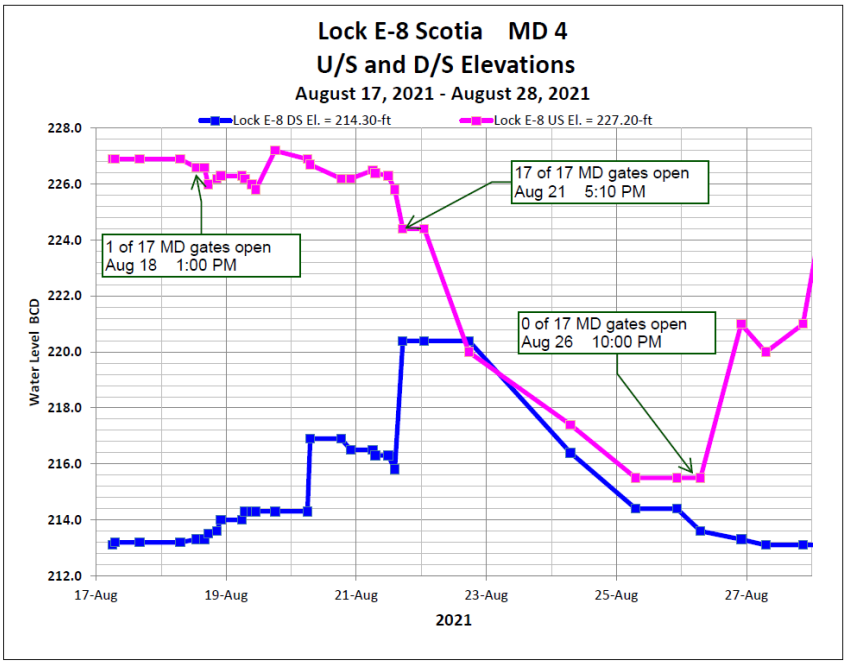


Figure 40: Movable Dam Operations Lock E-8 (MD 4) During August 2021 Flood

3.5 OSWEGO RIVER BASIN CHARACTERISTICS

The Oswego River Basin drainage area covers approximately 5,122 square miles in Central New York and the Finger Lakes Region (see Figure 40). The western portion of the Basin drains to the Seneca River while the eastern portion drains to the Oneida River. The two rivers combine 2.2 miles upstream of the Village of Phoenix at the Three Rivers Junction to form the Oswego River, which flows northwest into Lake Ontario. The dominant land cover types include agriculture (37%), forest (33%), wetlands (10%), and developed open space (6%). The National Land Coverage Data describes developed, open space as areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Please refer to the Basin Schematic Diagram (Figure 41) for the approximate locations of the major and minor tributaries and lakes. The Canal, which is fed with water from the Niagara and Genesee Rivers, enters the Oswego River Watershed at Lock E-30 (Macedon), after being conveyed through the 60-mile pool (between Erie Canal Locks E-34 and E-33), and through the 17-mile pool [between Erie Canal Locks E-32 and E-30 (there is no Lock E-31)]. Flow from west of Erie Canal Lock E-30 is not conveyed into the Oswego River Basin during flood events. Through the Basin, the Canal/River system has an elevation change of 217-feet from the upper pool of Erie Canal Lock E-30 to Lake Ontario via the Erie Canal (Seneca River and tributaries) and Oswego Canal (Oswego River). The average gradient, from Erie Canal Lock E-25 (May's Point) to Oswego Canal Lock O-1 (Phoenix), is relatively flat at 0.4 feet of elevation change per mile, however, in the Oswego Canal from Phoenix to Lake Ontario the average gradient increases dramatically to 5.5 feet per mile.

There are a total of 285 miles of Canal within the Oswego River Basin, including Oneida, Cayuga and Seneca Lakes. In the western portion, Ganargua Creek, the first significant tributary entering the Canal, enters immediately downstream of Erie Canal Lock E-29 (Palmyra). The Canal flows east towards Erie Canal Lock 28B (Newark) for approximately 5 miles until levels in excess of Canal operational needs pass over the Harrison Spillway Dam into a north flowing Ganargua Creek. The Canal continues eastward through Erie Canal Locks 28B (Newark) and 28A (Lyons) before Ganargua Creek re-enters the Canal in the Erie Canal Lock E-27 (Lyons) upper pool. The Clyde River is formed by the confluence of the Canal with the Canandaigua Outlet and Flint Creek immediately downstream of Erie Canal Lock E-27. The Clyde River and Canal are either co-located or adjacent to each other from this point to the confluence with the Seneca River/Cayuga Seneca Canal outlet.

The Oswego River Basin is significantly influenced by the Finger Lakes. There are over 7,000 miles of river and streams, seven Finger Lakes (Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Otisco), two other large lakes (Onondaga and Oneida), and numerous smaller lakes, including Cross Lake, which is part of the Seneca River west (upstream) of Erie Canal Lock E-24 (Baldwinsville). Keuka Lake, the most southern finger lake, discharges at the Village of Penn Yan with the outlet discharging into the west side of Seneca Lake roughly 13 miles south of Geneva. The Seneca River is canalized to form the Cayuga Seneca Canal between Seneca Lake at East Geneva through a series of four locks (Cayuga Seneca Canal Locks CS-4, CS-3, CS-2, and CS-1) that lower the Canal level 72-feet between Seneca Lake and the lower pool of Cayuga Seneca Canal Lock CS-1 (Mud Lock). Immediately downstream of Cayuga Seneca Canal Lock CS-1, the Seneca River is joined by the Clyde River.

The Clyde River has no appreciable storage capacity and the Seneca River, once released from Cayuga Seneca Canal Lock CS-1, has minimal storage at Cross Lake. The Seneca River flows east from the junction with the Clyde River adding additional tributary flows from Crusoe Creek, Cold Spring Brook, Owasco Lake Outlet, and Skaneateles Lake Outlet before flowing through Cross Lake to Erie Canal Lock E-24 (Baldwinsville). The Seneca River continues flowing east, where it confluences with Onondaga Lake Outlet 5.5 miles downstream of Erie Canal Lock E-24. Another 6.7 miles downstream the Seneca River joins the Oneida River at Three Rivers Junction forming the Oswego River and the Oswego Canal. The Oneida River and Erie Canal are collocated between Three Rivers Junction and Oneida Lake. East of Oneida Lake to the summit section at Rome, the Erie Canal is not collocated with any river system but intercepts Fish Creek and Wood Creek. The drainage area contribution of the Oneida River system at Three Rivers Junction is 27% of the Oswego Basin's drainage area. The Oswego River is canalized between Three Rivers Junction

and Lake Ontario by the Oswego Canal consisting of a series of seven locks (O-1, O-2, O-3, O-5, O-6, O-7 and O-8) that lower the water level 118 feet from Three Rivers Junction to Lake Ontario.

Except for Cayuga Lake that is regulated by NYSCC, the Finger Lakes are operated by a combination of private and public entities with the overall operation of each lake, including Cayuga Lake, governed by a 'Rule Curve'. Rule curves have been developed to maintain a summer water level 1 to 3 feet above the winter water level for recreational uses. The lowered winter water levels are meant to reduce flood and ice damage along the lake shorelines. In general, each rule curve includes an upper and lower target lake elevation for different times of the year, and some include an initiation of flooding level above the upper summer target level. Rule curves for all the Finger Lakes and Oneida Lake are presented in Appendix C. While the lake operators can normally follow the rule curves by operating gates at the lake outlets, the rule curves do not consider the downstream impacts of releases made during a flooding event to keep the lake within the rule curve target elevation range. From what can be observed from lake level records, Cayuga and Oneida Lakes (both operated by NYSCC) are the only lakes that are regulated, when possible, to reduce downstream flooding without causing significant flooding on the lake.

The NYSCC operates 20 locks on three canals (the Erie, the Oswego, and the Seneca/Cayuga Canals) within the Basin. At17 locks, NYSCC has limited operational capability. However, five locations where NYSCC has operational control include:

- Erie Canal Lock E-27 and Tainter gated dam
- Erie Canal Lock E-26 and Tainter gated dam
- Erie Canal Lock E-25 and Moveable Dam MD 18 at Mays Point
- Cayuga Seneca Canal Lock CS-1 (Mud Lock) and Tainter gated dam, Outlet of Cayuga Lake that becomes the Seneca River
- Erie Canal Lock E-23 and Caughdenoy Tainter gated dam, that controls Oneida Lake outflow

Locations where NYSCC has partial control, and other entities are involved, include:

- Erie Canal Lock E-24 (Baldwinsville): Seneca and Baldwinsville hydropower facilities- privately owned and operated.
- Oswego Canal Lock O-1 (Phoenix): Phoenix hydroelectric project which is privately owned and operated.

Locations where NYSCC has no control include:

- Oswego Canal Locks O-2 through O-8
- Canandaigua Lake Outlet
- Keuka Lake Outlet
- Seneca Lake Outlet
- Owasco Lake Outlet
- Skaneateles Lake Outlet
- Otisco Lake Outlet

Schematic Diagram | Oswego River Basin

LEGEND

DRAINAGE AREA X (Y%) - drainage area in **X** square miles and Y% of Oswego River Basin drainage area
DISCHARGE CAPACITY - spillway capacity in **Z** cfs
RIVER - flows from lake to canal, see legend above
CANAL - numbers indicate the elevations of canal segments, in feet
(A-#) - canal name (Erie, Cayuga-Seneca, Oswego) lock name A and number
(MD #) - movable dam number

Note: Oswego River Basin at Lake Ontario is 5,100 square miles.

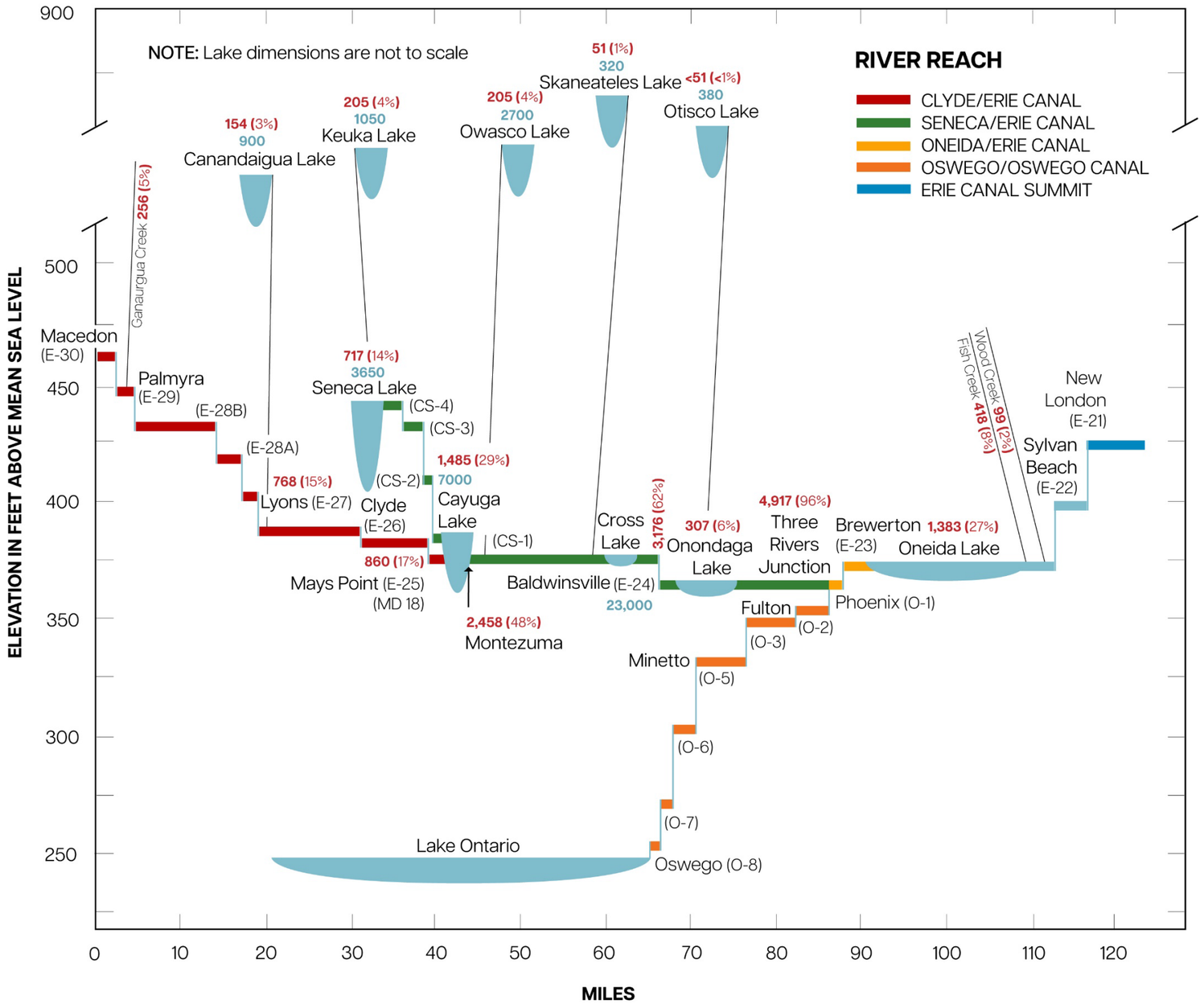


Figure 41: Schematic Diagram, Oswego River Basin

3.6 CHARACTERIZATION OF OSWEGO RIVER BASIN FLOODING

In the Oswego River Basin, peak daily flows can range from two (2) to 10 times the monthly average discharge in the subbasins. Seasonality is a key contributor toward variations in discharge and flow events. High flows often occur in the springtime, coinciding with snowmelt and precipitation. Oswego River Basin storm events generally produce slow rising and slow receding flood events lasting several days to weeks in the subbasins. This is attributable to the significant off-channel storage and low channel gradients upstream of Lock E-24- Baldwinsville. Refer to Figure 42 for a depiction of monthly average and daily peak flows within the Oswego River Basin. The data collected and displayed in this figure is more limited to recent years than in the Mohawk River Basin, and includes years 1949 to 2022 at Baldwinsville, 1996 to 2022 at Euclid, and 2007 to 2022 at Phoenix.

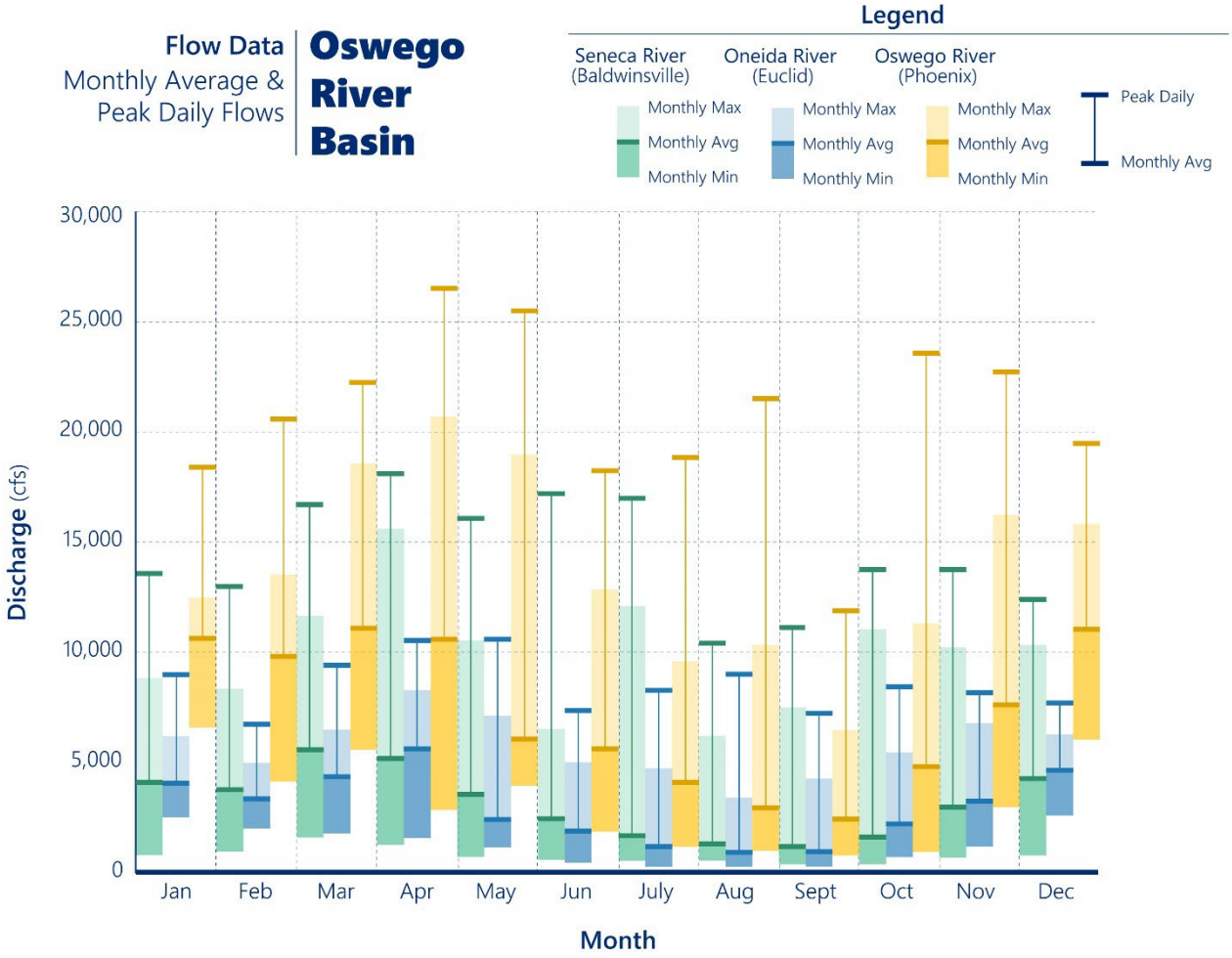


Figure 42: Monthly Flow Data, Oswego River Basin

3.7 OSWEGO RIVER BASIN RECENT FLOODING HISTORY

From 2017 – 2022, there have been two basin-wide flood events in areas specifically influenced by NYSCC operations. The first event occurred in the spring of 2017 and is indicative of the long duration flooding exemplified during spring thaw (snow melt) periods. The second event occurred in August 2021 due to Tropical Storms Henri and Fred and covered significant portions of the Oswego River Basin, and is indicative of the sporadic major storm events, the second type of significant storm that can occur in the Oswego River Basin. Other events have occurred

in the basin such as the Seneca River[7] experienced a peak flow of 13,500 cfs on April 8, 2017, which is the 5-year (20%) recurrence interval storm event. Cayuga Lake experienced three separate instances when the lake elevation rose to above the lake's reported damage initiation elevation. At Cross Lake there were thirteen separate instances of the water surface elevation rising above the reported damage initiation elevation. The Oneida River[8] experienced a peak flow of 9,840 cfs in May 2011 which is approximately the 3-year (33%) recurrence interval storm. Oneida Lake had two instances when the lake elevation rose above the reported damage elevation. On the Oswego River[9] there was a peak flow of 25,300 cfs in April 2011 which is approximately the 5-year recurrence interval storm. Table 12 summarizes the historic discharges on the Seneca, Oneida, and Oswego Rivers respectively, and Table 13 summarizes the occurrences and durations of high lake elevations on Cayuga, Cross, and Oneida Lakes, respectively during the past five years. Seneca Lake had no reported exceedances of the reported damage elevation during the past five years. Canandaigua, Keuka, Owasco, Skaneateles, and Otisco Lake rule curves do not report an initiation of damage elevation.

Table 12: Peak Flow Events, Oswego River Basin

BASIN	USGS GAGE	PERIOD OF RECORD (YRS)	HISTORIC PEAK FLOW (CFS)	DATE	ESTIMATED 100-YEAR EVENT (CFS)	RECENT PEAK FLOW (CFS)
Seneca River	04237496	73	22,100	March, 1936	20,450	13,500
Oneida River	04247000	17	10,600	May, 2011	14,304	9,840
Oswego River	04247055	15	26,500	April, 2011	36,050	25,300

[7] USGS 04237496 Seneca River at Baldwinsville, NY
[8] USGS 04247000 Oneida River at Euclid, NY
[9] USGS 04247055 Oswego River at Phoenix, NY

Table 13: High Lake Elevations, Oswego River Basin

LAKE	DATES WHEN LAKE LEVEL WAS ABOVE THE DAMAGE INITIATION ELEVATION
Cayuga (NNS)	4/10/2017 - 4/12/2017
Cayuga (NS)	8/22/2021
Cayuga (NS)	10/30/2021-11/8/2021
Oneida (NST)	4/8/2017 - 4/16/2017
Oneida (NS)	8/20/2021 - 8/27/2021
Cross Lake (NNS)	3/29/2017 - 5/16/2017
Cross Lake (NS)	5/21/2019
Cross Lake (NNS)	12/16/2019 - 12/18/2019
Cross Lake (NNS)	1/1/2020 - 1/3/2020
Cross Lake (NNS)	1/12/2020 - 1/14/2020
Cross Lake (NNS)	3/4/2020 - 3/8/2020
Cross Lake (NNS)	5/2/2020 - 5/13/2020
Cross Lake (NS)	5/11/2021 - 5/13/2021
Cross Lake (NS)	7/18/2021 - 7/21/2021
Cross Lake (NS)	8/20/2021 - 9/1/2021
Cross Lake (NS)	10/27/2021 - 11/23/2021
Cross Lake (NNS)	2/20/2022 - 3/28/2022
Cross Lake (NS)	8/9/2022

Damage Initiation Elevations and Seasons

Oneida = 372.4 ft BCD

Cayuga = 385.0 ft BCD
Cross Lake = 376.0 ft NGVD29
(NS) = Navigation Season
(NNS) = Non-Navigation Season
(NST) = Transition to/from Navigation Season

3.8 OSWEGO RIVER BASIN FLOOD MANAGEMENT OPERATIONS DURING RECENT FLOODS

3.8.1. Control Points

The NYSCC operates water level control points along the Canal System within the Oswego River Basin. The principal locations are Erie Canal Lock E-26 and Erie Canal Lock E-25 at Mays Point, Cayuga Seneca Canal Lock CS-1 (Mud Lock) at Cayuga Lake Outlet, Erie Canal Lock E-24 (Baldwinsville) on the Seneca River, Erie Canal Lock E-23 (Brewerton) and Caughdenoy Dam on the Oneida River, and Oswego Canal Lock O-1 (Phoenix) on the Oswego River. The location of each control point is shown in Figure 43. Physical information such as location, size, type, and width of gates, spillway lengths, and related data, is given in Table 14. Each control point is further discussed below.

- **Erie Canal Lock E-27** is located at Lyons approximately 1.3 miles downstream of Erie Canal Lock E-28A and 12 miles upstream of Erie Canal Lock E-26. This is the western most control structure in the Oswego River Basin and all inflow from non-Canal watersheds are unregulated at this location. Ganargua Creek, which initially joins the Canal from the south below Erie Canal Lock E-29 at the Palmyra Aqueduct and exits via the Harrison Spillway to the north approximately 3 miles downstream, terminates into the Canal upstream of this location. Immediately downstream of this structure the Canandaigua Outlet enters the Canal which contains unregulated flow from Flint Creek and regulated flow from Canandaigua Lake.

- **Erie Canal Locks E-26 & E-25** are located on the Erie Canal at Clyde and Mays Point respectively. These two locks are often considered together because they provide information on the inflow from the western, largely unregulated, portion of the basin. Ganargua Creek joins the Canal at Palmyra immediately downstream from Erie Canal Lock E-29 and then again upstream of Erie Canal Lock E-27. The major regulated lake in this area is Canandaigua Lake (regulated by the City of Canandaigua); its outlet is joined by Flint Creek at Phelps which flows into the Canal at Lyons, immediately downstream from Erie Canal Lock E-27 and about 12 miles upstream from Erie Canal Lock E-26. Erie Canal Lock E-25 (Mays Point) is about 1.5 miles west of where the Clyde River/Erie Canal joins the Seneca River/Cayuga Seneca Canal.
- **Cayuga Seneca Canal Lock CS-1**, on the Cayuga Seneca Canal, is located at the outlet of the Keuka, Seneca, and Cayuga Lake basins. The Cayuga Seneca Canal is essentially the regulated outlet river from Seneca Lake to Cayuga Lake and thence to Mays Point. Cayuga Seneca Lock CS-1 (Mud Lock) regulates the surface elevation of Cayuga Lake. NYSEG regulates a diversion into Keuka Lake from Waneta and Lamoka Lakes in the Chemung River Basin. Gravity Renewables also regulates the outlet from Seneca Lake.
- **Erie Canal Lock E-24** is located at Baldwinsville, 32 miles downstream from Cayuga Seneca Canal Lock CS-1, 30 miles downstream from Erie Canal Lock E-25 (Mays Point), and 11 miles upstream from Three Rivers Junction. Cross Lake forms a part of the Canal about 10 miles upstream. This part of the Canal is essentially formed by the Seneca River and many meanders have been cut off. One of the longer cut-offs is about 1 mile downstream from Cross Lake. The outlet creeks from Owasco and Skaneateles Lakes directly affect the Canal above this control point. The outlet from each of these lakes is regulated by the cities of Auburn and Syracuse, respectively.
- **Erie Canal Lock E-23** is at the downstream end of a manmade channel of the Oneida River near Brewerton. This channel is the first and longest of several channels that cut through the neck of Oneida River meanders. The entire east-west length of Oneida Lake is used in the canal system. The impoundment dam for this section is near Caughdenoy, on the river channel about five miles north of Erie Canal Lock E-23.
- **Oswego Canal Lock O-1** at Phoenix is on the Oswego River about three-miles downstream from the confluence of the Oneida and Seneca Rivers at Three Rivers Junction. This is the most downstream control point and controls the water level in the Erie Canal downstream from Erie Canal Locks E-24 and E-23 as well as the level of Onondaga Lake. Otisco Lake is a tributary to Onondaga Lake; its outlet is regulated by the Onondaga County Water Authority.

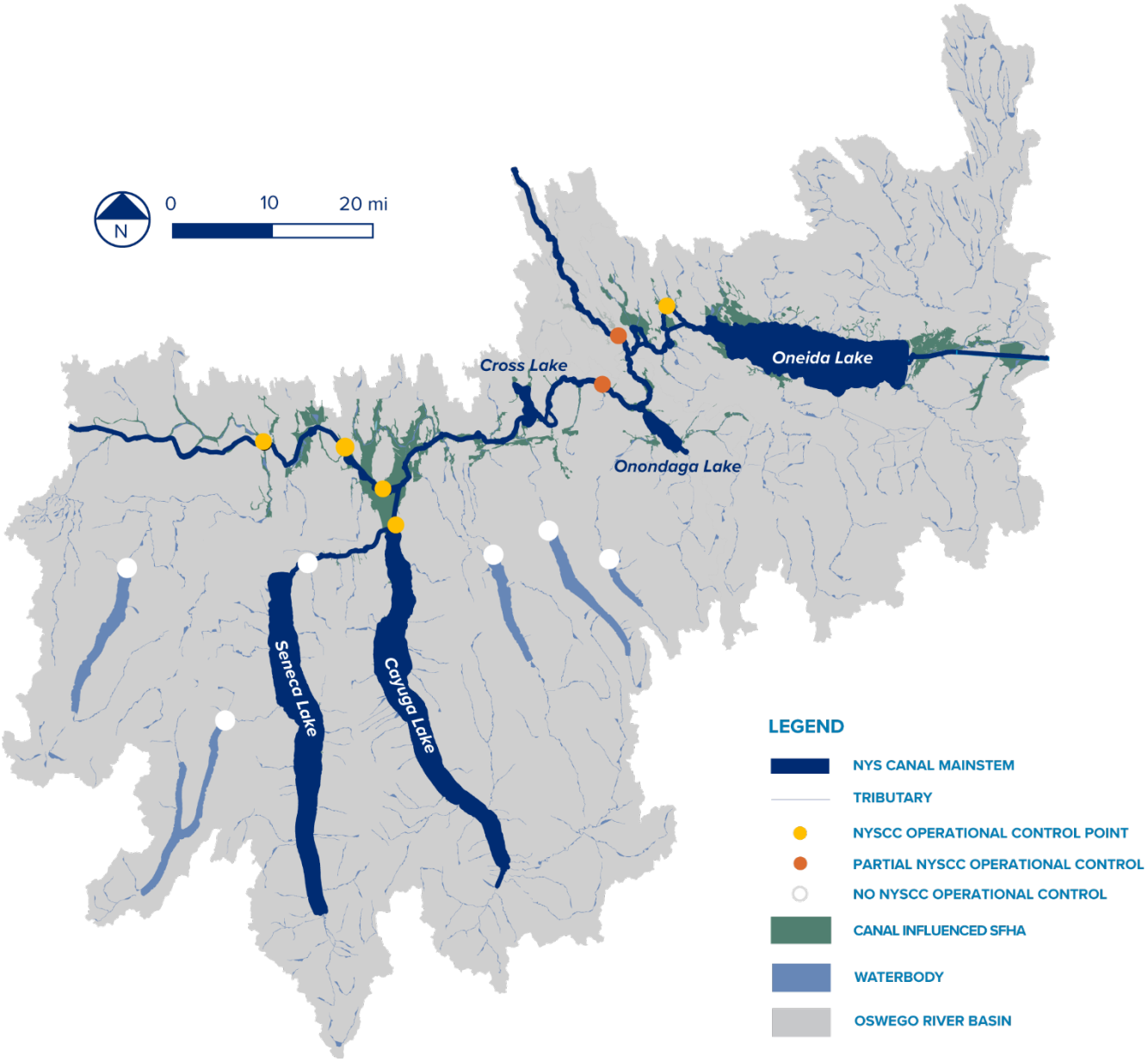


Figure 43: Control Points in the Oswego River Basin

Table 14: Structural Information on the Five Major Control Points of the Barge Canal System within the Oswego River Basin, NY

[Drainage areas in square miles. ft = feet, ft^3/s = cubic feet per second, elevations are in relation to Barge Canal Dam]

	Location, Lock Number, and Canal								
Canal Lock No.	Erie Canal Lock-26 (Clyde)	Erie Canal Lock E-25 (Mays Point)	Cayuga Seneca Canal Lock CS-1	Erie Canal Lock E-24 (Baldwinsville)		Oswego Canal Lock O-1 (Phoenix)			Erie Canal Lock E-23 (Brewerton-Caughdenoy)	
Location:										
Upstream drainage area (square miles)	812	863	1,564	3,138		4,927			1,382	1,382
Lock:										
Length (feet)	330	330	330	330		330			330	-
Width (feet)	45	45	45	45		45			45	-
Vertical lift (feet)	6	6	8.9	11		10.2			7.1	-
Guard Gate	No	No	Yes	Yes		No			Yes	Yes
Control Structure:										
Gate:										
Type	Tainter	-	Tainter	Tainter		Tainter	Tainter	Tainter	-	Tainter
Width (feet)	44	-	30	50		41.5	46.5	32.5	-	52
Number	1	-	6	1		2	3	1	-	7
Sill elevation (feet) NAVD88	374.5	-	369.8	364.7		352.5			-	361.5
Dam:										
Spillway type	Ogee	Mohawk	-	Ogee		Ogee			-	-
Crest elevation (feet)	384.5	3878.2	-	372.7		361.5			-	-
Width (feet)	294	120	-	352		521			-	-
Gates	-	4	-	-		-			-	-
Power Company:										
Name	-	-	-	Brookfield	Northline Energy LLC	Eagle Creek Renewable Energy			-	-
No. of generators	-	-	-	2	3	2			-	-
Max. discharge capacity (cfs)	-	-	-	1200	1700	4680			-	-

Notes:

1. Elevations are NAVD88

The NYSCC has retained remnants of the Southern (West) Reservoir System of the former historic Old Erie Canal. This system includes remnants of the Old Erie Canal extending east from I-481 where it discharges to the summit section of the Canal east of Erie Canal Lock E-21 at New London. Other components include Butternut, Limestone and Chittenango Feeder Canals, Cazenovia Lake, Erieville Reservoir, DeRuyter Reservoir and Jamesville Reservoir. Water not diverted to the Old Erie Canal discharges directly to Oneida Lake via Chittenango Creek. This remnant system and its features provide little water for navigation purposes and serve no purpose for basin wide flood management.

3.8.2. Priorities for Control Point Operations

Control structures at the outlets of Oneida and Cayuga Lakes and at Mays Point, Baldwinsville, and a portion of the Phoenix dam are regulated by NYSCC according to navigation priorities. The responsibility of NYSCC in the

operation of these control structures is to provide adequate water to maintain navigation requirements during the navigation season. During the non-navigation season, NYSCC has historically opened their regulating gates so as not to impede flood flows, with the exceptions of Cayuga Lake outlet and Baldwinsville. The navigation season extends from approximately May 15th through October 15th in the Oswego River Basin. The non-navigation season extends from approximately December 1st through April 1st. Between April 1st and May 15th, and between October 15th and December 1st, NYSCC is transitioning (filling or emptying) the Canal system. Priorities for control point operations in the Oswego Basin, during flooding events, are highly dependent on whether the flooding occurs during navigation season, non-navigation season, or during the filling and emptying transitions. The priorities for control point operations are discussed in more detail below from upstream to downstream and west to east.

- **Erie Canal Lock E-27** has two 20-foot wide Tainter gates and a 30-foot fixed crest dam associated with it. The Tainter gates are operated as needed during navigation season to maintain the upper navigation pool. The Tainter gates are completely open and not operated during the non-navigation season to mitigate flooding.
- **Erie Canal Lock E-26** has one 50-foot wide Tainter gate and 386-foot fixed crest dam associated with it. The Tainter gate is operated as needed during navigation season to maintain the upper navigation pool. The Tainter gate is completely open and not operated during the non-navigation season to mitigate flooding.
- **Erie Canal Lock E-25** has a movable dam associated with it. The movable dam is regulated by NYSCC operators who can open the upper and lower gates as needed during navigation season to maintain the upper navigation pool. The upper and lower gates are raised completely and not operated during the non-navigation season to mitigate flooding. The uprights remain in place during the non-navigation season. The 863 square mile drainage area upstream of the movable dam at Mays Point, other than Canandaigua Lake outlet, is unregulated.
- **Cayuga Seneca Canal Lock CS-1** at Cayuga Lake Outlet has a dam with six 30-foot Tainter gates that are regulated all year round by NYSCC. Daily precipitation measured at the site, iweathernet.com, and water surface elevations and flows from several upstream and downstream gages are used to help decision makers regulate the gates. In addition to regulating for navigation purposes, NYSCC regulates the dam's six Tainter gates to reduce the release of floodwaters to the Seneca River and Cross Lake by partially or completely closing some or all gates. NYSCC operators, however, must limit flooding of Cayuga Lake lakefront properties, and are significantly constrained because they have no control over the combined discharge from Keuka and Seneca Lakes, that amounts to 48% of the 1564 square miles of drainage area upstream of the dam.
- **Erie Canal Lock E-24** is associated with **Baldwinsville Dam** which has one 50-foot wide Tainter gate and 352-foot fixed crest dam associated with it. The Tainter gate is operated as needed during navigation season to maintain the upper navigation pool and through the non-navigation season to maintain the pool for hydropower generation. The downstream reach of the Seneca River is subject to flooding when the water surface elevation exceeds approximately 366 BCD. Two private hydropower facilities are located at Baldwinsville Dam and provide additional capacity for flood flows when operational.
- **Erie Canal Lock E-23** is associated with **Caughdenoy Dam** and includes seven 52-foot wide Tainter gates that are operated as needed during navigation season to maintain the upper navigation pool of Erie Canal Lock E-23. The Tainter gates are completely open and not operated during the non-navigation season to mitigate flooding. Thus, during non-navigation season Caughdenoy Dam has no influence on Oneida Lake flooding but can be opened during the navigation season to help reduce flooding on Oneida Lake.
- **Oswego Canal Lock O-1** is associated with **Phoenix Dam**. NYSCC and Eagle Creek Renewable Energy, share responsibility for regulating outflows from Phoenix Dam, located at the head of the steep gradient

on Oswego River. Within the last eighteen years, a high flow management rule, an agreement between Brookfield Power, Eagle Creek Power, and NYSCC, has provided some flooding relief to low-lying lands along the Seneca and Oneida Rivers upstream of Phoenix Dam. Under the plan, if the discharge at Phoenix Dam exceeds 10,000 cfs, and the lower pool elevation at Baldwinsville Dam at Eire Canal Lock E-24 is El. 366 BCD and rising, then Tainter gates 1 and 2 are opened by NYSCC when requested by Eagle Creek Power.

Cayuga and Oneida Lakes are the only lakes in the basin regulated by NYSCC. Seneca Lake is regulated by Gravity Renewables for hydroelectric power generation and is monitored daily by NYSCC. Canandaigua, Keuka, Otisco, Owasco, and Skaneateles Lakes are regulated by other agencies, mainly for water supply, recreation, and winter ice damage reduction purposes. NYSDEC requires minimum releases during low-flow periods to maintain adequate water quality downstream. Recreational levels take slight priority over flood storage during summer. A summary of the lake level operational control entities is provided in Table 15 below.

Table 15: Lake Level Control Responsibility

LAKE	**CONTROL ENTITY**
Canandaigua Lake	City of Canandaigua
Seneca Lake	Gravity Renewables
Cayuga Lake	NYSCC
Owasco Lake	City of Auburn
Skaneateles Lake	City of Syracuse
Otisco Lake	Onondaga County Water Authority
Onondaga Lake	NYSCC/Eagle Creek[1]
Oneida Lake	NYSCC
Keuka Lake	Village of Penn Yan[2]

Notes:

1. Onondaga Lake water surface is impacted by operations at Oswego Canal Lock O-1. NYSCC and Eagle Creek both have some operational control at this location.
2. Contracted to operate outlet gates via the Keuka Lake Outlet Compact - inter-municipal corporation consisting of eight municipalities: Village of Hammondsport, Village of Penn Yan, Town of Barrington, Town of Jerusalem, Town of Milo, Town of Pulteney, Town of Urbana, and Town of Wayne.

3.8.3. Rule Curves

Target rule curves for each of the major lakes in the Oswego River Basin are established to govern the operations of that lake. The rule curve for a lake considers the priority uses of that lake and balances the remaining needs of lake users. Lake elevation, as shown by the rule curve, varies season to season. For example, the minimum lake levels needed for navigation do not need to be met during the winter non-navigation season. However, if the lake level is dropped to a low level or there is no significant spring rains or snowmelt, it may not be possible to achieve the required navigation elevations. While rule curves generally stay the same from year to year, there can be some variations. During the winter season a priority use of the lake is to allow enough drawdown to store spring runoff. The amount of flood storage that will be needed is, in part, dependent on the extent of the winter snowpack which varies year to year. Rule curves for the lakes listed in Figure 44, Figure 45 and Figure 46 are presented in Appendix C.

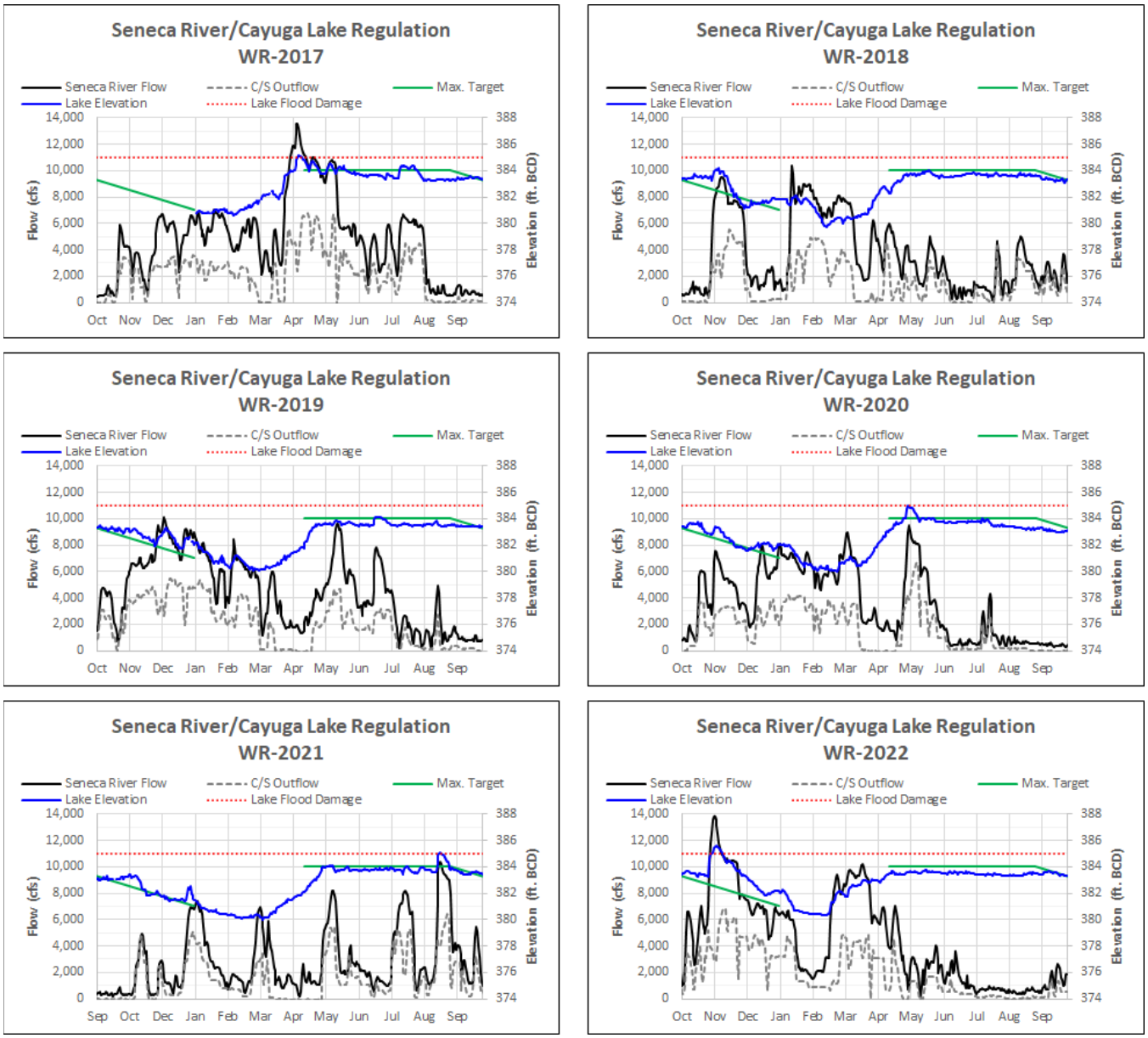


Figure 44: Seneca River/Cayuga Lake Regulation (Past 6 Water Years)

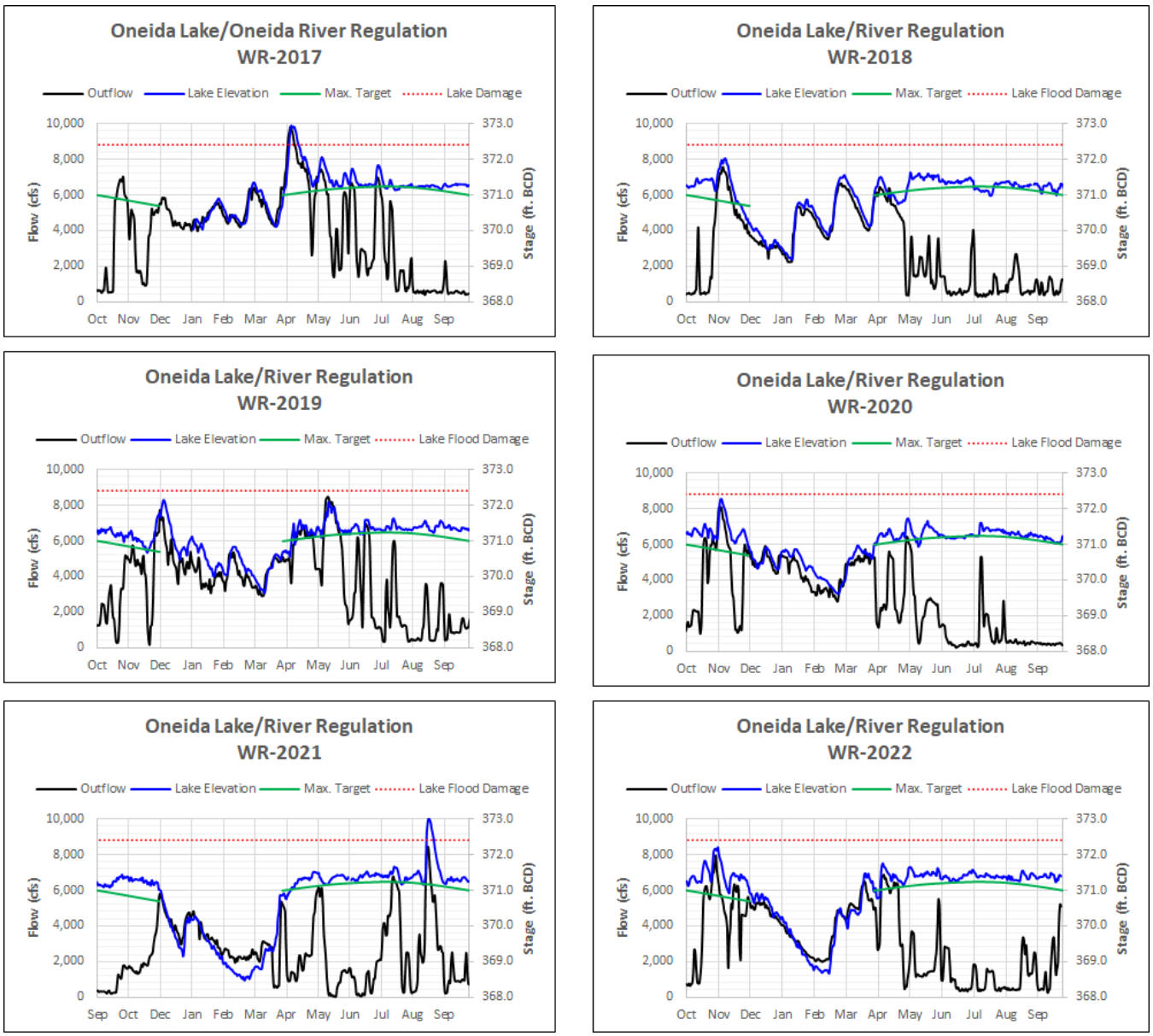


Figure 45: Oneida Lake/Oneida River Regulations (Past 6 Water Years)

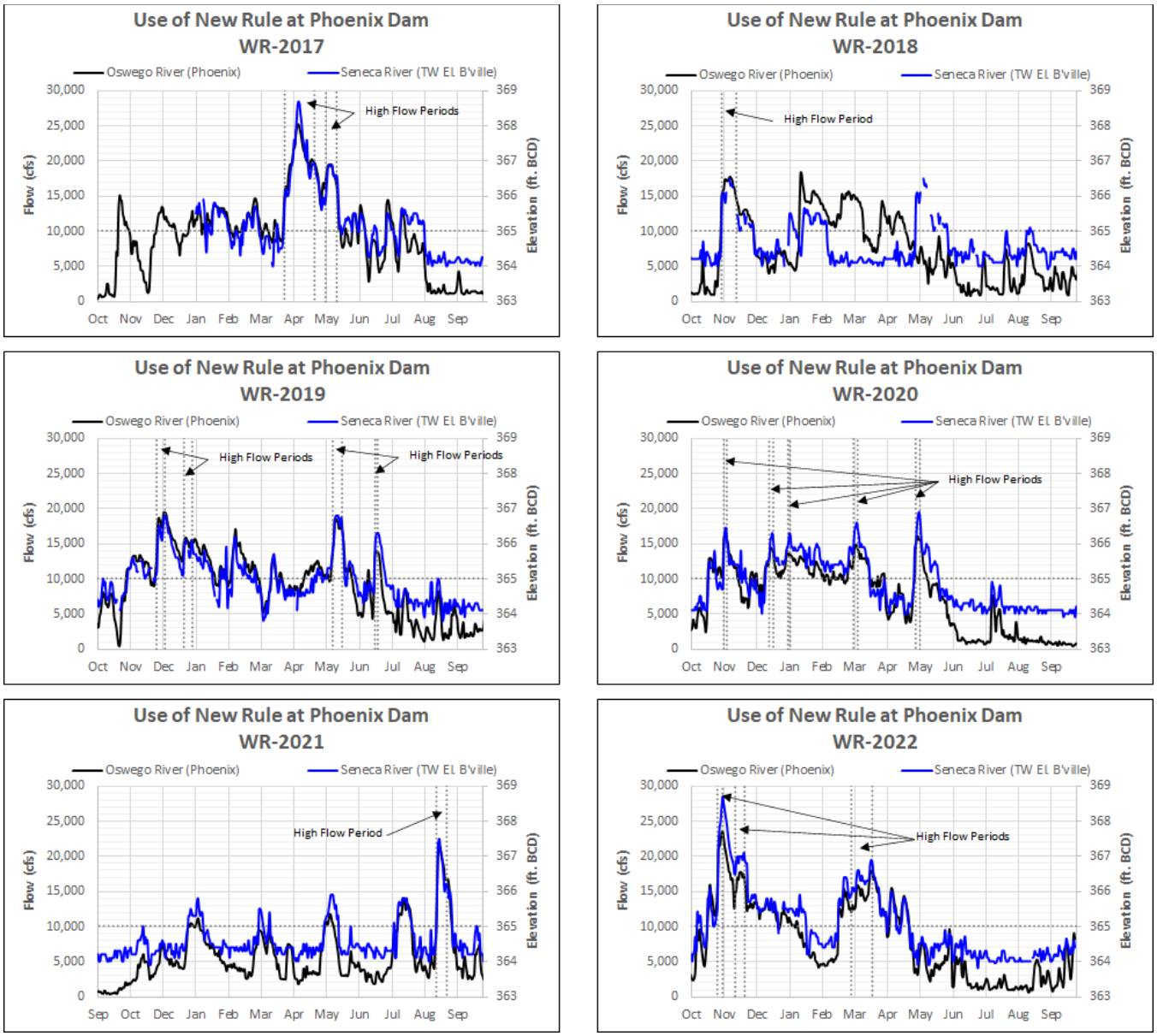


Figure 46: High Flow Periods as Defined by New Rule Curve at Phoenix Dam

3.8.4. General Operational Guidelines

As outlined in the USGS Technical Manual 900-0-02[10], the general operation of each control entails four steps: evaluation of the hydrologic conditions, data review, determination of appropriate action, and follow up monitoring to determine results of action. The following paragraphs explain the types of data needed for decision making in each guideline category and includes examples of their application.

[10] U.S. Department of Interior, the U.S. Geological Survey, *Water-Level Control In the New York State Canal System Within the Oswego River Basin – Description of Control Points And Guidelines To Their Operation*, Technical Manual 900-0-02, 1993.

- **Determine Present Condition** – Pertinent data including upper and lower elevations at each of the control points, gate settings, lake levels, USGS stream gages, meteorologic data (precipitation, snowpack, wind, air temperature, etc.) are obtained to inform all decision-making regarding operations of the control points.
- **Evaluation of Present Condition** – Once the data has been collected, an assessment of the current conditions is completed. This includes plotting of hydrologic data against established rule curves and/or determining changes in flow and lake elevations throughout the basin.
- **Recommend Action** – If the evaluation of data indicates that operational procedures should be adjusted, a particular control may be operated by a predetermined amount to maintain desired water levels upstream and downstream. Specific changes to operations are based on parameters (water surface elevations, flows, precipitation, etc.) that are outlined in USGS Technical Manual 900-0-02. Actions that would warrant changes in the operation procedures include water levels rising that are at or near a particular limit on a rule curve that should not be exceeded, weather forecasts indicate continued precipitation is anticipated, power generation facilities are operating at maximum capacity, and downstream discharges are at unacceptable limits. Control changes should be of sufficient magnitude to either increase or decrease the release perceptibly.
- **Monitoring of Results** – Results of the operational actions are monitored to verify the expected changes, with the above cycle repeated wherein hydrologic data is collected and evaluated to determine if further actions are warranted.

3.8.5. Limitation to the Control Evidenced During Recent Floods

The water year aligns with the federal government fiscal year, from October 1 of one year through September 30 of the next. Water year data consisting of discharge and surface elevation elevations collected from flow and water level gages for the period October 1st 2016 through September 30th 2022 was compiled in a set of six figures and is presented in Appendix D. From review of this information, which shows the extent and duration of flooding, and the season during which the flooding occurred (indicating the effects of NYSCC gate operations for that season) we identify how operations by all operators, during specific flooding events, either reduced flooding, increased flooding or what additional actions by NYSCC and others could have reduced flooding if agreements and operating rules were modified from the rules that are followed today.

Flooding conditions and operations of NYSCC and others can be best discussed in the context of two subbasins: the Seneca River upstream of Three Rivers Junction for flooding of Cross Lake and other low-lying areas along the Seneca and Clyde Rivers and the downstream ends of tributaries affected by them; and the Oswego River upstream of Three Rivers Junction for flooding on Oneida Lake and tributaries affected by its water surface elevation. The specific flood-prone lands are indicated on the Special Flood Hazard Area (SFHA) maps.

- Seneca River Upstream of Three Rivers Junction
  Changes in the water levels behind each control point are dictated by the difference between the inflows and outflows to that respective structure. Inflow cannot (for the most part) be controlled by the NYSCC. This is exemplified by the inflow to Erie Canal Locks E-26 and E-25 that (besides the outflow from Canandaigua Lake) is largely unregulated. Additionally, outflow can be controlled to a certain extent based on the discharge capacity of the outlet structure with the capacity influenced by the physical state of the control structure (i.e. gate settings, spillway elevations, etc.). For Erie Canal Lock E-24, discharge capacity is far exceeded by potential inflows to Cayuga Lake so water surface elevations will respond slowly to adjustments made to gate settings. Additionally, the difference between the water surface elevations upstream (headwater) and downstream (tailwater) of a structure will limit outflow capacity. At Cayuga Seneca Lock CS-1, inflow from the Clyde River can raise tailwater elevations in the Cayuga Seneca Canal where no flow

is possible out of Cayuga Lake. In extreme cases with high enough tailwater, flow can be reversed (i.e., Cayuga Seneca Canal flowing into Cayuga Lake in this part of the Basin.)

Since NYSCC only controls a portion of the entire river basin, their amount of influence in preventing downstream flooding is largely limited. Flow entering the Clyde River (USGS 0423527080) is largely unregulated (aside from 184 square miles of Canandaigua Lake's watershed) and greatly contributes to the flooding that occurs along the Seneca River, specifically in the Cross Lake section between Erie Canal Locks E-25 and E-24 (see Figure 47). The flooding that occurred in April 2023 along Cross Lake exemplifies this limitation. Figure 48, Figure 49, Figure 50, Figure 51, and Figure 52 below illustrate the discharge hydrographs at USGS gages during the event and the water surface between the E-24 dam and a point just downstream of Cayuga Seneca Canal Lock CS-1 Tainter gated dam.

On April 6, 2023, NYSCC began reducing outflow from Cayuga Lake at Cayuga Seneca Canal Lock CS-1 in response to a spring rainfall-runoff event (Figure 48). One day later, after NYSCC had reduced Cayuga Seneca Canal CS-1 outflow, water surface elevations at Cross Lake reached the damage initiation elevation, driven by flow from the western portion of the Oswego River Basin as noted by the inflow at Clyde (Figure 49). Two days later, while NYSCC continues to limit outflow from Cayuga Lake, yet water surface elevation at Cross Lake has crested (Figure 50). Three days later, NYSCC begins to increase outflow from Cayuga Seneca Canal Lock CS-1 once the water surface elevation at Cross Lake has fallen below the Cross Lake damage initiation elevation (Figure 51). Four days later, NYSCC further increases outflow from Cayuga Seneca Canal Lock CS-1 as the water surface elevation at Cross Lake continues to fall (Figure 52). In this instance, NYSCC conducted operations at Cayuga Seneca Canal Lock CS-1 to limit downstream flooding but in spite of their best efforts water surface elevations reached and exceeded the damage level along Cross Lake.

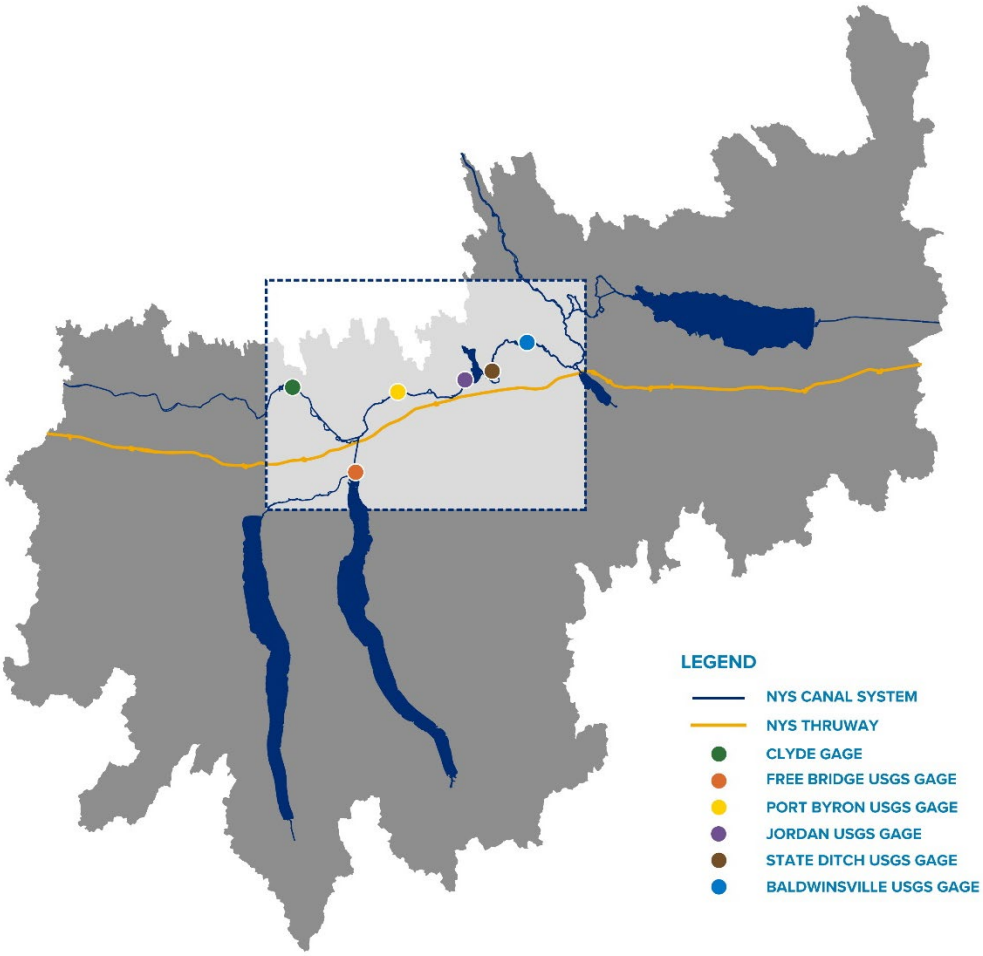


Figure 47: Location of USGS Stations along the Clyde and Seneca Rivers

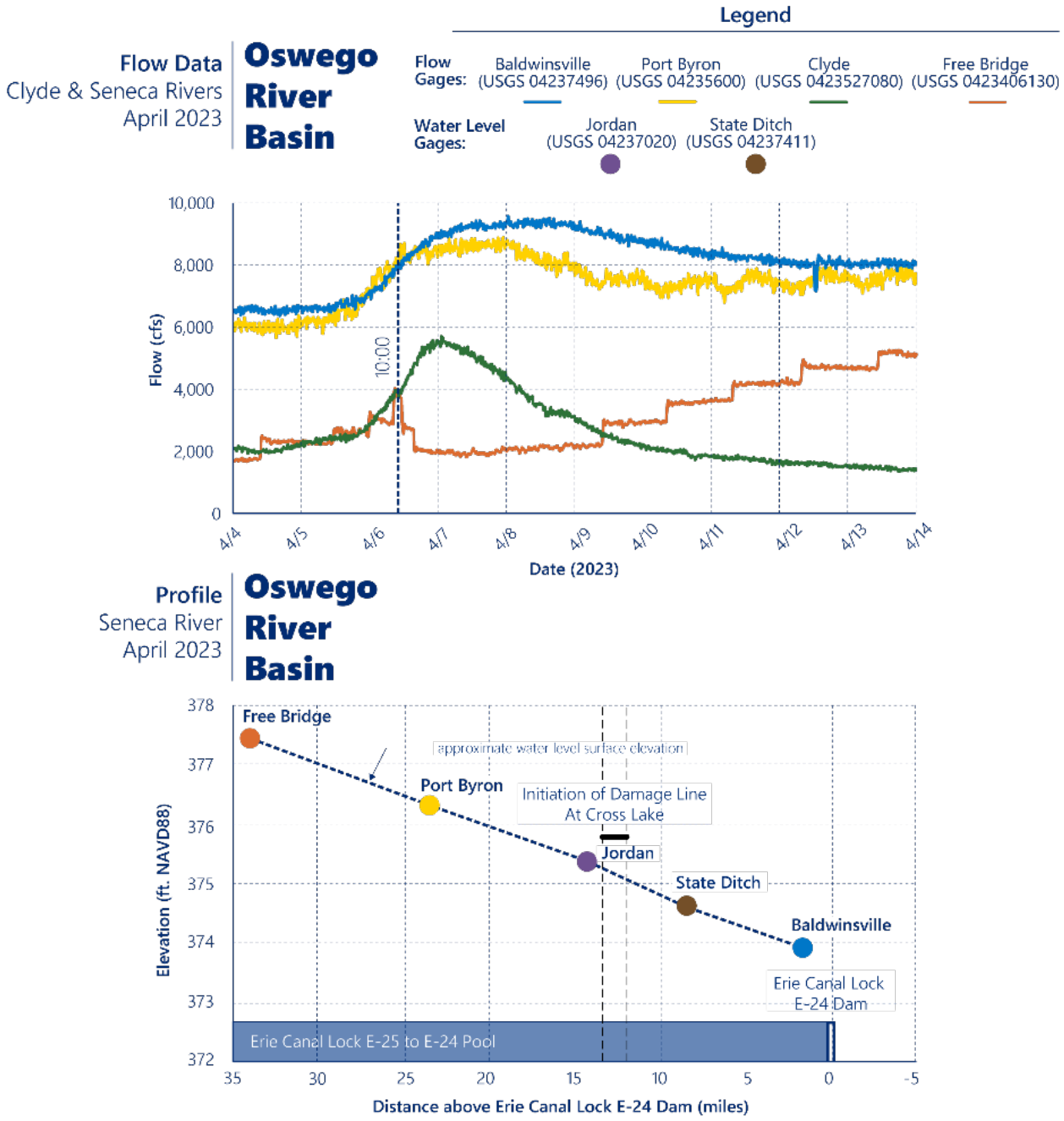


Figure 48: Hydrographs and Stage Profiles for the Seneca River (4/6/2023, 10:00 am)

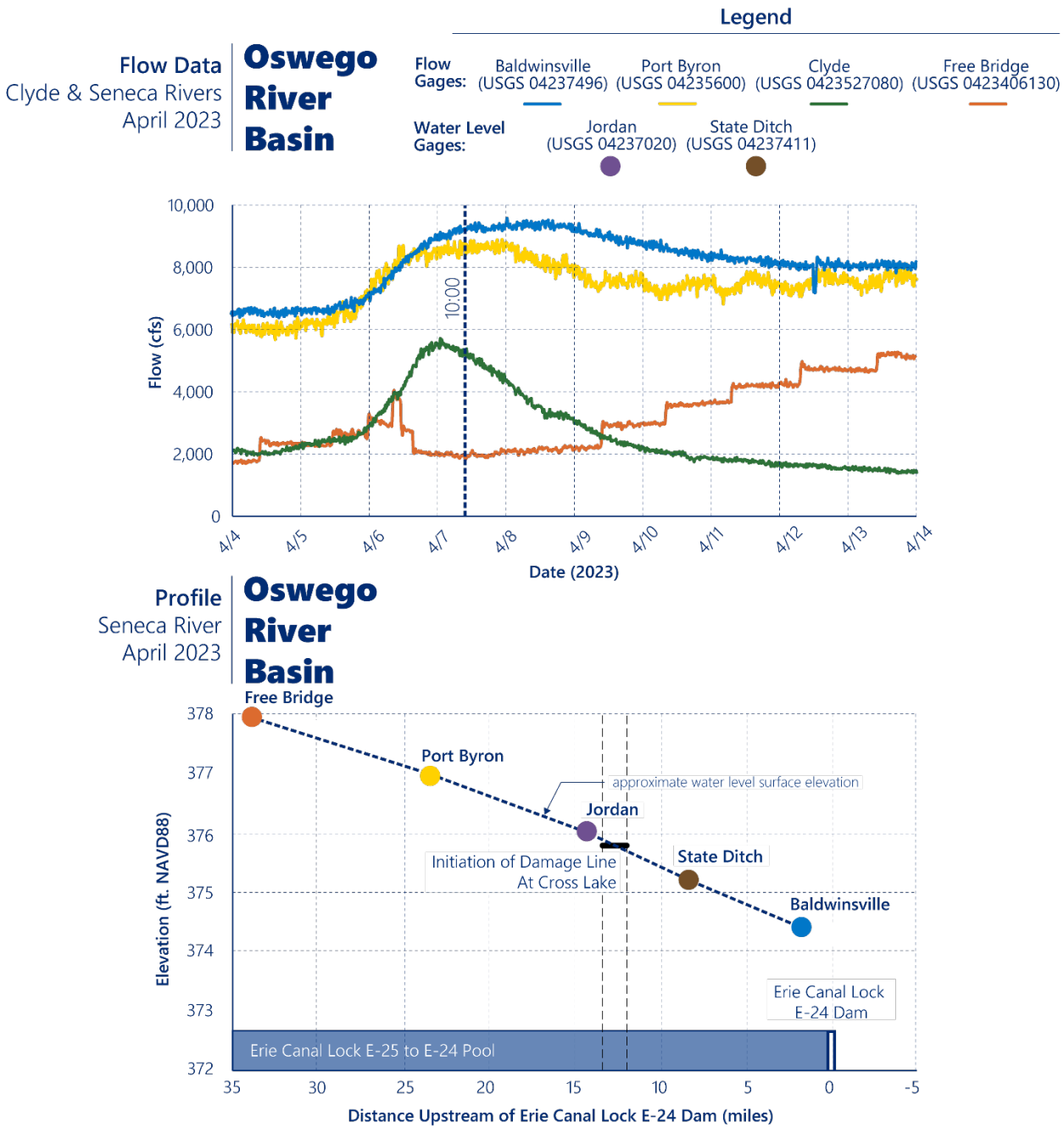


Figure 49: Hydrographs and Stage Profiles for the Seneca River (4/7/2023, 10:00 am)

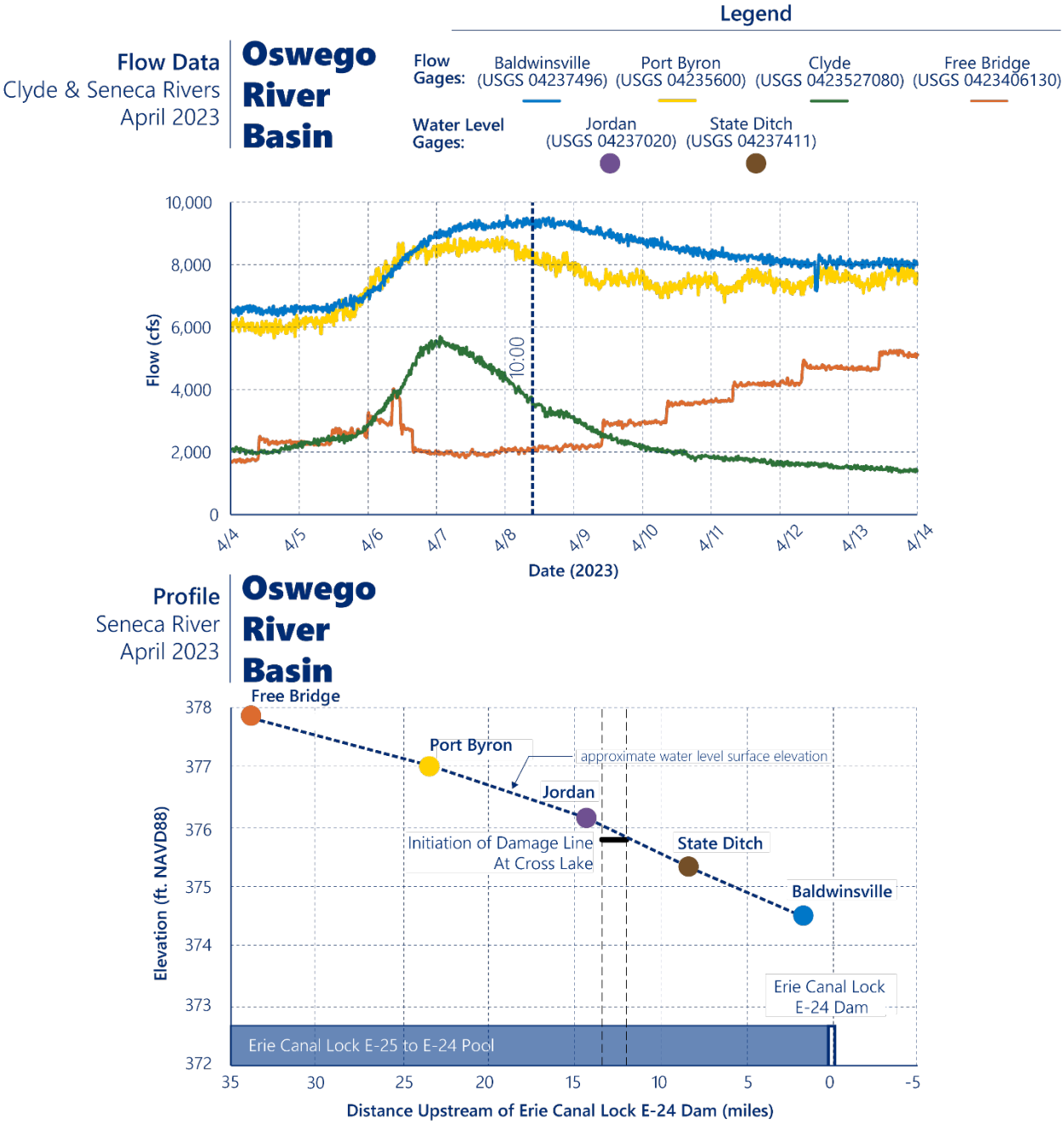


Figure 50: Hydrographs and Stage Profiles for the Seneca River (4/8/2023, 10:00 am)

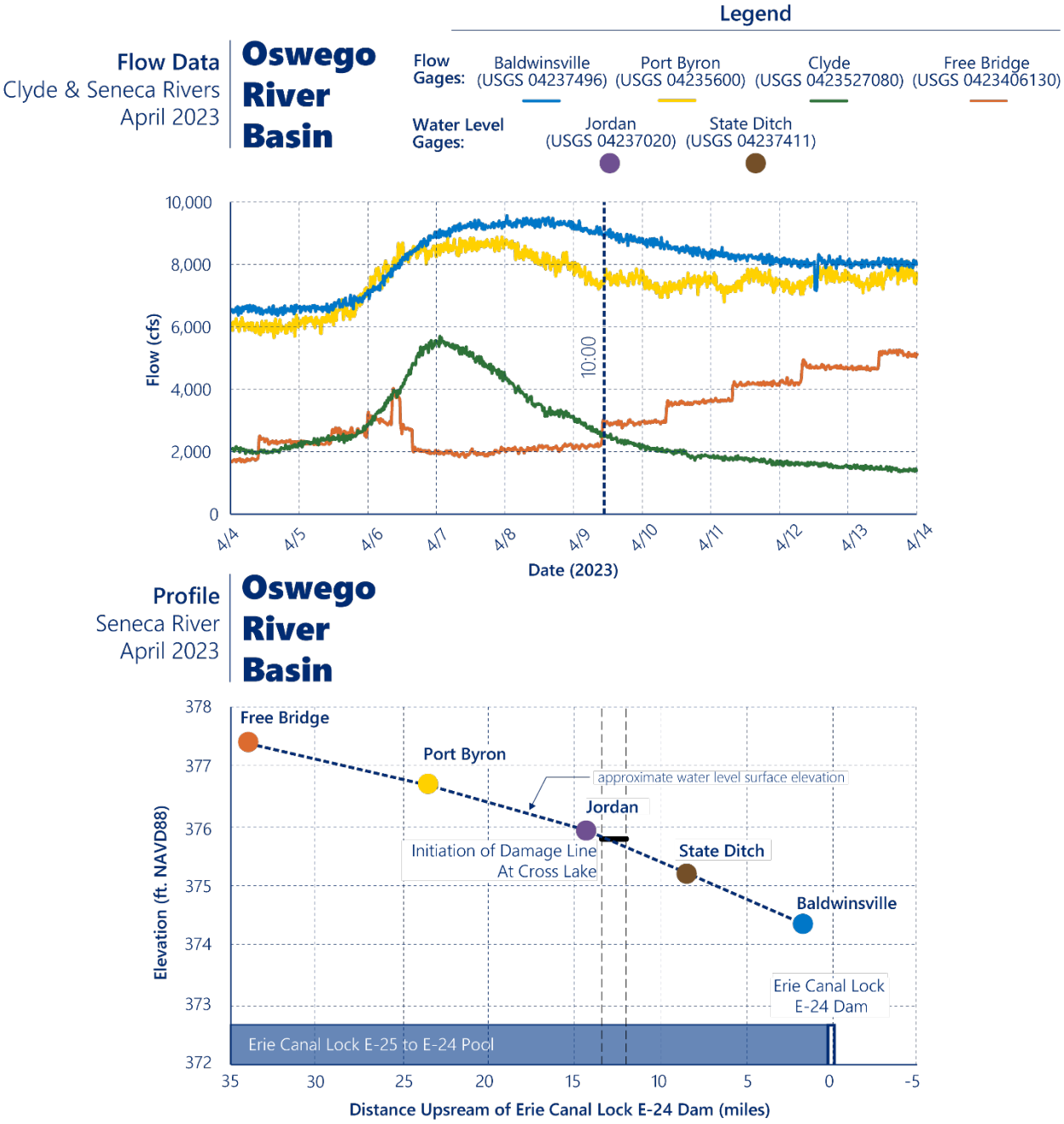


Figure 51: Hydrographs and Stage Profiles for the Seneca River (4/9/2023, 10:00 am)

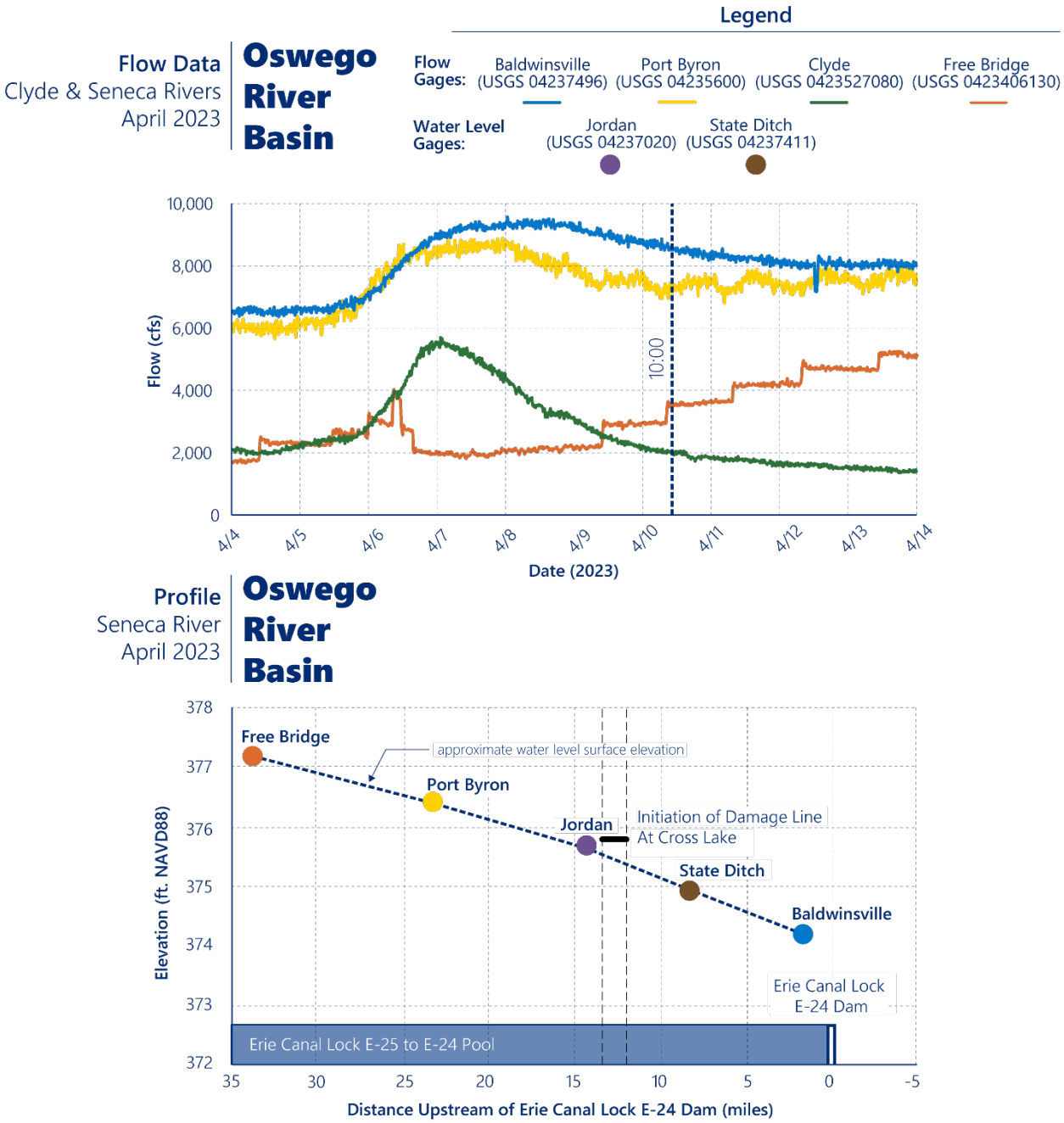


Figure 52: Hydrographs and Stage Profiles for the Seneca River (4/10/2023, 10:00 am)

- Oneida River Upstream of Three Rivers Junction - From a review of the flow and water surface elevation records from the USGS gage no. 04247000, Oneida River near Euclid, NY for the period from October 1st 2016 thru September 30th 2022, we find that Oneida Lake levels have not approached the Lake's damage initiation elevation at any time in the last six years during the non-navigation season when NYSCC has all the gates of Caughdenoy Dam open and implements the high flow management plan at Phoenix Dam. All Oneida Lake flooding and near flooding events have occurred during navigation season or during the operations transitions between navigation and non-navigation season. These events were summarized in Table 13 above. The first of these occurred between April 8 – 17, 2017 when the Canal was being rewatered

for navigation season when the high flow management rule at Phoenix was in effect and utilized. During this event, Oneida Lake rose approximately 0.5 feet above flood stage. During the flood, the seven Caughdenoy Dam Tainter gates were fully opened. The second of these occurred between August 20 – 27, 2021 during navigation season when the high flow management rule at Phoenix was in effect and utilized. During this event, Oneida Lake rose approximately 0.5 feet above flood stage. During the flood, the seven Caughdenoy Dam Tainter gates were fully opened. Based on discussions with NYSCC, it takes an hour for a crew to open all seven gates which is sufficient time to respond to a flood event in this portion of the basin.

- Underutilized Flood Storage in Finger Lakes – From examination of the Appendix D (6 graphs/lake group) rule curves, Owasco, Seneca and Keuka Lakes operate well below their reported damage initiation elevation, meaning that if the control points at the lake outlets of the lakes followed a different operating procedure during high flow events, potential downstream flooding could be mitigated. For example, during a spring period, high flow procedure could allow a for a greater amount of surface runoff to be stored below the initiation of lake flooding line. The flooding along Cross Lake that occurred during Spring 2017 exemplifies the potential for downstream flood mitigation. During this period, Cross Lake exceeded its damage initiation level for almost 2-months. While this was happening, many of the upstream lakes with available records were operating near their targeted rule curve, well below their respective damage initiation elevation. Cayuga Lake was the only lake operating above or within 0.5-ft of the damage initiation level. Stage records from this event are shown in Figure 53. The potential available storage for each of the lakes in the Oswego River Basin is summarized in Table 16. Rules would be seasonally developed for these three lakes for summer and winter operating levels, and the transitions between the seasonal operating levels.

Figure 53: Available Stage Hydrographs During Spring 2017

Table 16: Potential Available Storage in the Oswego River Basin Lakes

Waterbody	Contributing Drainage Area (mi^2)	Target Rule Curve Max. Elevation[1] (El. ft)	Target Rule Curve Min. Elevation[1] (El. ft)	Flood Damage Elevation[1] (El. ft)	Minimum Available Storage[3]		Maximum Available Storage[5]	
					Volume (ac-ft)	Runoff[5] (inch)	Volume (ac-ft)	Runoff[5] (inch)
Canandaigua Lake	184	688.0	686.4	689.0	10,671	1.09	27,745	2.83
Keuka Lake	182	714.0	711.5	714.5	5,850	0.60	35,100	3.62
Seneca Lake	704	444.8	443.8	446.5	74,180	1.98	117,180	3.12
Cayuga Lake	1,564	382.4	379.4	383.2	34,182	0.41	162,363	1.95
Owasco Lake	205	712.5	709.5	714.5	13,194	1.21	32,985	3.02
Skaneateles Lake	73	864.3	861.3	864.8	4,375	1.13	30,625	7.90
Otisco Lake	39	789.2	785.2	789.6	948	0.45	10,178	4.86
Oneida Lake[2]	1,382	370.4	366.9	371.5	56,342	0.76	235,612	3.20

Notes:

1. WSE in feet NAVD88 unless otherwise noted
2. No winter drawdown in Oneida Lake – assumed minimum WSE
3. Minimum Available Storage = Storage at Flood Damage – Storage at Maximum Rule Curve Elevation
4. Maximum Available Storge = Storage at Flood Damage – Storage at Minimum Rule Curve Elevation (i.e., Winter Drawdown)
5. Runoff = Volume/Drainage Area x 43,560-ft2/1-ac x (1-mi/5,280-ft)2 x 12-in/1-ft
6. Source: USACE "Cross Lake/Seneca River Flood Damage Reduction Measures", Appendix A, October 1997

3.9 ERIE CANAL OPERATIONS AND FLOODING FINDINGS

Through reviewing prior studies of the Mohawk and Oswego Basins (Appendices A and B) and assessing New York Canal System operation procedures and plans in the Mohawk and Oswego Basins over the Canal's history since 1918 and specifically over the last five years, from 2017 through 2022, yielded the following findings:

1. Numerical watershed models capable of estimating the magnitude, timing, and duration of flood peaks do not exist and are essential to improving Canal System operations, emergency response during flood events, and estimating benefits of operational or structural changes.
2. No single entity has full operational control over normal water releases or managing flooding within either basin, therefore, mechanisms to encourage cooperation and communication between water control entities, community stakeholders, state agencies is needed.
3. Although FEMA utilizes the NAVD88 datum to communicate flood elevations to the public, NYSCC still presents publicly facing water levels in Barge Canal Datum, and some other entities use NGVD29 datum to publicly communicate water levels. This creates confusion for the public and can result in miscommunication between water management entities.
4. Since 2018 when NYSCC developed and implemented a Movable Dam procedural change to reduce flooding damages to their own infrastructure and to residents and businesses, only seven of 52 FIRM panels have been revised to reflect this procedural change. This results in higher NFIP flood insurance premiums for residents and businesses located in the SFHA impacted by the change.
5. NYSCCs movable dams use early 20th century, labor intensive technology to raise and lower the gate structures requiring at least 72 hours advance notice of a storm to fully raise all movable dams. The reliance on longer range forecasts reduces accuracy and can lead to unnecessary interruptions in navigation.
6. Baldwinsville Dam at Erie Canal Lock E-24, although operated in coordination with Phoenix Dam at Oswego Canal Lock O-1, provides very little active flood control on the Seneca River upstream of Baldwinsville due

to the low gradient and presence of only one Tainter gate, relying on overflow of the spillway for most storm flow passage.

7. Several flood mitigation regions (Counties) within the Mohawk and Oswego River Basins do not have digital FIRMs based on recent studies which are needed by local communities for floodplain management and flood insurance ratings as well as local stakeholders to properly assess their risks. These include Herkimer, Cayuga, Oneida, Onondaga, Oswego, Madison and Schuyler Counties.

These findings illustrate that while the NYSCC has been thought by some to exert primary control of water releases and flood risk management in the Mohawk and Oswego River Basins, actual water control and flood risk management is shared by many water control entities, making water control operations and flood risk management much more complex, requiring a broad range of adaptive measures that are presented in Section 5 of this report.

4.0 Assessment of Floodplain Regulation Policies

The Task Force recognizes that NYSCC and NYPA have limited ability to reduce flooding. There are steps that can be taken within the areas of Canal jurisdiction to reduce the adverse effects of flooding, including changes to Canal infrastructure and operations that have reduced or will reduce the recurrence and extents of flooding. This includes changes to the operation of the movable dams on the Mohawk River, the use of the ice breaker on the lower Mohawk River, as well as recommendations made in Section 5 of this Report.

Unfortunately, there is no silver bullet to eliminate flood damage. As long as homes, businesses and infrastructure intrude into natural floodplains, there will be flood damages. Flood damages are also increasing due to an increase in peak precipitation in the Northeastern United States, and due to changes in development within watersheds.

Solutions to flood damage cannot be accomplished by any single agency. Within New York State, agencies that must contribute to reducing flood damages include but are not limited to NYSDEC, the Environmental Facilities Corporation, NYSDHS, the Division of Housing and Community Renewal, the Department of Education, NYSDOT, the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP), the Office of Resilient Homes and Communities (formerly GOSR), Division of Homeland Security and Emergency Services (DHSES) as well as NYSCC. These agencies must also partner with Federal agencies including FEMA, EPA, USGS, USACE, NRCS and others. On the local level, county and regional planning agencies, soil and water conservation districts, cooperative extensions, and individual towns, cities, and villages all have important roles to play.

Approaches to flood damage cannot simply move flooding from one location to another. While the water must go somewhere, blocking flows, redirecting flows, or increasing flows should not be done if the result is to increase flooding elsewhere.

4.1 FLOODPLAIN MANAGEMENT

All water bodies have a floodplain. This is an area of normally dry ground that periodically floods. Throughout much of American history, people have addressed periodic flooding primarily by trying to separate the water from developed land using structural devices such as dams and levees. People have also ignored the threat of periodic floods by building in places that only flood occasionally.

Floodplain management is a different approach. There is no single definition. Rather than fighting an ultimately losing and expensive battle to keep water away from development, the idea is to manage development so that when floods happen, damages are minimized, and repairs and restorations can occur quickly and with minimal expense. This is done through floodplain development regulations, land use planning, building codes, mitigation, and other techniques.

To manage and reduce future flood damage, we need approaches within the water bodies themselves, within the floodplains, as well as within the watersheds. We need the tools to make informed decisions, such as gauges and flood maps. We need sufficient weather and stream gauges to monitor conditions and study changes. Data from stream gages, LiDAR (Light Detection and Ranging used to derive detailed topographic mapping), topographic survey and elevation data of structures along our streams must be fully integrated into updated flood maps so that residents, businesses, and government agencies can make better decisions to protect against future floods.

The recommendations in Section 5 would help all of upstate New York, including the Oswego and Mohawk watersheds, take major steps to reduce future flood damage.

4.2 FLOOD MAPPING

Detailed FEMA flood maps and accompanying Flood Insurance Studies (FIS) determine 10%, 2%, 1%, and 0.2% annual chance flood flows, flooding extents, and flood elevations. This is the equivalent of 10-year, 50-year, 100-year, and 500-year floods. It is more accurate to present this as an annual probability rather than a recurrence

interval. While a 1% annual probability seems small, within any 30-year period, that equates to a 26% chance of occurrence. The 1% and 0.2% floods are depicted on FEMA's FIRMs where detailed flood studies have been done. The 10% and 2% floods, in addition to the 1% and 0.2% floods, are depicted on stream profiles in the FIS documents.

Up to date flood maps are needed to make informed decisions about the design and placement of buildings and infrastructure. While much of the Mohawk River Basin has been remapped by FEMA in the past 15 years, much of the Oswego River basin does not have updated, recent, digital flood maps. There are many areas in which flood maps only show "approximate" flood zones without detailed studies. In those areas, the maps only show the estimated 1% annual chance of flooding without any flood elevations.

FIS and FIRMs are developed and published by FEMA. Prior to about 2000, maps, and the studies used to develop the map information, were completed primarily on municipality-by-municipality basis. As a result, a town or village may have a FIRM with different flood extents or flood elevations than the town or village across the river or reservoir, or there may be a sudden jump or drop in flood elevations at a municipal boundary. Beginning in about 2000, new FIRMs are released on the county level. However, in many places, the older flood studies were merely "redelineated" onto a new topographic layer with no change in flood elevations or changes in the FIS. Only since about 2010 has FEMA begun to undertake flood mapping studies on a watershed basis.

Many counties with land within the Mohawk and Oswego watersheds still have old paper flood maps, some of which date back to the 1980s. Counties without even digital maps include:

Mohawk Basin: Fulton, Hamilton, Herkimer, Lewis, Madison, and Saratoga, however, digital mapping is in progress for Fulton and Saratoga Counties.

Oswego Basin: Chemung, Cortland, Ontario, Schuyler, Seneca, Steuben, Tompkins, Wayne, and Yates, however, digital mapping is in progress for Ontario, Seneca, Tompkins, Wayne, and Yates Counties.

Flood map updates in New York and throughout the nation have lagged due to federal budget limitations. During most budget years, FEMA spends about $400 million nationwide on FIS and FIRM updates. The Association of State Floodplain Managers (ASFPM) estimates the cost to complete the updated flood mapping nationwide is between $3.2 billion and $11.8 billion, with a cost to maintain the FIRMs ranging from $107 million to $480 million annually. Federal flood mapping expenditures can barely maintain existing maps and cannot begin to tackle the unmet mapping needs.

Even where maps are updated, mapping data looks backwards, using either stream gage records, or USGS regression equations that are in turn based on gage records in portions of the state or adjacent states. New maps should look not only at current flood risk but should also incorporate information about future flood risk due to climate change plus the impact of development on runoff and peak floods. The new future conditions mapping would also support the State Flood Risk Management Guidance (SFRMG) developed to assist permittee comply with the Community Risk and Resiliency Act (CRRA) and the Climate Leadership and Community Protection Act (CLCPA) Note that North Carolina has contributed funds so that flood maps in much of that state include future conditions based on future development within watersheds.

FEMA flood maps also assume that floods are free flowing. They do not consider debris blockages and potential ice jams are not considered. As a result, FIRMs, by definition, underestimate flooding extents where debris blockages or ice jams are present.

FEMA is willing to add data to mapping products but is not able to do so within FEMA's limited mapping budget. More useful maps and studies, including future conditions data and flood depth data, can be produced but require non-federal partnerships. FEMA has a program known as Cooperating Technical Partners (CTP) that allows for non-federal partners to contribute to flood map production. New York State, through the NYSDEC Floodplain Management Section, is a CTP and uses this arrangement to assist with mapping related community outreach and

development of non-regulatory mapping products such as Base Level Engineering but does not currently have the resources to produce additional regulatory mapping data or to accelerate the pace of mapping.

4.3 BUILDING CODES AND DEVELOPMENT STANDARDS

Regulations promulgated for floodplain development only apply within the FEMA defined SFHA, which is the area on FEMA published FIRMs that would be inundated by the 1% annual chance flood. Development standards within those areas are derived from FEMA regulations and also exist in the Uniform Code of New York State. FEMA minimum standards are contained in the Code of Federal Regulations at 44 CFR 60.3. Those regulations have not been updated since the 1980's although FEMA is currently investigating the possibility of a regulatory update. The Uniform Code of New York is based on the International Building Code with some variations and is updated every three years.

Minimum federal NFIP standards are enforced on the local level, or by the State of New York for state projects. FEMA standards include elevating at least to the lowest floor of a new or substantially improved building to the Base Flood Elevation (BFE – Elevation of the 1% annual chance flood). Non-residential buildings must be either elevated or floodproofed to at least the BFE. Regulations do not extend beyond the horizontal extent of the Base Flood, even if development or climate change expands the area at risk of flooding. Without new maps and regulations, there is no current authority to regulate development in the wider area subject to larger and more damaging floods.

Since 2006, the Uniform Code of New York State has exceeded FEMA NFIP minimum standards by requiring the lowest floor of new or substantially improved buildings within the SFHA to be at least two feet higher than the BFE. Non-residential buildings must either be elevated to the elevation standard or be floodproofed to that elevation. This significantly reduces flood risk for new and substantially improved buildings. The additional elevation above the base flood elevation is known as freeboard.

Land use activities other than buildings also affect flood risk. This is reflected in FEMA regulations and local laws with respect to floodways. Floodways are areas adjacent to rivers and streams that must be kept clear of development to pass the base flood without increasing flood elevations. Floodway boundaries are estimated by first establishing the BFE, and then theoretically squeezing the floodplain from both sides until the BFE increases by one foot at some location. At that point, the floodway is designated and no new development within the floodway is allowed by NFIP compliant local laws without either an engineering analysis that concludes that the development will not increase the base flood elevation by any measurable amount, or by undertaking a Letter of Map Change to show the change. The map change process must not result in increasing harm to any developed property.

Other land use activities are vaguely referenced in FEMA's regulations by requiring all building sites, subdivisions, and other proposed new development to be "reasonably safe from flooding." FEMA regulations also require water supply systems and sanitary sewer systems to be designed to minimize or eliminate infiltration of flood waters into the system and, in the case of sanitary sewer systems, prevent discharges from the systems into flood waters.

Within existing regulations, it is legal to elevate land outside of the floodway by means of fill. There are also no specific floodplain standards with respect to runoff.

Most of the region's building stock was constructed before there were floodplain regulations. The earliest NFIP local regulations date to the mid-1970s. Structures built before that are grandfathered (not subject to updating based on a new rule or law) unless they have been substantially damaged or are being substantially improved. Substantial damage is defined as damage from any cause that would cost at least 50% of the pre-damage structure value to repair and restore to pre-damage condition. Substantial improvement is any physical improvement, including additions, that costs at least 50% of the pre-improvement structure value. In these cases, a structure is treated as though it is new construction and must meet all current floodplain development requirements if any portion of it is within a SFHA.

An under-utilized state regulation is 6 NYCRR Part 502. This NYSDEC regulation requires all state projects to meet FEMA floodplain standards. A state project is any project on state land, or any project undertaken or fully or partially funded by a state agency. No permit from either the state or FEMA is required, however, NYSDEC is authorized to issue variances from the floodplain standards and requirements. This regulation is important, underutilized, but also dated. For example, the regulation does not include current state building code freeboard standards. Also, without a specific oversight responsibility and sufficient resources, many state funded projects "fall through the cracks".

There are three areas in which current regulations fail to adequately protect against flood damage. They relate to older structures that do not meet current standards, standards that need to be strengthened, and land use decisions that could increase flood risk.

Detailed recommendations are contained in the New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act (August 2020, NYSDEC)). The Community Risk and Resiliency Act (CRRA) applies to various state permit programs. However, the published guidance should apply to all development under state or local jurisdiction. Major recommendations are based on the Federal Flood Risk Standard, updated in 2015 by Executive Order 13690[11], are that flood hazard areas and BFEs should be based on one of the following:

- The elevation and horizontal flood hazard area that results from adding two feet (three feet for critical facilities) of freeboard to the base flood elevation and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground;
- The vertical flood elevation and corresponding horizontal floodplain subject to flooding from the 0.2% annual chance flood; or
- The elevation is determined by a climate-informed science guideline elevation in which adequate actionable science is available.

Other suggestions for higher floodplain standards relate to filling of flood-prone land. FEMA's floodway standard has already been covered. That standard does not allow any development, including fill, within a designated regulatory floodway without an engineering analysis that can prove that the development will not result in any (0.00 foot) increase in the BFE, either by backing up floodwaters or increasing peak flows downstream by eliminating floodplain storage by filling of flood-prone land. New York uses the FEMA minimum floodway standard, which establishes the floodway boundary based on a one-foot rise in the BFE if the area between the edge of the floodway and the edge of the SFHA are filled in. This area is known as the floodway fringe. Other states, including New Jersey, use a higher standard in developing the floodway, with a computed increase in the BFE of less than one foot. The actual amount varies by states that have more restrictive standards. The result is a wider mapped floodway and a lower increase in the BFE if the floodway fringe is developed.

Even within the floodway fringe, fill can result in increases in base flood elevations, even if the increase is less than that allowed when establishing the floodway. Often new development is elevated on fill to raise the lowest floor to above the BFE plus freeboard. This significantly decreases the risk to the development, but also reduces flood storage capacity within the floodplain. While an individual development may not create a measurable increase in flood elevations, multiple developments combined may have an impact. A way to avoid that impact is to not allow fill in an SFHA unless at a minimum, a comparable amount of material is removed. This is known as compensatory flood storage.

Stream buffers are another way to decrease risk to future development, while maintaining the environmental benefits of floodplains. Stream buffers can include space for recreation and enjoyment of natural resources. A

[11] E.O. 13690 built upon and strengthened an earlier Executive Order, E.O. 11988 (May 24, 1977) with respect to federal projects in floodplains. The E.O. was overturned by E.O. 13807 (8/15/2017) but reinstated by E.O. 14030 (5/20/2021)

challenge with stream buffers is that different rivers and streams behave differently, and a simple buffer width may not be appropriate in all locations.

4.4 LOCAL GOVERNMENT ASSISTANCE

Federal and State Governments cannot directly manage land use. However, under the NFIP, local governments with land use authority (towns, cities, and villages in New York) agree to pass and enforce local laws or ordinances that meet or exceed FEMA's regulations to participate in the National Flood Insurance Program (NFIP). Federally backed flood insurance may only be purchased in NFIP participating communities. Federal disaster assistance for damaged buildings within the SFHA is not available in communities that do not participate in the NFIP.

Floodplain regulations are enforced at the local level except for state or federally owned land. Local governments are responsible for enforcing floodplain standards both under their local laws, passed as a condition of participation in the NFIP, and through the Uniform Code of New York State.

Nearly all New York municipalities that are covered by a FEMA flood map participate in the NFIP. The Floodplain Management Section of NYSDEC assists communities by helping them pass compliant local laws, by offering technical assistance and training, and by undertaking reviews of their floodplain permitting and enforcement. However, with over 1500 NFIP participating communities in New York (the second most of any state in the nation) and with the limited floodplain management dedicated NYSDEC staff, the existing staff cannot begin to offer the amount of assistance needed at the local level.

Local governments' buildings, code enforcement, zoning, and planning staff are constantly changing. Many of our municipalities are small and municipal employees often serve several functions. For this reason, local expertise is often lacking, and local governments depend on outside assistance to carry out their responsibilities.

NYSDEC receives an annual grant from FEMA, known as the Community Assistance Program – State Support Services Element (CAP-SSSE) to help fund the state's floodplain management program that assists local communities in implementing the NFIP requirements. The CAP-SSSE grant has not been sufficient to provide NYSDEC with all the resources needed to perform its functions and additional resources are needed either from FEMA or, potentially, the state.

In addition to the increased state capacity to assist municipalities with NFIP compliance, additional resources could be used to assist more communities to participate in FEMA's Community Rating System (CRS). The CRS is a FEMA program that provides flood insurance discounts in communities that go beyond FEMA's minimum requirements. It operates on a detailed points system, with communities gaining points for various activities and with every 500 points providing a 5% flood insurance discount within the community. Because it is a complex program, currently only communities with sufficient staff participate in the program without outside assistance. Increasing NYSDEC's floodplain management resources would not only result in better local enforcement of floodplain regulations but also savings at the local level through CRS program participation.

In addition to the NYSDEC floodplain management program, NYSDHSES has a significant role to play with respect to hazard mitigation. NYSDHSES outreach is primarily through county emergency management agencies. While the goals of hazard mitigation and floodplain management are complementary, neither NYSDHS nor NYSDEC has sufficient resources to integrate the programs and provide sufficient local outreach and assistance.

4.5 MITIGATION OF AT-RISK STRUCTURES

Mitigation actions are those that reduce risk to existing structures. Mitigation can include structural projects such as changes to NYSCC movable dam operations or dam modifications. Mitigation can also include projects to reduce risk to existing structures, such as elevating or removing structures. Most hazard mitigation funding comes from FEMA, and is administered by NYS DHSES, in the form of Hazard Mitigation Grant Program (HMGP) funds after disasters, Building Resilient Infrastructure and Communities (BRIC) annual funding, and Flood Mitigation Assistance

Program (FMAP) funding. More can be done to help communities help themselves and to reward communities that do more to reduce flood risk.

The state must also be prepared to take advantage of new programs that can help leverage mitigation. In particular, the federal STORM Act (Safeguarding Tomorrow through Ongoing Risk Mitigation) authorizes FEMA to provide capitalization grants to states to establish low interest revolving loan funds that provide hazard mitigation assistance to local governments. In 2022, $50 million dollars was made available nation-wide to begin to leverage state loan funds. The New York State Environmental Bond Act creates a perfect mechanism to utilize state funds to leverage the federal funds and increase flood mitigation in New York.

4.6 INFRASTRUCTURE DEVELOPMENT APPROACHES

State and local governments make decisions on the location and expansion of infrastructure such as roads, water lines, stormwater collection systems, and wastewater conveyance and treatment systems. Expanding infrastructure into hazardous areas promotes development in unsafe locations. Some infrastructure must be in floodplains, such as water supply sources, wastewater treatment plants, and bridges. They must be designed in a manner that does not increase flood risk for others, and that keeps them safe during floods.

4.7 WATERSHED MANAGEMENT

Reduction of flood risk cannot be accomplished only within the floodplains themselves. Every place is within a watershed, and what happens anywhere within that watershed affects water quality and quantity downstream. In November 2018, New York State launched the Resilient NY program. The overall goal of the program is to improve community resiliency to extreme weather events that result in flooding and ice jam formations. 48 high-priority watersheds throughout the state were identified and $3 million in funding has been committed to the Resilient NY initiative through the state's Environmental Protection Fund.

NYSDEC and the NYS Office of General Services (NYSOGS) have retained two consulting firms to prepare the watershed studies. The process includes outreach, data collection, flood mitigation analysis, and reporting. Many of the high-priority watersheds are within the Mohawk or Oswego Basins. One study includes the entire main stem of the Mohawk River.

These studies have provided a unique opportunity to take a watershed approach to studying and recommending flooding solutions on a local basis.

4.8 FLOOD DISCLOSURE

Buildings that have had previous flood damages are those most likely to suffer future damages. However, there is a general lack of awareness during real estate transactions regarding the flood risk to structures. Current state law requires real estate sellers to complete a property condition disclosure statement. The disclosure includes only a single question regarding flooding which is "Is any or all of the property located in a designated floodplain?" with the response options being yes, no, or unknown. Failure to disclose or knowingly provide false information on the disclosure may result in a $500 fine.

The New York State Legislature recently passed a bill, that is awaiting the governor's signature, to tighten real estate disclosures requirements related to flood risk upon property sales. The Bill requires disclosure on whether a property is within a 100-year or a 500-year floodplain according to FEMA's maps, whether the property is required under federal law to obtain and maintain flood insurance, and the property's flood insurance claims history, and history of other federal flood related disaster assistance.

Should the Bill be signed into law, real estate agents in the Oswego and Mohawk basins, and elsewhere in New York State, need to be educated on the requirements of the law and how to best advise their clients.

5.0 Recommended Adaptive Measures

The Task Force and its subcommittees have reviewed the available reports, NYSCC operational records, and historic flow information as part of the preparation of this report. Based on the information available, discussions between Task Force members and subcommittees, public input, and each member's area of expertise, the Task Force recommends the following Adaptive Measures be further studied or implemented to help reduce flooding in the Mohawk and Oswego River Basins. Costs shown in this section are rough order of magnitude (ROM) cost estimates in 2023 dollars unless otherwise noted.

5.1 COMMON RECOMMENDATIONS

A critical initial project is the development of detailed watershed models and improved communications across each watershed. As noted throughout this Report, the two watersheds are complex systems that are managed by many different private and public entities for various purposes, including ecological, recreation, potable water supplies, navigation, and hydropower. A common understanding of how these complex systems react and operate during normal flow conditions as well as different and changing weather patterns to minimize flooding, while still supporting their core purposes, will be needed to develop programmatic approaches to inform operations and policy actions throughout the two basins. The Task Force recommends the following adaptive measures be applied to both the Mohawk River and Oswego River Basins.

5.1.1 Numerical Watershed Models

Description

No commonly used full watershed model is currently available to provide accurate estimation of normal or flood flows for either basin. These models are critical for informing operational changes as well as estimating the impact of any recommended modification.

Recommended Adaptive Measure

Develop and calibrate model(s) utilizing industry standard software such as the HEC series for each watershed (multiple models may be required per watershed) to allow scenario development and response estimation. Detailed bathymetric and LiDAR survey should be completed where existing data is insufficient within the Oswego and Mohawk River Basins. The data available and acquired must be included in the model(s) to ensure accuracy. Bathymetric and LiDAR survey information and the corresponding models should be updated on a regular basis (every 5 years). It is further recommended that reasonably accurate and computationally efficient hydrologic/hydraulic models be developed based on the full basin models. These 'simplified' models are necessary for use as an operational model to account for rainfall, reservoir regulation, snowmelt, and dam and control structure operation. This could include working with National Weather Service, Northeast River Forecast Center, USGS, and educational entities to improve currently used forecast methodologies and to ensure all models used have the same predictive ability.

The development of trustworthy models is a very important first step to managing the two watersheds. Many of the Recommended Adaptive Measures that follow are predicated on the development and implementation of these models. The development of these models will permit more informed decision making across the various watershed managing entities to ensure intended benefits of the proposed Recommended Adaptive Measures and future adaptive measures are achieved.

A model scoping study is recommended to further refine the extents and goals of modeling, identify availability and quality of any existing models and data, identify gaps in existing models and data, determine appropriate methodologies to be employed, and research prior studies. The outcome of the model scoping study will provide

the basis to accurately define the needed model and estimate the funding necessary to fully develop the watershed models. It is recommended by this Task Force that both the model scoping study and numerical models be funded and undertaken without delay.

Potential Barriers to Implementation Identified

- Resource availability to conduct a model scoping study.
- Resource availability to conduct bathymetric and LiDAR surveys to support model development and updating in subsequent years.
- Communication with state and federal agencies regarding existing models and development of the new models.

Implementation ROM Cost Estimate

Provide a model scoping study at a ROM cost of $1.4 million.

5.1.2 Standing Committees

Description

The watersheds each have drainage areas of more than 3,000 square miles encompassing significant populations with a wide range and variety of needs, interests and concerns regarding the use of water. All these uses provide benefits by supporting ecological resources, such as fisheries, drinking water, recreation, navigation and hydropower, among other benefits. These uses generally dictate impoundment levels during normal conditions which can reduce needed flexibility during storm events. No single entity within the watersheds has flood mitigation as its primary mandate when managing water releases from lakes and reservoirs located within a discrete portion of the watershed. Certain uses are also dictated by operating diagrams or flow requirements, which are often embedded in federal, state or local permits or other authorizations, as well as association by-laws. Currently there is a lack of communication between these entities especially during flood events, although NYSCC has conducted outreach to operators to better understand basin conditions and adjust NYSCC operations if needed or deemed beneficial in reducing flooding.

Recommended Adaptive Measure

Create a permanent, standing committee for each watershed to include water control entities, community stakeholders, DEC, DHSES, and other appropriate entities. The purpose of the Committees would be to develop better flood operational strategies, to direct water releases during a flood event or create actionable operational plans for high flow events during navigation and non-navigation seasons, and to provide better public communication during extreme events.

Potential Barriers to Implementation Identified

- Several agencies would be involved in a committee for either basin. Some of these agencies would not have an incentive to participate in a committee.
- Each watershed includes several hydroelectric facility owners and operators. The majority of facilities are FERC Licensed which requires the Licensee to adhere to License requirements regarding impoundment water level regulation. This would require additional coordination with FERC and may require License amendments to allow full utilization of potential flood benefits. Amendments can take significant time and effort for the Licensee to complete.

Implementation ROM Cost Estimate

ROM cost estimate to be determined based on the committee members and any incentives needed to increase participation.

5.1.3 Increase Public Outreach, Education, and Communication

Description
Several reports reviewed recommend a collaborative effort to conduct educational events and develop materials to better educate the public regarding flood risks.

Recommended Adaptive Measure
Recommend developing an informal group including NYSDEC, NYSCC/NYPA, lake associations, the New York State Floodplain and Stormwater Manager's Association, and local governments to develop an educational strategy to inform and provide land use tools to both local government and those stakeholders residing near or within the floodplain to reduce flooding long term and increase awareness of their risks during a flood event. NYPA should lead this effort and produce a product within 12 months.

Additionally, develop and provide information/disclosure of flood prone areas to municipalities, real estate companies and the general public to manage the property buyer's development expectations.

Potential Barriers to Implementation Identified
- Resource availability to support the communication and development of education materials could slow or otherwise impact the identified participants.

Implementation ROM Cost Estimate
An ROM cost estimate of $100,000 is provided for outside services.

5.1.4 Communicate High Flow Event Elevations Using a Common Datum

Description
To improve communication with the public and other stakeholders, especially during high water events, communicate all elevations using a common datum. Presently, publicly facing elevations are presented using several datums (e.g., BCD, NAVD88, NGVD29). Providing elevations on a common datum consistent with current NFIP map (NAVD88) datum is recommended to improve and simplify communication with the public. This would also help potentially impacted residents understand their risks during an event when forecasting is presented using the same datum as the FIS and NFIP maps.

Recommended Adaptive Measure
Recommend that all publicly facing flood event elevations be reported and displayed in NAVD88 datum, and that all agencies providing flood event elevations (NYSCC, USGS, NWS, DHSES) utilize NAVD88 datum. Discontinue use of the Barge Canal Datum (BCD) and NAVD29.

Additionally, a central, electronic location should be developed to allow stakeholders to obtain and view existing conditions and forecast condition information to better understand their risk.

Potential Barriers to Implementation Identified
- Field survey will be required to convert all existing elevation reporting locations to NAVD88. Additional funding would be required to effect this change.

Implementation ROM Cost Estimate
A one-time ROM cost of $250,000 is assumed for additional survey to implement this change in reporting of flood elevations.

5.1.5 Purchase and/or Restore Disconnected Floodplains

Description

Over time, many floodplain areas have become disconnected from rivers and streams by berms, roads, etc. The result is lower available area and volume within the floodplain causing higher water levels and reducing flood storage and carrying capacity.

Recommended Adaptive Measure

Support state and local entities and Non-Government Organizations (NGO's) efforts and initiatives to purchase and/or restore these areas to provide additional flood storage and peak flow attenuation potentially reducing current upstream and downstream flooding impacts and improving water quality Recent examples of successful floodplain reconnection projects include the floodplains at the south ends of Canandaigua and Owasco Lakes. Floodplain reconnection also provides means of reducing nutrient laden sediments prior to reaching a lake or main river channel. The Resilient NY program has, through grant programs, purchased lands to reconnect channels that have become disconnected from their adjacent floodplains through urbanization. These and other success stories are provided in Appendix F.

The following New York State grant programs allow for the monies to be used for floodplain reconnection projects: Green Infrastructure Grants Program; Environmental Bond Act; and the Water Quality Improvement Program. Recent floodplain reconnection projects, on average, have cost approximately $1 million per acre.

NRCS and USFWSS have a rate cap for floodplain easement cost by county and land classification (120, 130, 321, 323) in New York State that limit land purchase cost for floodplain reconnection projects.

Potential Barriers to Implementation Identified

- Resource availability for property purchases.
- Resource availability for barrier removal (permitting, construction).
- Potential tax base loss due to public ownership of additional lands although benefits provided by creating additional open space and reducing flood impacts would likely offset short term tax base loss.

Implementation ROM Cost Estimate

Provide seed money to fund land purchases and easements to reconnect disconnected floodplains in the Mohawk and Oswego basins at a ROM cost of $2 million per year.

5.1.6 Purchase Flood-Prone Structures within the Floodplain

Description

Each watershed has a significant number of structures (residential and commercial) within the FEMA floodplain that include other impervious surfaces on their property. The presence of the structures reduces the available flow area during flooding events, the presence of impervious surfaces (buildings, parking lots, and roadways) increases runoff, and habitable structures can present a significant hazard to their occupants.

Recommended Adaptive Measure

Develop a more robust, coordinated flood buyout program throughout the basins for homes within the FEMA floodplain. The buyout program should be targeted for properties subject to severe flooding, not nuisance flooding. These would be properties that are within FEMA mapped floodways, especially those properties subject to repretive flooding.

Develop a 'toolkit' for municipalities and residents to allow them to seek the best buyout program option for their situation. The Federal Emergency Management Agency (FEMA) has several programs including Building Resilient Infrastructure and Communities (BRIC) and the Hazard Mitigation Grant Program (HMGP), which are administered by DHSES. A breakdown of the various Federal grant programs is provided in Appendix G.

Regardless of the program used for buyouts, all properties successfully purchased should be restored to the pre-development condition or enhanced to provide additional flood mitigation capabilities and permanent land use restrictions should be created, such as deed restrictions or conservation easements, to prevent future development. The flood buyouts parcels would be used to provide more flood storage/mitigation with the space available.

Potential Barriers to Implementation Identified

- Resource availability for property purchases.
- Resource availability for structure removal (permitting, construction).
- Potential local community tax base loss due to public ownership of additional lands.
- Ensuring existing property owners have sufficient incentives to relocate outside of a floodplain.

Implementation ROM Cost Estimate

Provide seed money to fund buyouts for flood prone structures in the Mohawk and Oswego River Basins at a ROM cost of $1 million per year per basin.

5.1.7 Address Tributary and Main Stem Erosion and Sedimentation

Description

Many tributaries within each watershed originate in higher elevation areas and have steep gradients, which generally results in higher velocities and in higher levels of streambank erosion and sediment mobilization. Additionally, as areas adjacent to and within the floodplain are developed, floodplain can become disconnected and riparian buffers are often deforested, which can lead to new or increasing sediment entering a tributary or river. These eroded materials travel into the larger tributaries, rivers, Canal or reservoirs where flow velocities are substantially reduced, allowing suspended sediments to settle out. This deposition of materials changes the stream/Canal/lake characteristics and can impact flood carrying capacity as well as Canal navigation, recreation, and water quality.

Recommended Adaptive Measures

There are many different local, state, and federal agencies involved in reducing sedimentation and erosion. NYSCC and DEC should initiate discussions with other responsible local, state and federal agencies as well as local stakeholders for each watershed to champion programs, provide information on available grant programs, and, if agreeable, begin working on basin wide planning for sediment and erosion reduction.

Local Flood Analysis (LFA) studies have been funded in the past through the NYC Water Supply Stream Management Program and NYSDOS. A study of 53 miles of the Lower Schoharie Creek between the Blenheim-Gilboa Dam and the confluence with the Mohawk was funded under a NYSDOS Local Waterfront Revitalization Grant. The process consists of two steps: 1) an engineering analysis of flood conditions and identification of potential flood mitigation projects articulated in a plan and 2) project design and implementation. The NYCDEP and NYSDOS programs have components and goals similar to those of the Resilient New York program.

In addition, further investigation into a potential riparian reforestation program and support to apply for riparian easements through the NRCS CREP or CRP. These programs provide federally based rental payments to farmers for keeping stream-side areas out of production, allowing for natural vegetation growth providing a buffer further reducing soil erosion and sediment transport.

Recommend that some seed money be set aside to develop a program that: reviews the work done on the Schoharie Creek LFA study; creates a framework and performs example study projects where erosion, scour and sedimentation are known to be problematic either for NYSCC sediment removal, local flooding or bank instabilities.

Potential Barriers to Implementation

- Resources available within responsible local, state and federal agencies.
- Given the overall size of each basin, a full basin group may not be reasonably achievable, smaller, tributary specific groups may be advisable starting with the tributaries known for sediment and erosion issues.

Implementation ROM Cost Estimate

Assume an ROM cost estimate of $100,000 for program development and $250,000 to study 50 stream miles of main stem streams for erosion and sedimentation. Develop additional study stream miles based on results of developmental work and pilot program.

5.1.8 National Flood Insurance Program (NFIP) support for Municipalities and DEC

Description

Municipalities participating in the NFIP are required to follow guidelines to regulate development within their floodplain and are trained and audited by DEC to ensure compliance.

Recommended Adaptive Measure

Pursue and implement additional measures to assist NYSDEC Floodplain Management Section with program oversight and pursue additional funding or educational opportunities to assist communities with implementation and compliance.

NYSDEC is currently a participant in the FEMA Community Assistance Program: State Support Service Element (CAP-SSSE) as an Advanced State, which is the highest performance rating and receives a federal grant to support these efforts. Unfortunately, the federal grant is not sufficient to meet the full needs of all municipalities within the state which would require additional federal or state resources. CAP-SSSE is designed to assist states to provide training and technical assistance to local communities and other state agencies in meeting the development standards of the NFIP. There are over 1,500 local communities in New York State that participate in the NFIP. With current staffing limitations, NYSDEC cannot reach all communities that need assistance and training, particularly smaller more rural communities that lack in-house capabilities. Additional state or federal funding would allow NYSDEC to add staff to provide dedicated support to communities in the Mohawk and Oswego basins.

NYSDEC also participates in FEMA's Cooperating Technical Partners (CTP) program that provides additional federal grant funds to assist with floodplain mapping and outreach. NYSCC is not currently a participant in the CTP but should pursue CTP status to afford better communication and cooperation with FEMA and NYSDEC with respect to updating flood maps, particularly with respect to mitigation projects designed to reduce flood risk. Participation of both agencies in the CTP would allow establishment of a more robust State Floodplain Mapping program to address state and local floodplain mapping priorities beyond FEMA's mapping budget limitations, and to produce flood mapping layers, such as depth of flooding and future conditions flooding, that go beyond current FEMA mapping guidelines.

Potential Barriers to Implementation Identified

- Resource availability at both NYSDEC and NYSCC to maximize benefits of CTP participation and expanded community outreach.
- Limited FEMA funds available for FEMA Region 2 CTP program partners.

Implementation ROM Cost Estimate
Funding for NYSDEC Floodplain Management Section, with ROM cost estimate of $250,000 annually.

5.1.9 Reduce Development in Flood Prone Areas

Description
All municipalities participating in the NFIP are required to have planning and land use requirements to control activities within the floodplain through local laws or ordinances. Zoning regulations are not required by FEMA, however they can be a useful tool for managing development within flood hazard areas. The NYSDEC assists local communities by providing model local laws, and reviews individual local laws whenever flood maps are replaced. As part of the Task Force effort, a few randomly selected zoning regulations were reviewed. The review noted significant differences in what is required to construct or alter a structure within the floodplain. Differences ranged from requiring only zoning officer and no further approval, to a "Flood Damage Prevention Law" requiring the applicant to show just cause for an alteration or any construction within the floodplain. Increase review, audit, and enforcement of NFIP standards and requirements.

Recommended Adaptive Measure
Develop an outreach program at the state level to assist municipal governments having jurisdiction over properties in each watershed. Consider this as part of education and buyout efforts. Additionally, provide municipalities with a 'toolkit' including recommended model zoning and land development provisions, as well as higher standards for their local laws for flood damage prevention, that would be helpful in reducing flooding and flood damages over time. The goal would be to reduce filling in flood prone areas, reduce runoff, and reduce approval of future development in flood prone areas.

Potential Barriers to Implementation Identified
- Resource availability within NYSDEC to dedicate time to answering inquiries and assisting municipalities above the current level.
- Resource availability for review, audit, and enforcement.

Implementation ROM Cost Estimate
Funding for NYSDEC Floodplain Management Section, with ROM cost estimate of $250,000 per year.

5.1.10 Sharing of Agency Hydraulic Studies with Other Agencies and Stakeholders

Description
Several New York State and federal agencies regularly conduct hydraulic studies in support of their missions. In New York State, 6 NYCRR Part 502 *Floodplain Management Criteria for State Projects* requires that the use of State lands and the siting, construction, administration, and disposition of State-owned and State-financed facilities are conducted in ways that will minimize flood hazards and losses so that New York State, as a CTP, and its 1500 participating communities continue their qualification as participating communities in the NFIP. For federal actions or federally funded actions located within floodplains, agencies must comply with Executive Order 14030[12]. Both the New York State and federal regulations require consideration of the NFIP and the effective FIS where an agency action is proposed.

It has not been common practice for New York agencies to share the hydraulic models and studies with other agencies and many times other agencies are unaware of the efforts. This is unfortunate because the studies and hydraulic models are prepared to verify compliance with the NFIP. Sharing the models would provide other agencies

[12] E.O. 14030 (5/20/2021) builds upon and strengthens an earlier Executive Order, E.O. 11988 (May 24, 1977) with respect to federal projects in floodplains.

with useful hydraulic models and studies that could reduce flood mapping update costs, provide improved flood mapping information that could be used by local floodplain administrators, and prevent redundant efforts.

Recommended Adaptive Measure
A more formal framework for sharing hydraulic modeling completed by state agencies should be developed and implemented to avoid redundant efforts and to keep all agencies informed of ongoing efforts.

Potential Barriers to Implementation Identified.

- Resource availability within state agencies.

Implementation ROM Cost Estimate
Provide $100,000 annually for each state agency, or $600,000 for all agencies to provide hydraulic modeling and studies (NYSDOT, NYSDEC, NYSCC, NYSDHSES, DASNY, NYSDOC).

5.2 MOHAWK RIVER BASIN

The Task Force recommends the following adaptive measures specific to the Mohawk River Basin be implemented.

5.2.1 Update FEMA FIRM Mapping based on NYSCC 2018 Procedural Change

Description
In 2018, NYSCC developed and implemented a new procedure for Movable Dam operation throughout the Mohawk River Watershed. This procedure requires the removal of the movable dams from the river in advance of a predicted storm event (less than the 100-year recurrence interval). Doing so reduces the opportunity for flooding in the areas immediately upstream of the movable dams. The most recent FEMA Flood Insurance Rate Maps (FIRM) do not take the procedure into account, modeling the movable dams remaining in place and potentially overestimate the number of properties within the floodplain. Hydraulic analysis utilizing the procedural change conducted for a proposed project at Erie Canal Lock E-11 (Amsterdam) resulted in a Letter of Map Revision (LOMR) for seven FIRM panels in the lock vicinity and upstream reducing the number of structures within the regulatory floodway and SFHA, thus reducing the cost of flood insurance premiums for those effected residents.

Revisions to an additional estimated 45 FEMA panels between Frankfort and Erie Canal Lock E-8 would be required to fully update the effective FIRMs using LOMRs or a Physical Map Revision (PMR).

Recommended Adaptive Measures
Flood Insurance Rate Maps should be updated in the vicinity of the NYSCC's movable dams based on the Movable Dam operational changes (procedure). All new FEMA Discovery and map updates should incorporate this change in operations. There are approximately 45 additional panel FIRM panels that would require modification to incorporate this change.

Potential Barriers to Implementation Identified

- Resource availability to develop the necessary models to support the FIRM changes.
- CTP participation by NYSCC to ensure cooperation and ease of implementation.

Implementation ROM Cost Estimate
Based on the per panel cost for the LOMR covering the seven panel LOMR for the Mohawk River between Erie Canal Locks E-10 and E-12, the ROM cost estimate to revise an additional 45 map panel to reflect the movable dam upgrades between Frankfort and Erie Canal Lock E-8 would be $0.7 million.

5.2.2 Investigate modernization of NYSCC's Movable dams

Description

The movable dams owned and operated by NYSCC are original to the Barge Canal upgrade (early 1900's) and require significant maintenance and upkeep as well as substantial time and manpower to remove prior to a flood event. Currently, the removal procedure for the movable dams is based on the 72-hour advance forecast as it requires a minimum of 24 hours to notify mariners to seek safe harbor and approximately 48 additional hours to open all movable dams. In the 100+ years since the movable dams were constructed, several technologies have advanced which serve a similar function but require significantly less time, maintenance, and manpower to operate. The reduction in time to operate the movable dams would allow a faster response time to open all the movable dams, allow operators to respond to updated forecasts, and a reduction in the number of times the movable dams are removed unnecessarily due to forecasted events that do not materialize.

Recommended Adaptive Measures

A movable dam modernization program should be implemented. The goal of the program would be to reduce the time required to remove and re-install the movable dams for flood events and to reduce operational cost. Based on other NYSCC projects involving similar features undergoing modernization, the movable dam sites would have bottom mounted hinged gates, new controls and local SCADA systems. Superstructures (trusses) would be retained and be used as walkways and to carry power and communications from one side of the river to the other. The total length of the ten Mohawk River Movable dams MD 4 through MD 12, and MD 14 is 4,221 feet.

Additionally, strengthening of the movable dam components and machinery following the 2011 floods included Movable dams MD 4 through MD 11 but did not include upgrades to Movable dams MD 12 and MD 14. If modernization cannot be implemented at these structures in the near term, then structural upgrades should be made to Movable dams MD 12 and MD 14 like those made to the downstream movable dams as soon as practicable.

Potential Barriers to Implementation Identified

- Resource availability to provide a modernization study to evaluate potential alternatives, provide concept design, a final design report, and construction cost estimate.

Implementation ROM Cost Estimate

- Modernization studies (concept design, Final Design Report, cost estimating = $5 million (ten movable dams)

5.2.3 Ice Jam Mitigation in the Schenectady area

Description

During the past three winters, NYSCC/NYPA has deployed an ice breaking tugboat to break sheet ice between Vischer Ferry Dam (Erie Canal Lock E-7) and Erie Canal Lock E-8. The breaking has been successful in that no ice jam has formed during the limited operation. Additionally, the Reimagine the Canals Task Force report recommended pursuing modifications at Vischer Ferry Dam to further benefit ice jam mitigation efforts and estimate benefits for open water flooding events.

Recommended Adaptive Measures

The Task Force recommends the ice breaking operations continue and be permanently funded and any additional ice jam mitigation efforts identified be funded to reduce the likelihood of ice jam formation on the Mohawk River in the Schenectady area.

Potential Barriers to Implementation Identified

- Resource availability, however, NYPA has submitted a FEMA HMGP Grant Application to fund modifications recommended at Vischer Ferry Dam to further mitigate ice jam formation.

Implementation ROM Cost Estimate

- Based on information from NYPA, the ROM operating cost estimate for ice breaking vessels in the Mohawk River reach upstream of VFD between Erie Canal Locks E-7 and E-8 is $500,000/year.
- Based on the report *Vischer Ferry Dam Modification Project Justification Report* the ROM capital cost estimate is $27.75 million and annual operations and maintenance ROM costs are $350,000 per year.

5.2.4 Investigate modifying operations at Delta Reservoir and bifurcated Canal Sections

Description

Delta Reservoir is one of the few reservoirs within the watershed that could have available flood storage capacity if the reservoir were not operated to maintain the pool at the dam crest during the navigation season. Additionally, several sections of the Canal are bifurcated from the Mohawk River, and it is possible flood elevations on those Mohawk River sections could be reduced if the bypassed Canal sections and locks were modified to allow flood flow passage.

Recommended Adaptive Measure

Additional study is needed to better estimate the benefit of modified Delta Reservoir operation during navigation season and recommend special consideration be given to the reservoir's intended purpose (to provide upper Mohawk River minimum flows during times of drought) and the impact any operational change would have on that purpose/need. Combining study of Delta Reservoir with potential modifications to the bifurcated Canal section through the Utica area would be helpful to determine if required modifications would meet necessary Cost/Benefit requirements for grants or outside funding sources.

Other Canal sections where the Canal and Mohawk River are bifurcated should be studied to estimate whether the potential flood mitigation benefits would be sufficient to justify the estimated costs without negatively impacting downstream areas.

Potential Barriers to Implementation Identified

- Resource availability to develop the study, however NYPA has submitted a grant application to FEMA under the Hazard Mitigation Grant Program (HMGP) to study Delta Reservoir operation and the bifurcated Canal section between Rome and Frankfort which includes the City of Utica.

Implementation ROM Cost Estimate

The ROM cost estimate for implementing the study is $4 million.

5.2.5 Update FEMA FIRMS within the Mohawk Basin

Description

There are still significant gaps to ensuring New Yorkers have technically credible information on flood risks from which to make good decision needs:

- Out of an inventory of ~30,000 miles of riverine waterways across New York, less than 30% have valid regulatory data presented on a FEMA FIRM;
- Only 52% of New York's flood maps are digital, representing a limiting factor to easily integrating flood hazard information into community planning and flood risk management;
- The remaining 48% of New York's flood maps, based on area, that are not digital, cover the homes, businesses, and critical infrastructure for over 2 million New Yorkers.

Within the six Flood Mitigation Regions of the Mohawk River Basin, which includes Albany, Herkimer, Montgomery, Oneida, Saratoga, and Schenectady Counties complete digital coverage of flood studies and reports related to the flood prone areas are complete or in progress for all counties, except Herkimer County.

Recommended Adaptive Measure

For Herkimer County, an engineering study of the floodplains and a countywide digital FIRM needs to be prioritized to allow agencies, homeowners, and stakeholders better understand areas vulnerable to flooding and the extent of the vulnerability and have access to the digital representation of that data.

These efforts are largely funded through Congressional Appropriations to the NFIP, which is subject to Fiscal Year budget constraints. Funds may be provided through support from FEMA to the state, as a FEMA Cooperating Technical Partner (CTP). Floodplain mapping could potentially be further supplemented through the 2022 Environmental Bond Act.

While portions of Madison County drain to the Mohawk River, the cost for the digital mapping study is included in the Oswego River Basin estimate because the majority of Madison County is tributary to the Erie Canal system within the Oswego River Basin.

Potential Barriers to Implementation Identified

- Flood study funding is provided through Congressional Appropriations, which may fluctuate year to year, and may also be directed to other parts of FEMA's program. Additionally, there is limited opportunity to direct which counties are studied within FEMA's plan.
- State resource availability.

Implementation ROM Cost Estimate

An ROM cost estimate for a Herkimer County countywide update is below. This includes hydrologic and hydraulic studies for all reaches within the county that are unmapped or do not have a recent study, as well as the production of preliminary and final FISs and FIRMs.

County	ROM Cost Estimate
Herkimer	$6.0 million

5.3 OSWEGO RIVER BASIN

Given the number of water management entities across the Oswego River Basin, any operational or policy recommendations are predicated on a basis of improved coordination amongst water managers, The Task Force recommends the following adaptive measures specific to the Oswego River Basin.

5.3.1 Basin Water Release Coordination

Description

There is a need for better coordination between water management entities during normal conditions as well as flood events. The basin includes seven Finger Lakes that drain to the Seneca River and all appear to have some limited capacity to store water during a flood event. Each Finger Lake is governed by a Rule Curve specifically developed to address different interests within the immediate lake area and to reduce flooding to the extent possible along the lake shore. Generally, the rule curves provide an upper and lower target elevation for the lake

water surface, allowing additional elevation between the upper target elevation and the known lakeshore damage elevation. Additionally, discharge from each Finger Lake is controlled by a different entity.

The Seneca River's FEMA regulated floodplain from Erie Canal Lock E-25 and Cayuga Seneca Canal Lock CS-1 to Erie Canal Lock E-24 (Baldwinsville), including Cross Lake, contains a significant number of structures, with many experiencing 'nuisance flooding' during flood events less than the 1% annual probability event.

Recommended Adaptive Measure

The numerical models recommended for development and use would be necessary for estimation of the benefits that could be achieved utilizing flood storage above each lake's rule curve and to provide a framework for watershed releases during high flow events. It is recommended a stakeholder group be created to participate in reviewing the model results and include all entities with the ability or responsibility to control flood water discharges either directly to or from the Clyde, Seneca, Oneida, or Oswego River, a Finger Lake, or a tributary thereof, community stakeholder groups, DEC, and subject matter experts. Modeling should include recommended structural and operational changes up to and including modification of the rule curves, taking into consideration all water needs, uses, and requirements. Based on the findings, a recommendation should be made on the formation of the permanent, standing group structure to coordinate communication and releases during high flow events. The permanent group could take one of many forms including continuation of the initial group, expansion of a volunteer group, a recommendation to seek a legislative mandate to coordinate water releases or a request to initiate an independent water regulating district with the authority to direct water releases.

This adaptive measure has the potential to provide the most mitigation benefit but is potentially the most complex and difficult to implement. The implementation could be accomplished in phases, with an immediate formation of a voluntary flood condition communication protocol/group and advancing to a more formalized group depending on the findings and recommendations from the initial stakeholder group.

Potential Barriers to Implementation Identified

- Formation of a permanent group, committee, or district must include a variety of groups responsible for water releases with potentially competing interests as well as federal and state agency requirements which will complicate any recommendations or processes.

Implementation ROM Cost Estimate

ROM cost estimate to be determined based on group members and the type of committee or district formed.

5.3.2 Baldwinsville Dam (Erie Canal Lock E-24 Dam) Modification

Description

Baldwinsville Dam maintains the navigational pool between Erie Canal Lock E-24, Erie Canal Lock E-25, and Cayuga Seneca Canal Lock CS-1 in addition to providing the head pond for two FERC licensed hydroelectric facilities (Baldwinsville [P-5217] and Seneca [P-4296]). The impoundment stretches approximately 32 miles upstream and includes a portion of Cross Lake. The dam itself is a masonry structure approximately 400 feet wide with a 50-foot wide Tainter gate at the north end. Normal flow is released either by slightly opening the Tainter gate, through the hydroelectric plants, or is allowed to flow over the fixed dam crest. During high flow periods, the same release methods are used however the Tainter gate and hydroelectric facility capacities are generally exceeded with additional flow passing over the fixed dam crest and the upstream water surface elevation increasing to provide additional flow passage.

A previously completed USACE Report identified the most cost-effective solution to reduce flooding upstream of Baldwinsville Dam was to remove a portion of the fixed crest dam and replace that section with a pneumatic gate/flashboard system capable of being lowered to provide additional discharge capacity during high flow events.

Recommended Adaptive Measure

The recommended basin model should be used to analyze and properly size any recommended alternative to modify Baldwinsville Dam. The costs of the recommended alternative should be updated to see if the modification would qualify for FEMA grant funding given the recurrent nature of the upstream flooding.

Any recommended modification at the Baldwinsville Dam should also include estimation/analysis of any potential upstream constrictions that could impact the effectiveness of the modification. Special consideration should be given to the 'State Cut' and Jacks Reef area to ensure any additional high flow capacity gained at the dam is not reduced by lack of capacity to convey flow to the dam. Any area showing a flow constriction should have a corresponding recommendation to ensure full benefit of dam modification.

Potential Barriers to Implementation Identified

- The basin numerical model should be developed prior to conducting analysis of the dam and potential benefits of any proposed modifications.
- If the tailwater elevation is considered a limiting factor for discharge from Baldwinsville Dam, additional modifications to the dams at Oswego Canal Locks O-1 and O-2 may be required to increase their discharge capacity. This also has the potential to impact the floodplain downstream of these structures.
- Resource availability to complete the analysis and any recommended modifications.

Implementation ROM Cost Estimate

Study to estimate the benefits and costs of alternatives and recommend an alternative has a ROM cost estimate of $750,000.

5.3.3 Montezuma Area Floodplain Restoration

Description

The Seneca River between Erie Canal Locks E-25, E-24 and Cayuga Seneca Canal Lock CS-1 has little flood storage capacity with most being within Cross Lake. The use of Cross Lake and the upstream floodplain is problematic as there are many structures built within the FEMA regulated floodplain. There are significant portions of the historic floodplain that has become disconnected from the Seneca River and its tributaries.

Recommended Adaptive Measure

Recommend identifying potential floodplain and wetland restoration areas and disconnected floodplain(s) throughout the Clyde River watershed and immediately downstream of the confluence of the Clyde and Seneca Rivers adjacent to the existing Montezuma Wildlife Management Area (WMA). It appears this area could have up to 10,000 acres of privately owned historic floodplain that is no longer connected to the waterways and is currently used for agricultural purposes. If the modeling shows sufficient downstream flood mitigation benefits, a recommend a program could be developed to purchase as much of the disconnected area as possible and reconnect it to the waterways as floodplain. If property is acquired, it is recommended the property be provided to NYSDEC to be annexed to the adjacent Montezuma WMA and incorporated into their ongoing conservation efforts. An analysis of NYSCC property should also be included to determine if there are opportunities to enhance floodplain reconnection and/or storage. The Resilient NY program has, through grant programs, purchased lands to reconnect channels that have become disconnected from their adjacent floodplains through farming. The program highlights are compiled in Appendix F.

There are approximately 1200 acres of land in the Montezuma floodplain that is presently farmed and has approximately 1000 ft of perimeter berm and a pumping system. NYSDEC has identified this agricultural area as a potential floodplain reconnection project.

Potential Barriers to Implementation Identified

- Willingness of current owners to sell property.
- Resource availability

Implementation ROM Cost Estimate

This 1200 acres of land that is presently farmed, has 1,000 ft of perimeter berm and a pumping system. The cost of land purchase at $5,000 per acre and another $2 million for construction to create gaps in the perimeter berm, restore surfaces and provide some floodplain vegetation yields a total implementation ROM cost of $8 million.

5.3.4 Update FEMA FIRMS within the Oswego Basin

Description

There are still significant gaps to ensuring New Yorkers have technically credible information on flood risks from which to make good decision needs:

- Out of an inventory of ~30,000 miles of riverine waterways across New York, less than 30% have valid regulatory data presented on a FEMA FIRM;
- Only 52% of New York's flood maps are digital, representing a limiting factor to easily integrating flood hazard information into community planning and flood risk management;
- The remaining 48% of New York's flood maps, based on area, that are not digital, cover the homes, businesses, and critical infrastructure for over 2 million New Yorkers.

Within the 11 counties within the Oswego River Basin, there is complete digital coverage of flood studies and reports related to the flood prone areas within these watersheds for four counties (Cayuga, Oneida, Onondaga, and Oswego Counties). However, the modeling data behind these studies is outdated (up to 40 years old), and in some cases, may not even be readily available for use.

There are an additional five counties (Ontario, Seneca, Tompkins, Wayne, and Yates Counties) that have full countywide studies underway that will provide updated modeling for thousands of miles of stream in the next two years. The current projected preliminary issuance dates of FISs and FIRMs for Ontario, Seneca, Tompkins, Wayne, and Yates Counties are summarized below.

County	Actual/Projected Preliminary Issuance Dates
Ontario	Summer 2023
Seneca	Summer 2024
Tompkins	January 18, 2023
Wayne	Summer 2024
Yates	May 1, 2023

There are two counties (Madison and Schuyler Counties) that have no digital coverage available, with no plans in the near future for updates.

Recommended Adaptive Measure

For Cayuga, Oneida, Onondaga, and Oswego Counties, engineering studies of the floodplains need to be prioritized to allow agencies, homeowners, and stakeholders to better understand areas vulnerable to flooding and the extent of the vulnerability.

For Madison and Schuyler Counties, engineering studies of the floodplains and countywide digital FIRMs need to be prioritized to allow agencies, homeowners, and stakeholders better understand areas vulnerable to flooding and the extent of the vulnerability and have access to the digital representation of that data.

These efforts are largely funded through Congressional Appropriations to the NFIP, which is subject to Fiscal Year budget constraints. They may come through support from FEMA to the state, as a CTP. Floodplain mapping could potentially be further supplemented through the 2022 Environmental Bond Act.

Potential Barriers to Implementation Identified

- Flood study funding is provided through Congressional Appropriations, which may fluctuate year by year, and may also be directed to other parts of FEMA's program. Additionally, there is limited opportunity to direct which counties are studied within FEMA's plan.
- State Resource availability.

Implementation ROM Cost Estimate

A ROM cost estimate for updates for Cayuga, Oneida, Onondaga, and Oswego Counties is summarized below. This includes hydrologic and hydraulic studies for all reaches within the county that are unmapped or do not have a recent study, as well as the production of preliminary and final FISs and FIRMs.

County	ROM Cost Estimate
Cayuga	$1.3 million
Oneida	$2.3 million
Onondaga	$4.3 million
Oswego	$2.0 million

An ROM cost estimate for countywide updates for Madison and Schuyler is below. This includes hydrologic and hydraulic studies for all reaches within the county that are unmapped or do not have a recent study, as well as the production of preliminary and final FISs and FIRMs.

County	ROM Cost Estimate
Madison	$3.0 million
Schuyler	$0.7 million

5.3.5 Resilient New York Studies

Description

NYSDEC has completed a significant number of studies within the Mohawk River Basin as part of the Resilient New York program. Watershed studies have been completed in Fish Creek, Oneida Creek and Butternut Creek watersheds of the Oswego River Basin under Phases 1 and 2 of this program. These studies have been useful in

identifying localized flooding problems through hydrologic and hydraulic modeling, recommending innovative solutions, and identifying grant funding to implement the study findings. Phase 3 of Resilient NY may include studies on the Owasco River, Flint Creek, Clyde River and Ganargua Creek. Successfully implemented projects from Phases 1 and 2 of the Resilient NY program are provided in Appendix F.

Recommended Adaptive Measure

- Recommend that Resilient New York watershed studies be conducted for Owasco River, Flint Creek, Clyde River, and Ganargua Creek and Seneca River within the Oswego River Basin.

Potential Barriers to Implementation Identified

- Resource availability

Implementation ROM Cost Estimate

Under NYSDEC's Resilient NY program, based on the costs of previous studies assume a ROM cost of $200,000/study or $1 million total cost.

6.0 Conclusions

The work of the Upstate Flood Mitigation Task Force in the development of this Report has identified many adaptive measures that may be implemented to mitigate flood damage and associated flood damage costs within the Mohawk and Oswego River Basins. These recommended measures include both physical interventions as well as policy-driven adaptive measures.

The recommended adaptive measures, in general, utilize the development of a working numerical model of each basin as a foundation to better understand and estimate the potential benefits. Basin-level numeric models would provide a better understanding of regional hydrology and would improve prediction capabilities for system-wide storm event impacts. In the near term, numeric models would objectively inform operational changes to improve existing water management capabilities.

Once numerical models are developed, they will support the efforts of the recommended Standing Committees in each basin and will provide the Committee members a better understanding of how changing the rate and timing of water releases from lakes and reservoirs can impact each basin. Model development will also enable estimation of the potential impacts of any proposed physical change or intervention and provide a means to establish criteria for project funding requests and recommendations for implementation.

Most recommended adaptive measures include 'resource availability' as a barrier to implementation. This barrier was meant to identify funding requirements needed to advance the adaptive measures. Many physical adaptive measures provide funding values for studies and further investigation prior to full implementation, which was done to allow the measures to progress in the near term with limited funding requirements to ensure the viability of the measure. It is anticipated funding requirements for full implementation will be developed during the study period and presented to the Task Force to assist in identifying funding sources. While grant opportunities will be pursued by the Task Force and relevant State agencies, and all available public funding will be investigated, it is likely that, due to the magnitude of the overall funding necessary as well as the long-term view of the adaptive measures, targeted funding from the state legislature will be required to advance the recommendations. Existing funding sources with descriptions are provided in Appendix G.

While the scale of this ambitious Task Force undertaking is significant, this Report has attempted to distill the information and recommendations into actionable opportunities. It is the Task Force's belief that further investigation and implementation of the recommended adaptive measures is overdue. Previous efforts were not advanced, to the detriment of many New York State residents, and the flooding events in just the past five years documented in this Report demonstrate the severity and significant variability in the locations and durations of flooding events. Therefore, every effort must be made to advance the recommendations of this Report as soon as possible and to begin the task of doing what is possible to better assist and better protect the residents and infrastructure most vulnerable to flooding within the Mohawk and Oswego River Basins.

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Rotterdam, NY

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