NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

NEW YORK STATE OF OPPORTUNITY. Office of General Services | Design & Construction

FLOOD MITIGATION & RESILIENCE REPORT

Ramapo River - SD113

Prepared for:

New York State Department of Environmental Conservation,
in cooperation with the New York State Office of General Services

SLR #142.16511.00008

March 2023 (Revised May 2023)

SLR

Ramapo River - SD113

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New York State Office of General Services
Empire State Plaza
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Cover Image: Aftermath of flooding in hamlet of Ramapo in 1903. Photograph provided by Geoff Welch.

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TABLES

ACRONYMS

AHPS	Advanced Hydrological Prediction System
BFE	Base Flood Elevation
BIN	Bridge Identification Number
BRIC	Building Resilient Infrastructure and Communities
CEA	Critical Environmental Area
CFA	Consolidated Funding Application
CFS	Cubic Feet per Second
CMP	Corrugated metal pipe
CRRA	Community Risk and Resiliency Act
CSC	Climate Smart Communities
DGEIS	Draft Generic Environmental Impact Statement
ECL	Environmental Conservation Law
EFC	Environmental Facilities Corporation
EPOD	Environmental Protection Overlay District
EWP	Emergency Watershed Protection
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FPMS	Floodplain Management Services
GEIS	Generic Environmental Impact Statement
GIGP	Green Innovation Grant Program
GIS	Geographic Information System
HEC-RAS	Hydrologic Engineering Center – *River Analysis System*
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HRA	High Risk Area
LiDAR	Light Detection and Ranging
MPH	Miles per Hour
MWRR	Municipal Waste Reduction and Recycling
NBI	National Bridge Inventory
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation

NYSOGS	New York State Office of General Services
PDM	Pre-Disaster Mitigation
RCDA	Rockland County Drainage Agency
RCP	Representative Concentration Pathways
RFC	Repetitive Flood Claims
SDWA	Safe Drinking Water Act
SEQRA	State Environmental Quality Review Act
SFHA	Special Flood Hazard Area
SLR	SLR Engineering, Landscape Architecture, and Land Surveying, P.C.
SRL	Severe Repetitive Loss
STA	Station
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
USWRC	United States Water Resources Council
WRD	Water Replenishment District
WWTP	Wastewater Treatment Plant

SUMMARY

This analysis of Ramapo River is being conducted as part of the Resilient New York Program, an initiative of the New York State Department of Environmental Conservation (NYSDEC). The main stem of the Ramapo River originates at Lake Echo in the hamlet of Arden within the western portion of the town of Tuxedo and flows generally southward through the town of Tuxedo, through the village of Sloatsburg, and then eastward towards the town of Ramapo and southward through the village of Hillburn and along the western border of the village of Suffern before crossing into New Jersey.

The watershed is located northwest of New York City and is part of the New York Metropolitan Area. Portions of the watershed are densely developed, especially the downstream portions. Sections of the Ramapo River are confined by roads and railroads, which encroach upon the river's floodplain.

Rockland County, including the Ramapo River watershed, has an active history of flooding. According to National Oceanic and Atmospheric Administration historical records, 25 hurricane or tropical storm tracks have passed within 65 miles of Rockland County since 1861, with five passing directly through Rockland County. Based on stream flow records of peak flows from a United States Geological Survey (USGS) gauge in the village of Suffern, it can be estimated that peak flows on Ramapo River during the August 2011 Tropical Storm Irene exceeded the 100-year flood event.

As part of this analysis, flood-prone High Risk Areas, or HRAs, within the Ramapo River watershed are identified and an analysis of flood mitigation considerations within each HRA is undertaken. A total of five HRAs are identified and are located at population centers in communities, including Suffern and Hillburn (HRA 1), Sloatsburg (HRA 2), Harriman (HRA 4), and Monroe (HRA 5).

Several HRAs fall within areas identified as Disadvantaged Communities or Potential Environmental Justice Areas. Within HRA 1, critical facilities include a wastewater treatment plant, a water treatment plant, and the Department of Public Works garage. During Hurricane Irene, the water treatment plant was inundated, and the village was reportedly unable to supply safe water to the community for a month.

Factors with the potential to influence more than one HRA are also evaluated and discussed. It is recommended that new FEMA modeling be developed for the approximately 17 miles of the Ramapo River from the New Jersey state line upstream to the village of Harriman to reflect current hydraulic and hydrologic conditions. Modeling for this reach of the Ramapo River is based on an antiquated HEC-2 analysis dating from the 1980s. Updates to hydraulic modeling should then be reflected with updated FIRMs. The updated hydraulic modeling and mapping would reflect changes such as bridge replacements, flood mitigation projects, or updated flood hydrology.

Flood mitigation scenarios, such as floodplain enhancement and channel restoration, dam modifications, road closures, and replacement of undersized culverts, roadway bridges, and railroad bridges, are recommended where appropriate. Recommendations for flood protection at individual properties are provided. An analysis of watershed land use is conducted, and a Flood Resiliency Best Practices Audit is conducted for each community within the watershed.

High-priority recommendations for flood hazard mitigation along the Ramapo River include the following:

- In HRA 1, removal of the abandoned railroad bridge and embankment traversing the Ramapo River floodplain in the Suffern West Ward to reduce flooding of critical water supply and wastewater infrastructure

- Also in HRA 1, replacement of the Fourth Street bridge over the Ramapo River with a hydraulically adequate span to alleviate flooding of an electrical substation

- In HRA 3, replacement of the Arden Road bridge with a hydraulically adequate span and exploring the feasibility of raising the NY-17 and I-87 roadway elevations upstream to reduce or eliminate flooding of these highways

- In HRA 4, replacement of the Brookside Drive East culvert with a hydraulically adequate culvert to alleviate flooding of the upstream neighborhood

- In HRA 5, exploring the feasibility of removing, relocating, or lowering the Heritage Rail Trail embankment near the Harriman/Monroe village limits to reduce flooding at the Marc Terrace/ James Road and Dorothy Drive neighborhoods

- In HRA 5, exploring the feasibility of reducing the spillway elevation, e.g., with collapsible flashboards, or otherwise increasing the spillway capacity of the Monroe Ponds dam to reduce flooding of properties, businesses, and infrastructure surrounding Monroe Ponds

- Voluntary buyout or relocation of flood-prone properties and businesses identified throughout the HRAs

1. INTRODUCTION

1.1 PROJECT BACKGROUND AND OVERVIEW

This work is a component of the Resilient New York Program, an initiative of the NYSDEC, contracted through the New York State Office of General Services (NYSOGS). The goal of the Resilient New York Program is to make New York State more resilient to flooding and climate change. Through the program, flood studies are being conducted across the state, resulting in the development of flood and ice jam hazard mitigation alternatives to help guide implementation of mitigation projects.

Ramapo River originates in southeastern Orange County and drains generally southward into New Jersey, where it joins the Pompton River in Pompton Plains, New Jersey. This report will focus on the portion of the Ramapo River watershed located within New York State. The report begins with an overview of the Ramapo River watercourse and watershed, summarizes the history of flooding, and identifies High Risk Areas (HRAs) within the watershed. An analysis of flood mitigation considerations within each HRA is undertaken. Flood mitigation recommendations are provided either as HRA-specific recommendations or as overarching recommendations that apply to the entire watershed or stream corridor. Flood mitigation scenarios, such as floodplain enhancement and channel restoration, road closures, and replacement of undersized bridges and culverts, are investigated and are recommended where appropriate.

1.2 TERMINOLOGY

In this report, all references to right bank and left bank refer to "river right" and "river left," meaning the orientation assumes that the reader is standing in the river, looking downstream. Stream stationing is used in the narrative and on maps as an address to identify specific points along the watercourse. Stationing is measured in feet and begins at station (STA) 0+00 where Ramapo River crosses the New Jersey State border. As an example, Ramapo River flows under the New York State Thruway I-87 at STA 140+00.

This study focuses on the portion of the Ramapo River watershed located in New York State. Throughout this report, references to the Ramapo River, its tributaries, and the Ramapo River watershed pertain to the portions located in New York State. The Mahwah River, a tributary to the Ramapo River that enters the Ramapo just south of the New York/New Jersey state line, was evaluated in a separate flood study conducted under the Resilient NY Program (Flood Mitigation & Resilience Report, Mahwah River – SD 111).

The Federal Emergency Management Agency (FEMA) is an agency of the United States Department of Homeland Security. In order to provide a common standard, FEMA's National Flood Insurance Program (NFIP) has adopted a baseline probability called the base flood. The base flood has a 1 percent (one in 100) chance of occurring in any given year, and the base flood elevation (BFE) is the level floodwaters are expected to reach in this event. For the purpose of this report, the 1 percent annual chance flood is also referred to as the 100-year flood. Other recurrence probabilities used in this report include the 2-year

flood event (50 percent annual chance flood), the 10-year flood event (10 percent annual chance flood), the 25-year flood event (4 percent annual chance flood), the 50-year flood event (2 percent annual chance flood), and the 500-year flood event (0.2 percent annual chance flood).

The Special Flood Hazard Area (SFHA) is the area inundated by flooding during the 100-year flood event. Within the project area, FEMA has developed Flood Insurance Rate Mapping (FIRM), which indicates the location of the SFHA along Ramapo River and its tributaries.

2. DATA COLLECTION

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

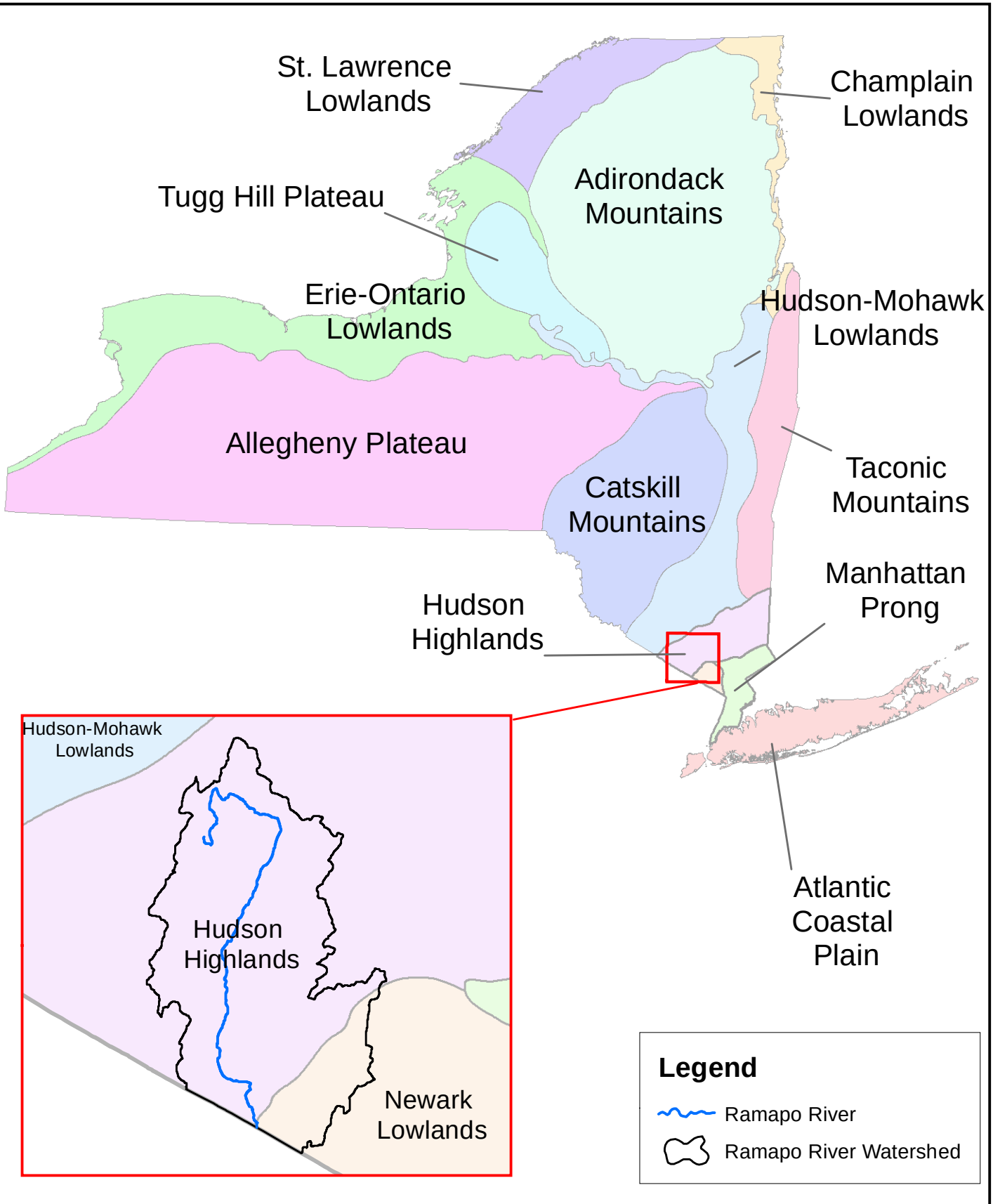
2.1 RAMAPO RIVER WATERSHED CHARACTERISTICS

The Ramapo River watershed is located in Orange and Rockland Counties in southeastern New York State. The watershed spans the Hudson Highlands and Newark Lowlands physiographic regions (Figure 2-1) and is oblong in shape. When measured at its confluence to Pompton River in New Jersey, the Ramapo River watershed is 161 square miles in size. When measured at the New Jersey State border, the watershed is 113 square miles in size. Figure 2-2 is a map depicting the Ramapo River watershed in New York State, and Figure 2-3 is a relief map of the watershed.

Bedrock underlying the Hudson Highlands, and therefore the Ramapo River watershed, is comprised of metamorphic rocks from the Middle Proterozoic Period. It is part of the earliest record of geologic history within southeastern New York. The bedrock contains a variety of layered and unlayered metamorphic units, each of which are highly intricate. Having been subjected to at least three mountain-building events throughout geologic time, these rocks were deformed and metamorphosed by an enormous amount of pressure and heat that created complex patterns of bedrock. The metamorphic units contain an assortment of gneisses, marbles, and quartzites. They are highly resistant to erosion and have withstood millions of years to create the elevated and rugged landscape that is seen in the Hudson Highlands today. Many north-east trending folds and faults are seen within the Ramapo River watershed, which influence drainage patterns. These parallel, deeply eroded faults lines hold streams and elongate lakes.

The Hudson Highlands are divided from the Newark Lowlands by the Ramapo Fault. The Newark Lowlands is a flat-laying, gently rolling surface that slopes down to the east. The bedrock found in this area is comprised of the Hammer Creek Formation. It is Upper Triassic Period in age and is a coarse-grained conglomerate, coarse sandstone, and shale.

Surficial materials underlying the Ramapo River watershed consist primarily of glacial till, with some small areas of exposed bedrock dispersed throughout the watershed. The entire length of the Ramapo River is underlain by alluvial deposits, with some outwash sand and gravel mapped at the lower end of the river where it crosses into New Jersey. Small amounts of kame deposits are also found along the Ramapo River.



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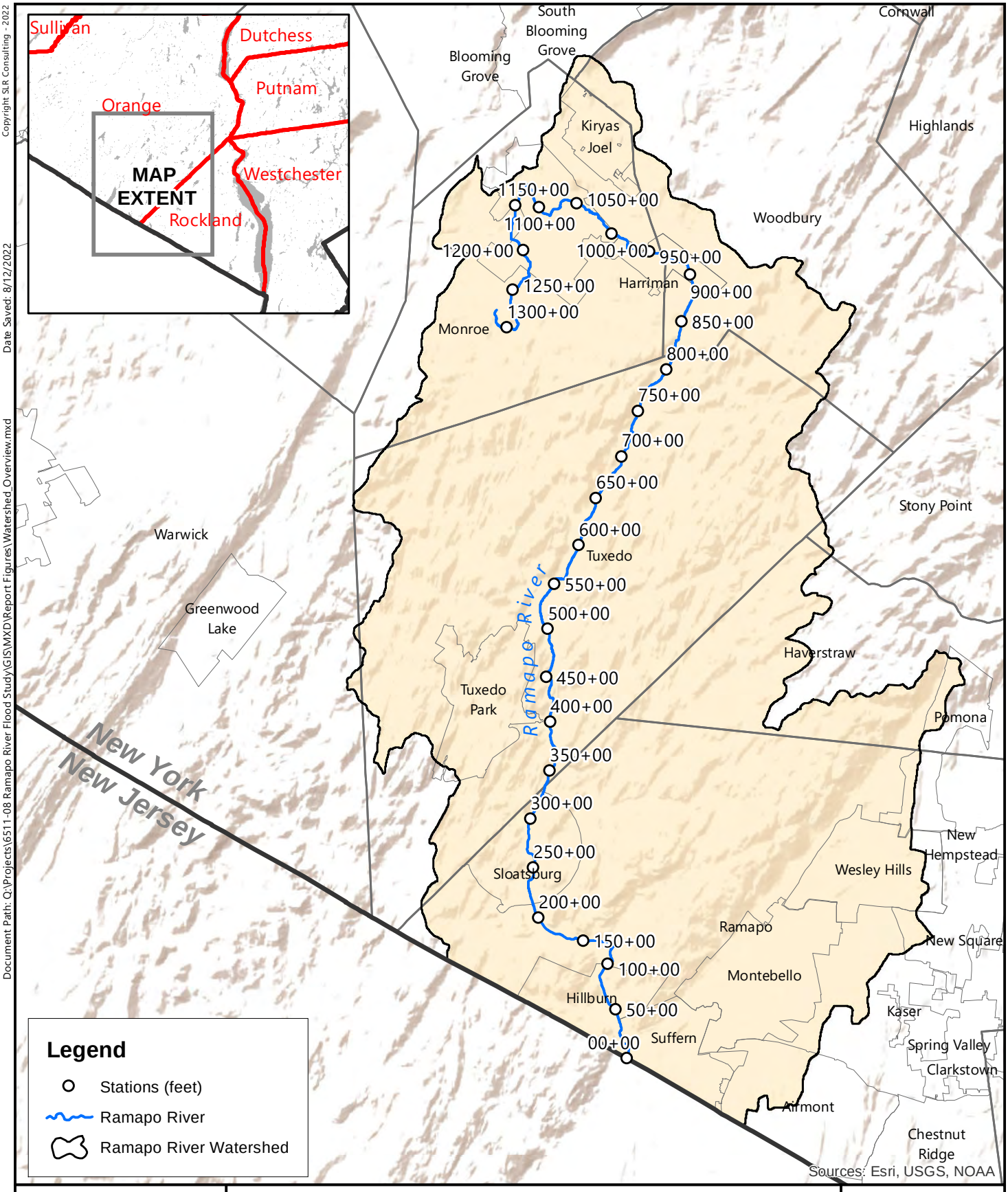
NYS PHYSIOGRAPHIC REGIONS
RAMAPO RIVER FLOOD & RESILIENCY STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N
0 140,000 280,000
Feet

SCALE 1 " = 300,000 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 2.1



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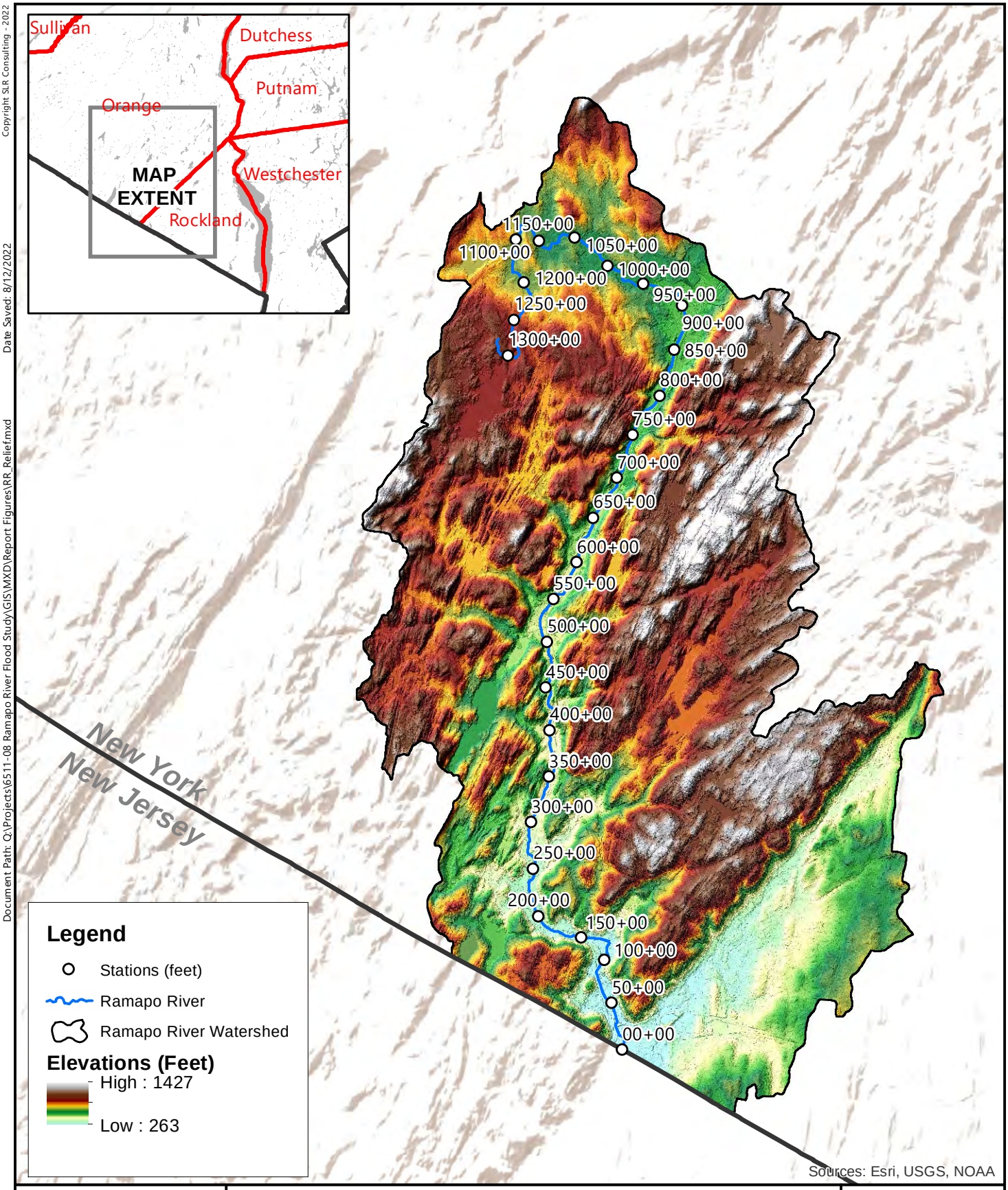
RAMAPO RIVER WATERSHED

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

SCALE 1 " = 11,976 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 2-2



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RELIEF MAP

RAMAPO RIVER FLOOD & RESILIENCE STUDY

SD 113

ROCKLAND COUNTY

NEW YORK

N

0 6,000 12,000
Feet

SCALE 1 " = 12,611 '

DATE 8/12/2022

16511.00008
PROJ. NO.

FIG. 2-3

During a rainfall event, the proportion of rainfall that runs off directly into rivers and streams or that infiltrates into the ground is greatly influenced by the composition of soils within a watershed. Soils are assigned a hydrologic soil group identifier, which is a measure of the infiltration capacity of the soil. These are ranked A through D. A hydrologic soil group A soil is often very sandy, with a high infiltration capacity and a low tendency for runoff except in the most intense rainfall events; a D-ranked soil often has a high silt or clay content or is very shallow to bedrock and does not absorb much stormwater, which instead is prone to runoff even in small storms. A classification of B/D indicates that when dry the soil exhibits the properties of a B soil, but when saturated, it has the qualities of a D soil. Figure 2-4 depicts the hydrologic soil groups present in the Ramapo River watershed. The prevalence of C and C/D soils in the watershed indicate a low infiltration rate and high runoff during storms.

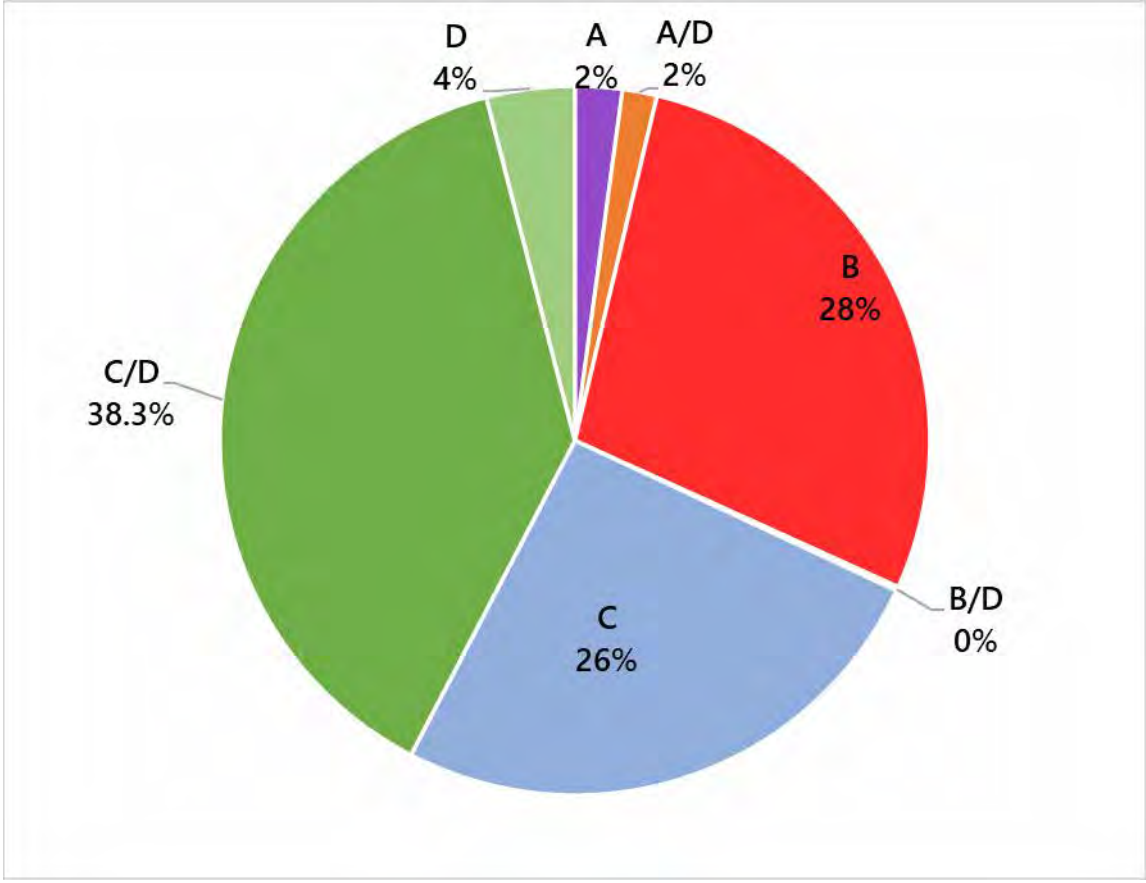


Figure 2-4: Hydrologic grouping of soils within the Ramapo River watershed

Land cover is another important factor influencing the runoff characteristics of a watershed. Orange and Rockland Counties are located north-northwest of New York City and are part of the New York Metropolitan Area. Land cover within the Ramapo River watershed can be characterized using the 2016 Multi-Resolution Land Characteristics National Land Cover Database for Southeast New York State and is shown graphically in Figure 2-5. Forested land is the most common land cover, representing 68 percent of the watershed. It consists of deciduous, coniferous, and mixed forest types. The second largest percentage of land cover is developed land at 20 percent of the watershed. Open water and wetlands

combined make up 7 percent of the land cover. The remaining 4 percent of the land cover consists of agricultural land, grassland and shrubland, and barren land.

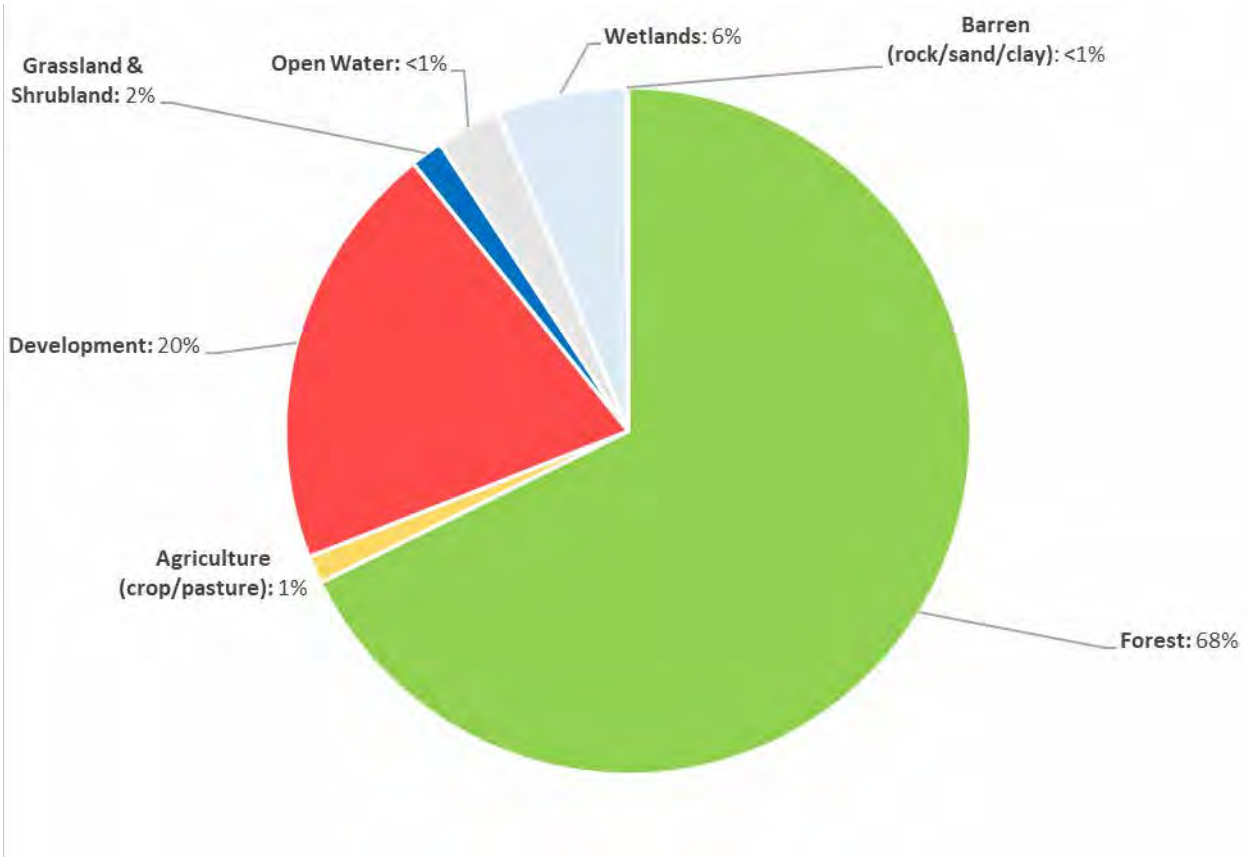


Figure 2-5: Land cover within the Ramapo River watershed

Wetland cover was also examined using information available from the U.S. Fish & Wildlife Service's National Wetlands Inventory (NWI). The NWI indicates that there are 5,888 acres of wetlands in the Ramapo River watershed, or approximately 8 percent of the watershed. The NWI mapping includes the following types of wetland habitats: freshwater forest/shrub wetland, freshwater emergent wetland, freshwater lakes and ponds, and riverine wetland.

It is estimated that since colonial times approximately 50 to 60 percent of the wetlands in the state of New York have been lost through draining, filling, and other types of alteration.

There are numerous NYSDEC-mapped wetlands in the Ramapo River watershed, including a complex of wetlands surrounding Cranberry Pond and Potake Pond; wetlands along the Ramapo River between Sloatsburg and Hillburn; Long Swamp, Bog Meadow, and Delaney Swamp wetlands near the Orange/Rockland County line; and wetlands along Warwick Brook.

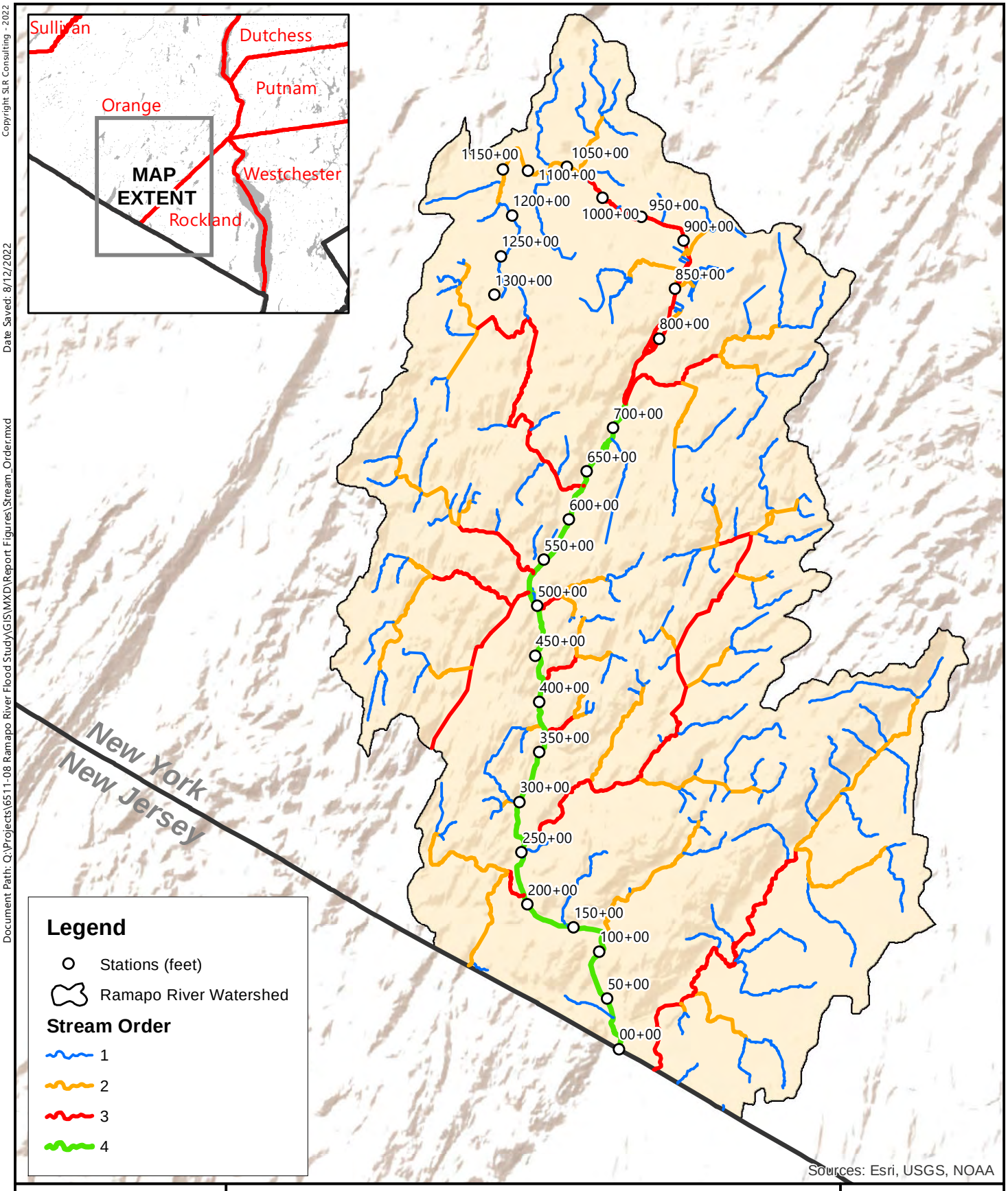
Wetlands play an important role in flood mitigation by storing water and attenuating peak flows. It is estimated that since colonial times approximately 50 to 60 percent of the wetlands in the state of New York have been lost through draining, filling, and other types of alteration.

The watershed has several large water bodies, including Tuxedo Lake, Lake Sebago, Lake Kanawauke, Mombasha Lake, Indian Reservoir, Sterling Lake, Cranberry Pond, Lake Stahahe, and Wee Wah Lake.

2.2 RAMAPO RIVER WATERCOURSE

The main stem of the Ramapo River originates in Echo Lake in the hamlet of Arden within the town of Ramapo and flows generally southwesterly in a relatively confined valley as it passes through the hamlets of Arden and Southfields and near to the village of Tuxedo Park. From there, the river turns more southerly and crosses into Rockland County near the northern limits of the village of Sloatsburg. After it bisects Sloatsburg, the river makes a turn to the east as it passes through the town of Ramapo, then to the southeast as it flows into the village of Hilburn. The Ramapo River runs along the boundary of the villages of Hillburn and Suffern for its last 4,000 feet in New York, and then flows into the town of Mahwah, New Jersey. The Ramapo River flows generally southwest for about another 15 miles from the state line before joining the Pompton River in Pequannock, New Jersey. Some named tributaries to the Ramapo River in New York include Stahahe Brook and Indian Kill in Tuxedo, Stony Brook in Sloatsburg, and Arden Brook in Arden.

Stream order provides a measure of the relative size of streams by assigning a numeric order to each stream in a stream network. The smallest tributaries are designated as first-order streams, and the designation increases as tributaries join. The main stem of Ramapo River can be characterized as a fourth-order stream for most of its length at the New Jersey border. Figure 2-6 is a map depicting stream order in the Ramapo River watershed.



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STREAM ORDER: RAMAPO RIVER

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N

0 5,500 11,000
Feet

SCALE 1 " = 11,596 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 2-6

Characteristics of each order of stream (total length, average slope, and percentage of overall stream network) are summarized in Table 2-1. First- and second-order streams account for most of the overall stream length within the Ramapo River watershed (74 percent). First-order streams are, on average, steeper in slope than higher-order streams.

Table 2-1 Stream Order Characteristics in the Ramapo River Watershed

Stream Order	Total Length (miles)	Percentage of Overall Network Length (%)	Average Slope (%)
1st	100.1	50	2.4
2nd	47.6	24	1.9
3rd	39.6	20	2.1
4th	14.0	7	0.5
Total	**201.3**	**100**	

2.3 HYDROLOGY

Hydrologic studies are conducted to understand historical, current, and potential future river flow rates, which are a critical input for hydraulic modeling software such as *Hydrologic Engineering Center – River Analysis System* (HEC-RAS). These often include statistical techniques to estimate the probability of a certain flow rate occurring within a certain period of time based on data from the past; these data are collected and maintained by the USGS at thousands of stream gauging stations around the country. For the streams without gauges, the USGS has developed region-specific regression equations that estimate flows based on watershed characteristics such as drainage area and annual precipitation as well as various techniques to account for the presence of nearby stream gauges or to improve analyses of gauges with limited records. These are based on the same watershed characteristics as gauged streams in that region so are certainly informative although not as accurate or reliable as a gauge due to the intricacies of each unique basin.

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

A simplified diagram of the hydrologic cycle is presented in Figure 2-7.

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

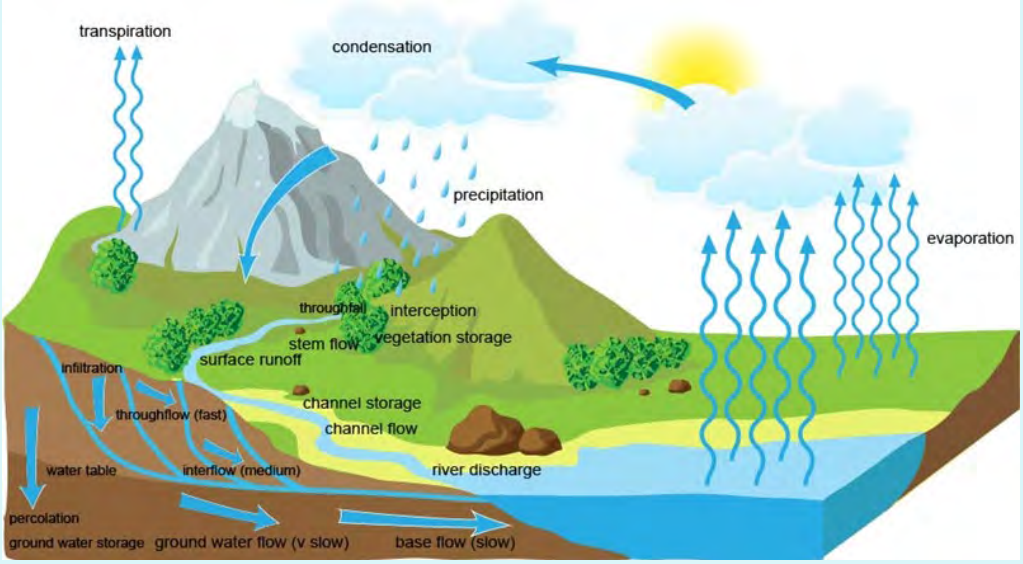


Figure 2-7: Diagram of simplified hydrologic cycle

Estimated flood flows on the Ramapo River are reported in the FEMA Flood Insurance Study (FIS) reports for Orange (36071CV001A) and Rockland (36087CV001A) Counties. Hydrology for the Ramapo River was not updated for the effective 2014 Rockland County-wide FIS; flood flows are based on past FIS analyses from the 1970s and 1980s as were flows on the Ramapo River in the town of Tuxedo in Orange County. For the Orange County-wide FIS, effective in 2009, hydrology was updated for new modeling of about 8 miles of the river in the towns of Monroe and Woodbury and villages of Harriman and Monroe.

The USGS currently operates three flow gauges on the Ramapo River in New York: stations in Suffern (01387420), where the river drains 93 square miles, and Ramapo (01387400), where the watershed is 86.9 square miles, have been in continuous operation since 1979; a gauge was installed in Harriman in 2020, where the watershed is 10.4 square miles (01387095). Several additional gauges have historically operated elsewhere along the river. The peak discharge for the periods of record at the Suffern and Ramapo gauges, including an estimated historical flood peak from 1936, was during Tropical Storm Irene in 2011. United States Water Resources Council (USWRC) Bulletin 17B flood frequency analyses were performed for these gauges' 43 years of record to estimate flood magnitude at these locations.

Regional hydrologic regressions described in the USGS publication SIR 2006-5112 and implemented by the *StreamStats* web service were used to estimate discharge along the Ramapo River. This report also

describes techniques for weighting the results of flood frequency analyses at stream gauging stations with the results of regional regressions to improve the reliability of estimates. The results of gauge record analyses at the Suffern and Ramapo gauges were so weighted using Equation (3) in SIR 2006-5112.

The flood magnitude estimates described above are summarized in Table 2-2, which compares flows estimated by FEMA, gauge analysis, regional regressions, and weighted gauge analysis at the Ramapo and Suffern gauge locations. The results of weighting the flood frequency analyses with regional regressions, highlighted in bold in Table 2-2, were used in hydraulic modeling.

Table 2-2 Comparison of Hydrologic Methods at Suffern and Ramapo Gauge Locations (Flows used for this study are highlighted in bold.)

Location	Flood	Discharge (cfs)			
		Rockland County FIS 36087CV001A	USWRC 17B Gauge Analysis	Regional Regressions (*StreamStats*)	**Gauge Analysis Weighted by Regional Regressions**
Ramapo at Suffern (01387420) (93 sq. mi.)	10-Year	5,340	7,168	4,560	**6,672**
	50-Year	9,785	13,560	7,700	**11,985**
	100-Year	12,455	17,204	9,360	**14,926**
	500-Year	20,340	28,448	14,100	**23,878**
Ramapo at Ramapo (01387400) (86.9 sq. mi.)	10-Year	5,200	6,476	4,340	**6,070**
	50-Year	9,545	12,432	7,380	**11,074**
	100-Year	12,030	15,925	9,000	**13,914**
	500-Year	19,815	27,041	13,700	**22,791**

cfs = cubic feet per second

Overall, the discharge estimates used for representative floods in hydraulic modeling for this study are somewhat more conservative than those used in the most recent FEMA studies. For other locations along the Ramapo River, flood discharge was estimated by scaling results from the Ramapo gauge (01387400) using the region-specific drainage-area-based transfer equation (5) described in USGS SIR 2006-5112. As an example comparison of this scaling technique farther upstream in the watershed, results at the Harriman/Monroe village boundary where the watershed covers 9.92 square miles are presented in Table 2-3 along with flows updated in the 2009 Orange County FIS and the results of regional regressions (*StreamStats*) at the same location.

Table 2-3 Comparison of Hydrologic Techniques at the Harriman/Monroe Village Boundary (Flows used for this study are highlighted in bold.)

Location	Flood	Discharge (cfs)		
		Orange County FIS 36071CV001A	Regional Regressions (*StreamStats*)	**01387400 Gauge Analysis Weighted and Scaled**
Harriman/Monroe Village Boundary (9.92 sq. mi.)	10-Year	1,443	905	**1,281**
	50-Year	2,427	1,590	**2,495**
	100-Year	2,978	1,960	**3,205**
	500-Year	4,172	3,030	**5,708**

The estimated 10-year flood flows used for this study are slightly less than those used in the FIS, a relatively minor increase in the 50- and 100-year floods, and a fairly substantial increase in the 500-year flood.

Representative flood hydrology used in this study at key locations along the Ramapo River is presented in Table 2-4.

Table 2-4 Selected Peak Flow Hydrology for Ramapo River in Rockland and Orange Counties

Location	Drainage Area (square miles)	Peak Flood Discharge (cfs)				
		10-Year	25-Year	50-Year	100-Year	500-Year
STA 26+00; Suffern, at USGS Gauge 01387420	93	7,168	10,490	13,560	17,204	28,488
STA 138+50; Ramapo, at USGS Gauge 01387400	86.9	6,476	9,542	12,432	15,925	27,041
STA 210+00; Sloatsburg	84.1	6,330	9,333	12,164	15,587	26,482
STA 315+00; Sloatsburg	60.1	5,262	7,657	9,886	12,556	20,917
STA 410+00; Tuxedo	58	5,134	7,475	9,655	12,266	20,488
STA 650+00; Southfields	54.1	4,892	7,131	9,217	11,719	19,560
STA 800+00; Arden	25.2	2,876	4,251	5,541	7,100	12,014
STA 875+00; Harriman	13.3	1,845	2,758	3,621	4,668	7,991
STA 970+00; Harriman	11.4	1,413	2,099	2,740	3,515	6,244
STA 1065+00; Monroe	6.18	922	1,385	1,820	2,350	4,220
STA 1185+00; Monroe	3.12	573	872	1,155	1,501	2,729

The web-based tool "Application of Flood Regressions and Climate Change Scenarios to Explore Estimates of Future Peak Flows" developed by the USGS (Burns et al., 2015a,b) was used to obtain estimates for changes to peak flood flows under a range of projected climate change scenarios at different periods in the future. This tool is currently only available for New York State and was used to assess flooding conditions that may occur in future decades, enabling proactive flood mitigation measures. These may include restricting development in areas that are not currently regulated floodplains but are reasonably expected to be in the future based on climate change projections or identifying bridges and culverts that currently perform well but may become hydraulically inadequate in the future.

Precipitation data were evaluated for two future scenarios, termed "Representative Concentration Pathways" (RCP), that provide estimates of the extent to which greenhouse gas concentrations in the atmosphere are likely to change through the 21st century. RCP refers to potential future emissions trajectories of greenhouse gases such as carbon dioxide. RCP 4.5 is considered a midrange-emissions scenario, and RCP 8.5 is a high-emissions scenario. Resulting precipitation and runoff estimates are based on five different climate models and are input into the USGS *StreamStats* program, a web-based implementation of regional hydrologic regression equations. Percent increases over *StreamStats* regression estimates based on current climatic data, as computed for the Ramapo River watershed, were applied to corresponding design flood flows used in hydraulic modeling of the stream and its tributaries. The flows based on the more moderate greenhouse gas scenario were used in the model. Proposed replacement stream crossings were assessed based on the flood flows the structure would be expected to encounter over its design lifetime. When modeling replacement culverts, the 2050-2074 projections were employed as a 50-year design life is typical for such structures; the 2075-2099 projections were used for bridges, which are often in service for 75 to 100 years or more. Projected 50- and 100-year future flows are presented in Table 2-5.

Table 2-5 Current and Projected Future Flows used in Hydraulic Analyses at Selected Locations on Ramapo River

Location	Peak Flood Discharge (cfs)					
	Current		Projected Future (RCP 4.5, 2050-2074)		Projected Future (RCP 4.5, 2075-2099)	
	50-Year	100-Year	50-Year	100-Year	50-Year	100-Year
STA 26+00; Suffern, at USGS Gauge 01387420	13,560	17,204	15,458 (+14%)	19,613 (+14%)	15,187 (+12%)	19,441 (+13%)
STA 138+50; Ramapo, at USGS Gauge 01387400	12,432	15,925	14,048 (+13%)	18,155 (+14%)	13,924 (+12%)	17,836 (+12%)
STA 210+00; Sloatsburg	12,164	15,587	13,745 (+13%)	17,769 (+14%)	13,624 (+12%)	17,457 (+12%)
STA 315+00; Sloatsburg	9,886	12,556	11,072 (+12%)	14,188 (+13%)	10,973 (+11%)	13,937 (+11%)
STA 410+00; Tuxedo	9,655	12,266	10,814 (+12%)	13,738 (+12%)	10,621 (+10%)	13,615 (+11%)
STA 650+00; Southfields	9,217	11,719	10,139 (+10%)	12,891 (+10%)	10,139 (+10%)	12,891 (+10%)
STA 800+00; Arden	5,541	7,100	6,040 (+9%)	7,739 (+9%)	5,929 (+7%)	7,597 (+7%)
STA 875+00; Harriman	3,621	4,668	3,947 (+9%)	5,088 (+9%)	3,874 (+7%)	5,041 (+8%)
STA 970+00; Harriman	2,740	3,515	2,959 (+80)	3,796 (+8)	2,932 (+7)	3,761 (+7)
STA 1065+00; Monroe	1,820	2,350	1,948 (+9)	2,561 (+9)	1,966 (+8)	2,538 (+8)
STA 1185+00; Monroe	1,155	1,501	1,270 (+10)	1,651 (+10)	1,258 (+9)	1,636 (+9)

2.4 HYDRAULICS

Hydraulic analyses on Ramapo River were conducted using the HEC-RAS computer software. This program was developed by the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center and is the industry standard for riverine flood analysis. The model is used to compute water surface profiles for one- and two-dimensional, steady- and unsteady-state flow conditions. The system can accommodate a full network of channels, a dendritic system, or a single river reach. HEC-RAS is capable of modeling water surface profiles under subcritical, supercritical, and mixed-flow conditions. Water surface profiles are computed from one cross section to the next by solving the one-dimensional energy equation with an

iterative procedure called the standard step method. Energy losses are evaluated by friction (Manning's Equation) and the contraction/expansion through the channel. The momentum equation is used in situations where the water surface profile is rapidly varied such as hydraulic jumps, mixed-flow regime calculations, hydraulics of dams and bridges, and evaluating profiles at a river confluence.

2.4.1 EXISTING CONDITIONS MODELING

HEC-RAS one-dimensional hydraulic modeling of the Ramapo River developed in 2007 for the 2009 Orange County FIS extends from just downstream of the Harriman village limits, upstream through the villages of Harriman and Monroe, and continues into the town of Monroe, terminating near the river's headwaters. This model was obtained from NYSDEC and updated for this study to reflect current conditions, including breach or removal of a dam at STA 952+00, removal of the former Hill Street bridge deck at STA 1147+00, and removal of two small culvert crossings at STA 1184+00 and STA 1190+00. Hydrology was also updated for this reach as described in Section 2.3.

Up-to-date hydraulic modeling was not available for the approximately 17 miles of the Ramapo River in New York from the New Jersey state line to the village of Harriman. To assess flood hazards and mitigation alternatives in these areas, a new model was developed based on Light Detection and Ranging (LiDAR)-derived topographic mapping, aerial imagery, field measurements by SLR Engineering, Landscape Architecture, and Land Surveying, P.C. (SLR), bridge inventory data, and channel bathymetry and bridge geometry data from FIS reports. LiDAR-derived topographic surfaces are available from the New York State (NYS) Geographic Information System (GIS) Clearinghouse for Rockland County, collected in 2011 and produced at a 2-meter grid resolution, and Orange County, collected in 2014 and produced at a 1-meter grid resolution.

In addition to adjusted hydrologic conditions, one of the more significant updates made to the effective FEMA modeling of the Harriman and Monroe reach is the use of tailwater elevations determined by the new modeling of the downstream reach as an existing conditions downstream boundary condition. Effective modeling uses a normal depth downstream boundary, which does not account for the backwaters generated by both topography and infrastructure downstream. With this adjustment, the effective FIS model appears to underestimate flooding along the approximately 4,500 feet of the Ramapo River downstream of the NY-17M bridge by more than 5 feet.

HEC-RAS modeling completed in 2013 for the 2019 revisions to the Bergen County, New Jersey FIS was obtained and used to assess flood mitigation alternatives near the state line.

2.4.2 PROPOSED CONDITIONS MODELING

Several HEC-RAS model geometries were developed to represent proposed conditions in order to assess alternatives at the identified HRAs on Ramapo River. These involved modifications of the terrain, cross sections, bridges and dams, boundary conditions, surface roughness, or combinations thereof. Flood mitigation alternatives were modeled individually and in combination to assess practical and effective short- and long-term solutions.

2.5 STAKEHOLDER MEETINGS

An important component of the data gathering for this study took place through stakeholder engagement. Two formal stakeholder meetings were convened by video conference call. The first meeting was held on the evening of October 4, 2021. This meeting was geared toward participation from members of watershed groups. The second meeting was held on October 6, 2021, with participation from government agencies, county, and municipal staff and included participation from NYSDEC, NYSOGS, and Rockland County. A final stakeholder meeting will be coordinated at the close of the study to share findings and recommendations.

2.6 INFRASTRUCTURE

In 2014, the Community Risk and Resiliency Act (CRRA) was signed into law to build New York's resilience to rising sea levels and extreme flooding. The Climate Leadership and Community Protection Act made modifications to the CRRA, expanding the scope of climate hazards and projects for consideration. These modifications became effective January 1, 2020. NYSDEC has provided guidelines for requirements under CRRA, which are summarized in a publication entitled *New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act.*

Several bridge crossings of the Ramapo River are contained within identified HRAs and in certain cases may contribute to flooding in these locations. These structures and summary details are listed below in Table 2-6. A number of additional structures span the river but were not assessed in detail because they were adequately sized, relatively new, or did not significantly increase the flood hazard in surrounding developed areas.

Table 2-6 Bridge Summary Data (limited to bridges in Identified HRAs)

	Roadway	River Station (feet)	Structure Description	NBI BIN* (Owner)	Year Built	Total Span (feet) (Number of Spans)	Rise Above Streambed (feet)	Estimated Bankfull Width (feet) (Regional Regressions)
HRA 1	Railway (out of service)	13+00				90 (1)	16	90
	I-287 N on ramp to I-87 S	26+00	Steel Multi-Beam	5523960 (State – Thruway)	1994	362 (2)	45	90
	I-87 N off ramp to I-287 S	32+00	Steel Multi-Beam	502761B (State – Thruway)	1995	1,987 (11)	55	90

	Roadway	River Station (feet)	Structure Description	NBI BIN* (Owner)	Year Built	Total Span (feet) (Number of Spans)	Rise Above Streambed (feet)	Estimated Bankfull Width (feet) (Regional Regressions)
	I-87 N/S	35+00	Steel Multi-Beam	5514139 (State – Thruway)	1955	476 (1)	40	90
	4th Street	60+00	Steel Multi-Beam	3346140 (County)	1966	99 (1)	17	90
	Orange Turnpike / NY-59	89+50	Steel Multi-Beam	1027590 (State)	2000	165 (1)	16	90
	Metro-North / NS Railroad	90+50	Lattice Truss	MNCW/NS		125 (1)	16	90
	Bridge Street (out of service, pedestrian only)	138+00	Warren Truss	2346230 (Private)	1904	106 (1)	17	90
	I-87 N	145+50	Steel Multi-Beam	5014082 (State – Thruway)	1953	799 (7)	50	90
	I-87 S	146+50	Steel Multi-Beam	5014081 (State – Thruway)	1953	760 (7)	50	90
HRA 2	Seven Lakes Drive (West)	262+00	Twin Concrete Arch	1050420 (State)	1929	66 (2)	11	86
HRA 2	Seven Lakes Drive (East)	262+00	Steel Multi-Beam	1050430 (State)	2011	103 (1)	12	86
HRA 2	Washington Avenue	289+00	Concrete Box Beam	3346170 (County)	1992	164 (3)	12	86
HRA 3	(East) Village Road	402+50	Concrete Box Beam	3345060 (County)	2019	102 (1)	11	80
HRA 3	Metro-North / NS Railroad	446+00		MNCW/NS		60 (2)	14	80
HRA 3	Metro-North / NS Railroad	458+00		MNCW/NS		144 (2)	11	80

	Roadway	River Station (feet)	Structure Description	NBI BIN* (Owner)	Year Built	Total Span (feet) (Number of Spans)	Rise Above Streambed (feet)	Estimated Bankfull Width (feet) (Regional Regressions)
	Kanawauke Road	543+80	Steel Multi-Beam	1040840 (State – Parks)	1947	190 (3)	30	80
	Arden Valley Road	722+50	Steel Multi-Beam	5514210 (State – Thruway)	1953	430 (5)	45	62
	Metro-North / NS Railroad	728+00		MNCW/NS		60 (1)	11	60
	Arden Road	762+50	Concrete Beam	3345030 (County)	1930	44 (1)	12	60
	Metro-North / NS Railroad	832+00		MNCW/NS		34 (1)	11	60
HRA 4	Metro-North / NS Railroad	880+00		MNCW/NS		60 (1)	13	52
	Arden House Road	905+00				30 (1)	8	52
	NY-17M	927+50	Prestressed Concrete Beam	1014020 (State)	1993	70 (1)	9	47
	River Road	946+00	Steel Multi-Beam	3369190 (County)	1985	65 (1)	9	47
	Freeland Street	1045+00	Concrete Arch	3364840 (Village)	1940	24 (1)	16	41
HRA 5	Stage Road	1102+50	Culvert - Concrete Arch	N/A		20 (1)	7	35
	Lakes Road/ Lake Street	1122+00	Twin Arches	2223570 (Village)	1994	40 (2)	7	35
	NY-17M	1128+50	Culvert – CMP and Box			8 & 16	8	35
	High Street	1133+50	Culvert – CMP Arch			13	8	35
	Lakes Road	1136+00	Culvert – Concrete Arch			16	6	35

	Roadway	River Station (feet)	Structure Description	NBI BIN* (Owner)	Year Built	Total Span (feet) (Number of Spans)	Rise Above Streambed (feet)	Estimated Bankfull Width (feet) (Regional Regressions)
	Center Hill Road	1157+00	Culvert – Elliptical			8.75	6.25	34
	Rye Hill Road	1208+00	Culvert – CMP			3	3	22

*National Bridge Inventory Bridge Identification Number
cmp = corrugated metal pipe

Regardless of past bridge performance and flooding history, all replacement stream crossings should be accompanied by rigorous, up-to-date hydrologic and hydraulic analyses and incorporate the most current future flood projections and all applicable design standards and guidance set forth by New York State Department of Transportation (NYSDOT) and NYSDEC, as practical. Hydraulic design criteria developed by these agencies are presented below.

NYSDOT has established design standards for bridges, culverts, and highway drainage. Design criteria for new or replacement bridges are summarized in the inset below while design standards for culverts and highway drainage are summarized in Table 2-7.

NYSDOT Hydraulic Design Criteria for Bridges

- **The proposed structure shall not raise the water surface elevations anywhere when compared to the existing conditions for both the 50- and 100-Year flows.**
- **The proposed low chord shall not be lower than the existing low chord.**
- **A minimum of 2.0 feet of freeboard for the projected 50-Year flood is required for the proposed structure. The freeboard shall be measured at the lowest point of the superstructure between the two edges of the bottom angle for all structures.**
- **The projected 100-Year flow shall pass below the proposed low chord without touching it.**
- **The maximum skew of the pier(s) to the flow shall not exceed 10 degrees.**
- **For the purposes of resilient design, current peak flow estimates shall be increased by 10% in DOT Regions 4, 5, and 6, plus Cayuga, Onandoga, Seneca, and Tompkins Counties; in Regions 1, 2, 7, 8, 9, 10, and 11, plus Cortland and Oswego Counties, peak flows shall be increased by 20%.**

Reproduced from Section 3.2.3.1 of 2019 NYSDOT *Bridge Manual*.

Table 2-7 Design Flood Frequencies for Drainage Structures and Channels (Reproduced from Table 8-2 in 2018 NYSDOT *Highway Design Manual, Revision 91*)

HIGHWAY FUNCTIONAL CLASSIFICATION	DESIGN FLOOD FREQUENCY (YEARS)[1,3]		
	Culverts[2]	Storm Drainage Systems	Ditches[4]
Interstates and Freeways	50	10[5]	25
Principal Arterials	50	10[5]	25
Minor Arterials, Collectors, Local	50[6]	5[7]	10

1. The values in this table are typical. The selected value for a project should be based upon an assessment of the likely damage to the highway and adjacent landowners from a given flow and the costs of the drainage facility. Note: 100-year requirements must be checked if the proposed highway is in an established regulatory floodway or floodplain.
2. The check flow, used to assess the performance of the facility, should be the 100-year storm event.
3. Relocated natural channels should have the same flow characteristics (geometrics and slope) as the existing channel and should be provided with a lining having roughness characteristics similar to the existing channel.
4. Including lining material
5. As per 23CFR650A, and Table 1-1 of HDS 2, a 50-year frequency shall be used for design at the following locations where no overflow relief is available:
    a. sag vertical curves connecting negative and positive grades.
    b. other locations such as underpasses, depressed roadways, etc.
6. A design flood frequency of 10 or 25 years is acceptable if documented in the Design Approval Document, and when identified after design approval, in the drainage report. A design flood frequency of 10 or 25 years should be used in the design of driveway culverts and similar structures.
7. Use a 25-year frequency at the following locations where no overflow relief is available:
    a. sag vertical curves connecting negative and positive grades.
    b. other locations such as underpasses, depressed roadways, etc.

NYSDEC has also established standards for all stream crossings, both bridges and culverts; these are summarized in the inset below:

NYSDEC Stream Crossing Standards

- **Bridges and bottomless arches are preferred and should be used whenever possible.**
- **Box and pipe culverts, if used, must be:**
  - Embedded into the streambed to at least 20 percent of the culvert height at the downstream end
  - Used only on streambeds with slopes no steeper than 3 percent
  - Installed level
- **The crossing opening should be at least 1.25 times the width of the stream channel bed. This width is measured bank-to-bank at the ordinary high water level or edges of terrestrial, rooted vegetation.**
  - An average of three measurements, at the project location and upstream and downstream, should be used to determine the channel bed width.
- **At low flows, water depths and velocities should be the same as they are in natural areas upstream and downstream of the crossing.**
- **Natural substrate should be used within the crossing, and it should match the upstream and downstream substrates. It should resist displacement during floods and should be designed so that the appropriate material is maintained during normal flows.**

3. IDENTIFICATION OF FLOOD HAZARDS

3.1 FLOODING HISTORY

Rockland County and Orange County have active histories of hurricanes and tropical storms. According to NOAA historical records summarized in the FEMA FIS for Rockland County, 25 hurricane or tropical storm tracks have passed within 65 miles of Rockland County since 1861, including four Category 1 hurricanes, two Category 2 hurricanes, and 19 tropical storms. Of the 25 recorded storm events, five passed directly through Rockland County. Table 3-1 is a summary of flood events that impacted Rockland and Orange Counties and the Ramapo River watershed. The flood history is summarized from the FEMA FIS for Rockland County, the FEMA FIS for Orange County, NOAA historical storm records for Rockland and Orange Counties, and the Rockland County Multi-Jurisdictional Hazard Mitigation Plan.

Table 3-1 Rockland and Orange Counties Flood History

Date	Flood Event	Notes
1863 to 1915	Four unnamed tropical storms	
October 1903	Great Flood of 1903	Over 10 inches of rain fell over 30 hours, resulting in two fatalities, at least five dam failures in Ramapo, and destroyed all bridges across the Ramapo River except the Erie Railroad bridge between Ramapo and Hillburn. A history of this event, "The Great Flood of 1903 in the Ramapo Valley," by Craig Long of the Historical Society of Rockland County (South of the Mountains, Vol. 27, No. 3; July – September 1983) can be found online here: https://rocklandhistoryblog.tumblr.com/post/159260164455/the-great-flood-of-1903-in-the-ramapo-valley
1972	Tropical Storm Agnes	Tropical Storm Agnes first developed in the northwest Caribbean Sea on June 11. By the night of June 15, Agnes transitioned into a tropical depression as it moved northward into the Gulf of Mexico. When the storm hit the Florida panhandle, it had reached its peak intensity as a hurricane on June 18. Hurricane Agnes weakened as it moved northward up through North Carolina and Virginia but quickly regained its strength as it merged with another storm system over Pennsylvania. The states of Pennsylvania, Virginia, and New York received large amounts of rain. Rainfall amounts ranged from 6 to 12 inches. Almost $13 billion in damages were estimated to be caused by Hurricane Agnes nationwide.
September 1975	Hurricane Eloise	Rockland County was included in areas eligible for both Individual and Public Assistance under Disaster Declaration DR-0487, following the impacts of the remnants of Hurricane Eloise. Heavy rainfall caused riverine flooding and an estimated $300 million in damage across the northeastern United States.
November 1977	Unnamed storm	During this flood, Ramapo River reached its highest stage of 1.4 feet. The Sloatsburg USGS stream gauge, which is no longer active, recorded 4,000 cfs and is one of the worst events recorded at this time. The event caused damage to buildings, bridges, and roads.
April 1984	Unnamed storm	Recorded rainfall varied from 2 inches to slightly more than 8 inches within Lower New York and northeastern New Jersey. Most of the precipitation fell in under 24 hours. A storm had run through the area the week prior, creating saturated soil conditions and therefore causing low infiltration rates and large amounts of runoff. (Philips M. & Schopp R., 1986)

Date	Flood Event	Notes
December 21, 1992	Nor'easter	This nor'easter, which caused widespread flooding and damage to commercial and residential properties, utilities, roads, and other infrastructure, resulted in Disaster Declaration 0974, under which Rockland County became eligible for both Public and Individual Assistance.
July 13, 1996	Hurricane Bertha	Hurricane Bertha originally made landfall in North Carolina but had weakened to a Tropical Storm by the time it reached the New York City area. It passed Long Island, producing torrential rain and strong gusty winds. Torrential rain caused flooding of low-lying and poor-drainage areas, streams, and rivers across the area. The heaviest rain fell in a band to the northwest of Bertha's track over the Lower Hudson Valley. The Mahwah River at Suffern in Rockland County rose above its 4-foot flood stage from 11:30 a.m. EST on July 13 through 10:15 a.m. on July 14. The crest stage was 5.75 feet at 1:15 p.m. on July 13. The Saw Mill River in Westchester County also flooded. Rainfall amounts recorded in Rockland County ranged from 3.25 inches at West Nyack to 4.65 inches at Pomona. Rainfall amounts recorded in Orange County ranged from 3.26 inches at Ridgebury to 4.50 inches at Greenwood Lake.
September 1999	Remnants of Hurricane Floyd	Tropical depression by the time it reached Rockland County. Widespread flooding in Rockland, Orange, Putnam, and Westchester Counties; total damage costs estimated at $14.6 million. Rainfall amounts from 3.16 inches at Nanuet to 3.31 inches at New City. The Sloatsburg gauge along the Ramapo River, which is no longer active, recorded 5,780 cfs for this event. Rainfall amounts for Orange County ranged from 4.46 inches at Middletown to 8.25 inches at West Point. Orange and Rockland Counties were declared disaster areas.
September 2004	Hurricane Ivan	Tropical depression by the time it reached Southeastern New York. The remnants of Hurricane Ivan produced large amount rainfall in Orange County. Rainfall totaled 5 inches in some areas.
September 2004	Remnants of Hurricane Jeane	Remnants of Hurricane Jeane dropped large amounts of rainfall on Orange County. Rainfall amounts ranged between 3 and 6 inches in southeastern New York State. Flash flooding was observed in the area and caused several road closures.
April 15-16, 2007	Nor'easter	A nor'easter occurred during Sunday and Monday, April 15 and 16, which brought heavy rain and high winds that caused widespread and significant river, stream, and urban flooding of low-lying and poor-drainage areas. Rockland County was among the counties eligible for Individual and Public Assistance under the resulting Federal Disaster Declaration DR-1692. Costs to repair disaster damages to roads and drainage structures in Rockland County were estimated at $5,000,000. In Orange County, the Department of Emergency Services reported emergency declarations in the towns of Deerpark and Blooming Grove and in the villages of Washingtonville, Greenwood Lake, and South Blooming Grove. Rainfall amounts ranged from 4.26 inches in Westtown to 8.00 in Cornwall.
September 2008	Tropical Storm Hanna	Tropical depression by the time it reached southeastern New York. In Orange County, rainfall amounts ranged from 1.66 inches at Port Jervis to 4.13 inches at Sterling Forest. Property damage totaled just under $70,000 from Tropical Storm Hanna.

Date	Flood Event	Notes
August 28, 2011	Tropical Storm Irene	Hurricane Irene formed from a tropical wave on August 21, 2011, in the tropical Atlantic Ocean. It moved west-northwestward, and before becoming a hurricane, Irene struck Puerto Rico as a tropical storm. Hurricane Irene steadily strengthened to reach peak winds of 120 miles per hour (mph) on August 24. Irene then gradually weakened and made landfall on the Outer Banks of North Carolina with winds of 85 mph on August 27. It slowly weakened over land and re-emerged into the Atlantic on the following day. On August 28, Irene was downgraded to a tropical storm and made two additional landfalls, one in New Jersey and another in New York. Irene produced heavy damage over much of New York, totaling $296 million. The storm is ranked as one of the costliest in the history of New York, after Hurricane Agnes in 1972. Much of the damage occurred due to flooding, both from heavy rainfall in inland areas and storm surge in New York City and on Long Island. Tropical storm force winds left at least 3 million residents without electricity in New York and Connecticut. Ten fatalities are directly attributed to the hurricane. $296 million in damages across New York State, 7.52 inches of rainfall was recorded at Tappan, New York. Irene caused flooding along the Ramapo River. In Sloatsburg, extensive flooding occurred to properties around the Ramapo River and Stony Brook, including the railroad tracks. The bridge at Seven Lakes Drive was washed away, and the road was closed for months until bridge repair was completed. Many properties along the Ramapo River tributaries at the south side of the village needed to be evacuated. The municipal building was also damaged and needed electrical work performed.
October 29, 2012	Hurricane Sandy	Hurricane Sandy was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season as well as the second-costliest hurricane in United States history. Classified as the 18th named storm, 10th hurricane, and 2nd major hurricane of the year, Hurricane Sandy made landfall in the United States about 8:00 p.m. EDT October 29, striking near Atlantic City, New Jersey, with winds of 80 mph. A full moon made high tides 20 percent higher than normal and amplified Sandy's storm surge. Hurricane Sandy affected 24 states, including the entire eastern seaboard from Florida to Maine and west across the Appalachian Mountains to Michigan and Wisconsin, with particularly severe damage in New Jersey and New York. Its storm surge hit New York City on October 29, flooding streets, tunnels, and subway lines and cutting power in and around the city. Damage in the US is estimated at over $100 billion (2013 USD). Record flooding was seen in lower New York.
September 2021	Hurricane Ida	Hurricane Ida formed as a tropical depression on August 26 in the Caribbean Sea. Ida intensified into a hurricane on August 27 over the Gulf of Mexico and made landfall in Louisiana as a Category 4 hurricane. On September 1, Ida transitioned into a post-tropical cyclone while traveling across the northeastern United States. Extensive and historic flooding occurred in lower New York. A Federal Major Disaster was declared for Rockland County. 5.03 inches of rainfall was recorded at Suffern, New York. Flash flooding resulted in an estimated $10 million in damages across Orange County. Hurricane Ida made record for the second-most damaging hurricane to make landfall in the U.S. state of Louisiana. It is the costliest storm to hit the Northeastern United States since Hurricane Sandy.

There are three active USGS stream gauges on Ramapo River. They are in the village of Harriman (USGS gauge 01387095), the town of Ramapo (USGS gauge 01387400), and the village of Suffern (USGS gauge

01387420). Annual peak flow on the Ramapo River recorded at the Suffern, New York, USGS gauge 01387420 since 1980 provides a useful view of flood events. Figure 4-1 is a hydrograph showing annual peak flows recorded. Flood recurrence information from the FEMA FIS showing the magnitude of the 10-, 50-, and 100-year flood events has been superimposed on the hydrograph. Two flood events stand out: the April 1984 unnamed storm and the August 2011 Tropical Storm Irene. Tropical Storm Irene exceeded the 100-year flood at Suffern and the April 1984 event was close to exceeding the 100-year flood.

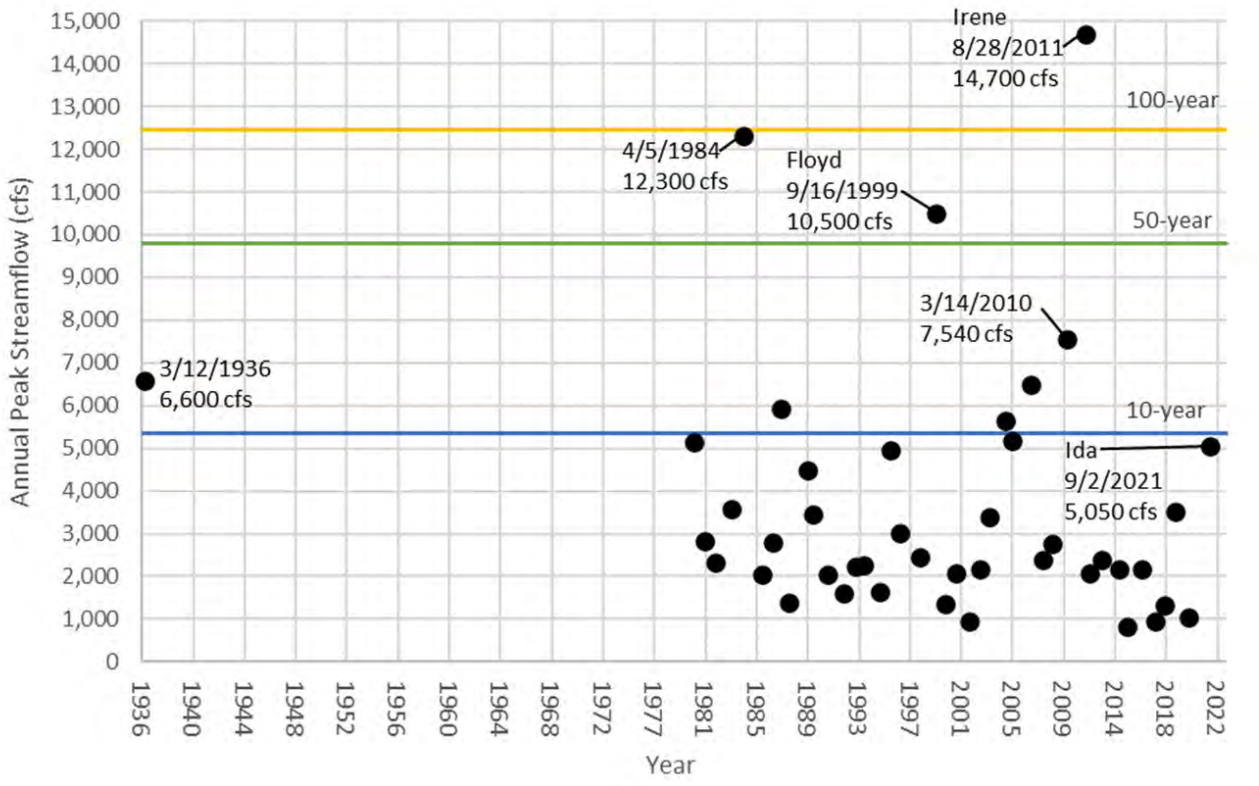


Figure 3-1: Hydrograph of annual peak flow on the Ramapo River at Suffern, New York 1980 – 2021

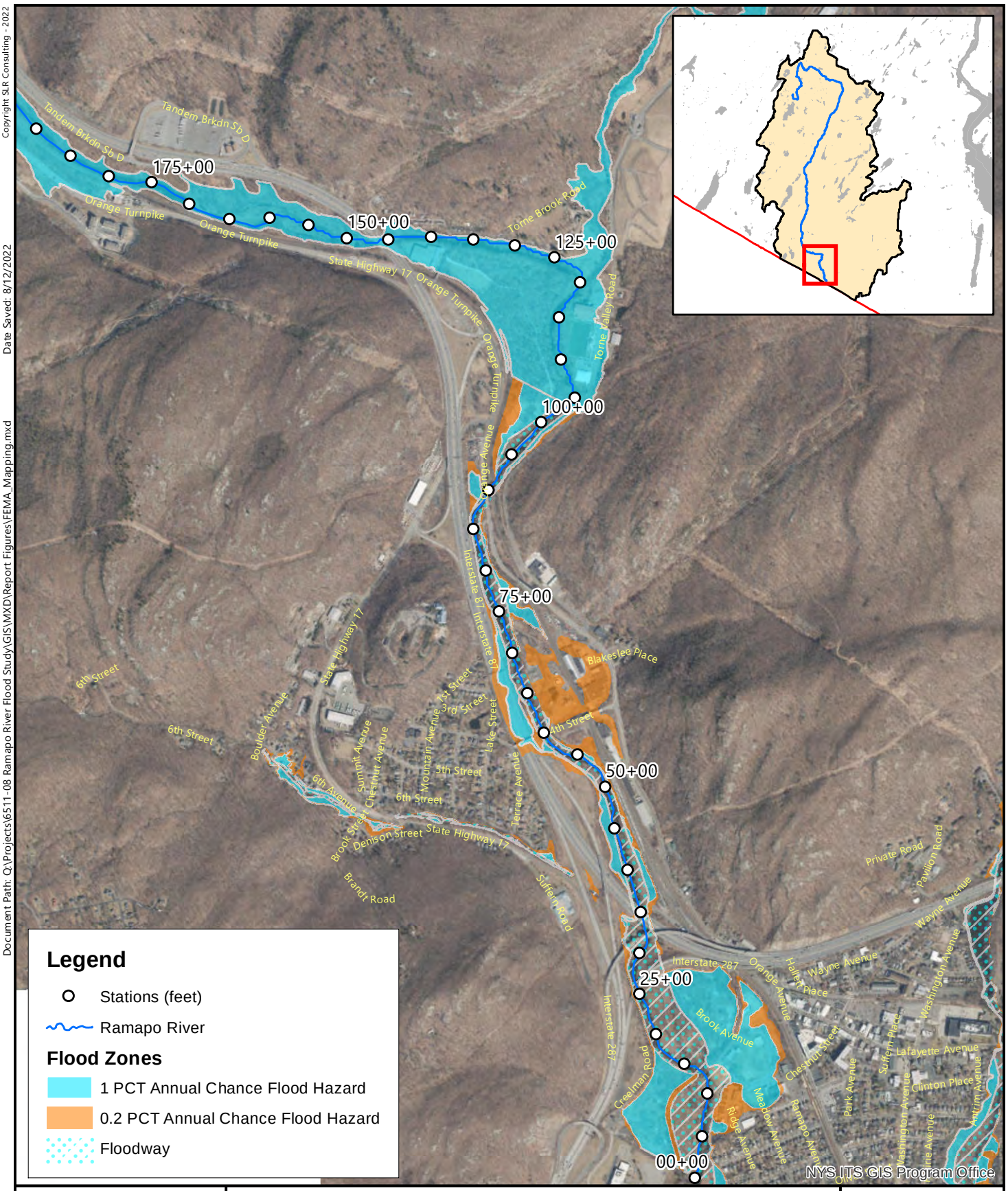
3.2 FEMA MAPPING

As part of the NFIP, FEMA produces FIRMs that demarcate the regulatory floodplain boundaries. As part of an FIS, the extents of the 100-year and 500-year floods are computed or estimated as well as the regulatory floodway if one is established. The area inundated during the 100-year flood event is also known as the SFHA. In addition to establishing flood insurance rates for the NFIP, the SFHA and other regulatory flood zones are used to enforce local flood damage prevention codes related to development in floodplains.

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

The FIS for Rockland County (36087CV001A) has been effective since March 2014, and the FIS for Orange County (36071CV001A) has been effective since August 2009. The flood hazard areas delineated by FEMA are mapped for each focus watercourse. Figures 3-2 through 3-9 depict flood hazard mapping along the Ramapo River. Each map displays the Special Flood Hazard Layers delineated by FEMA for each focus watercourse in this report, including the 1 percent annual chance flood hazard layer (100-year flood), 0.2 percent annual chance flood hazard layer (500-year flood), and the floodway hazard layer.

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



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SLR
231 MAIN STREET
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NEW PALTZ, NY 12561
845.633.8153

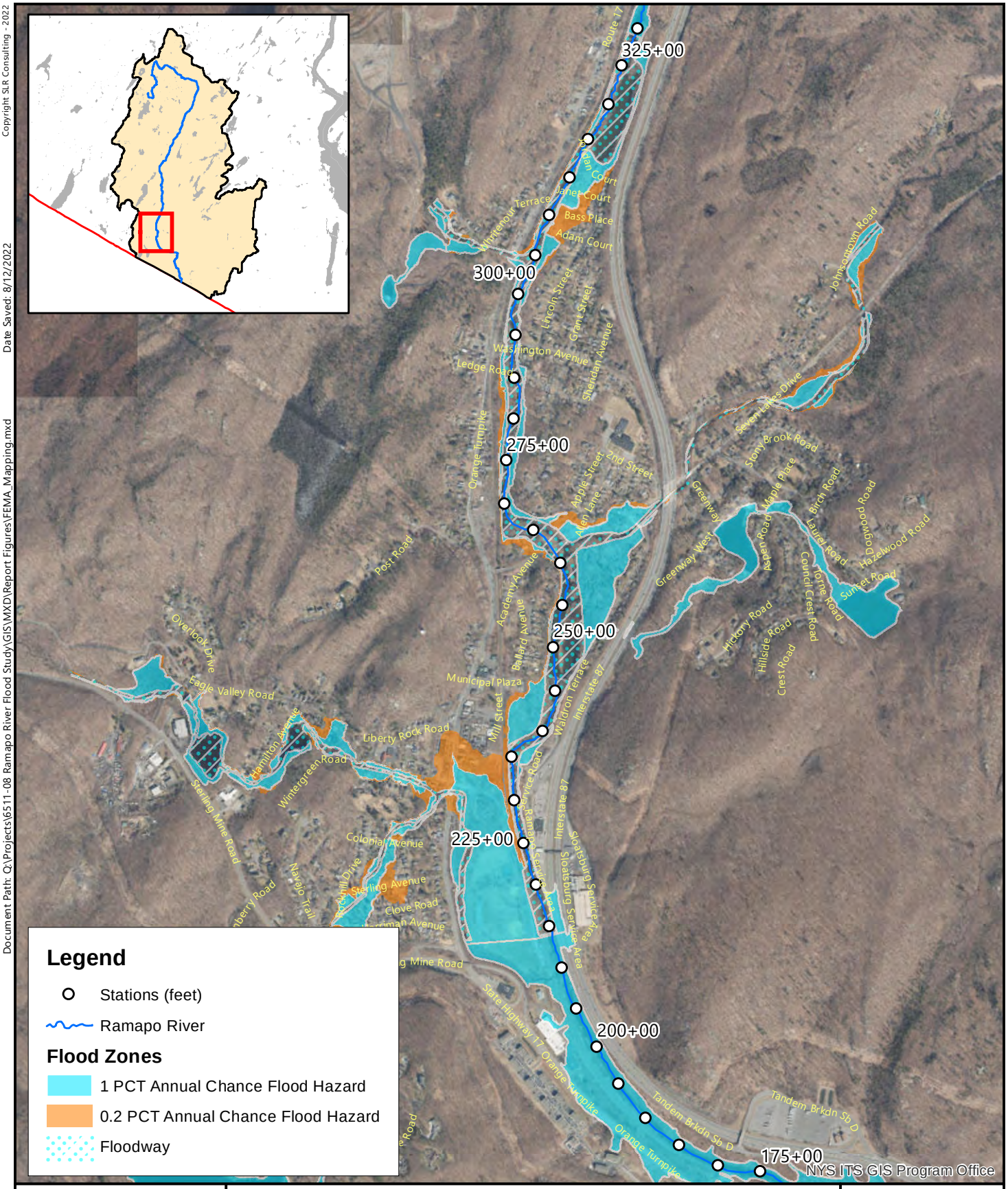
FEMA MAPPING: RAMAPO RIVER 1

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N
0 500 1,000
Feet

SCALE 1 " = 1,500 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 3-2



Legend

- Stations (feet)
- Ramapo River

Flood Zones

- 1 PCT Annual Chance Flood Hazard
- 0.2 PCT Annual Chance Flood Hazard
- Floodway

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FEMA MAPPING: RAMAPO RIVER 2

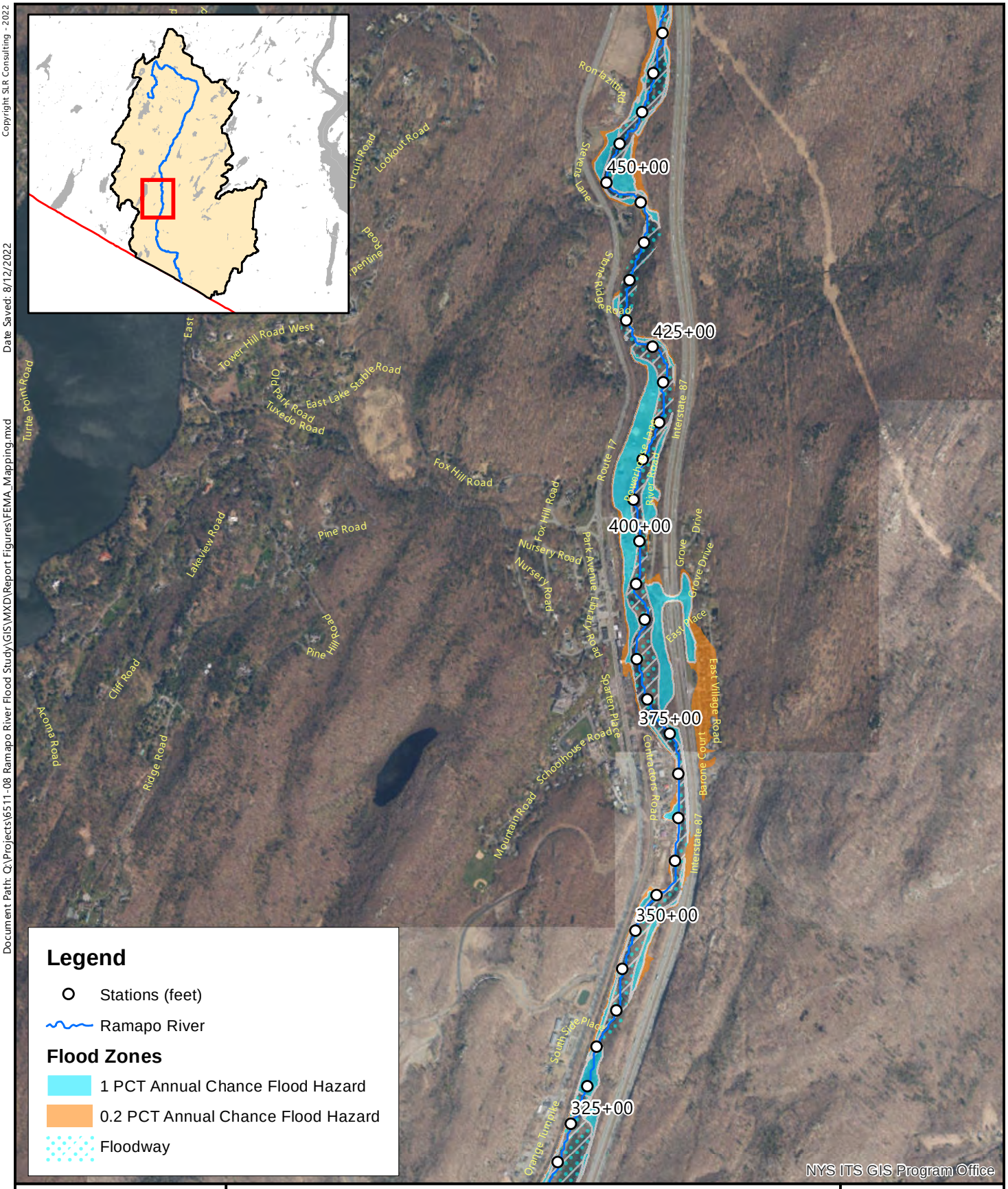
RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N

0 500 1,000
Feet

SCALE 1 " = 1,500 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 3-3



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FEMA MAPPING: RAMAPO RIVER 3

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N
0 500 1,000
Feet

SCALE 1 " = 1,500 '
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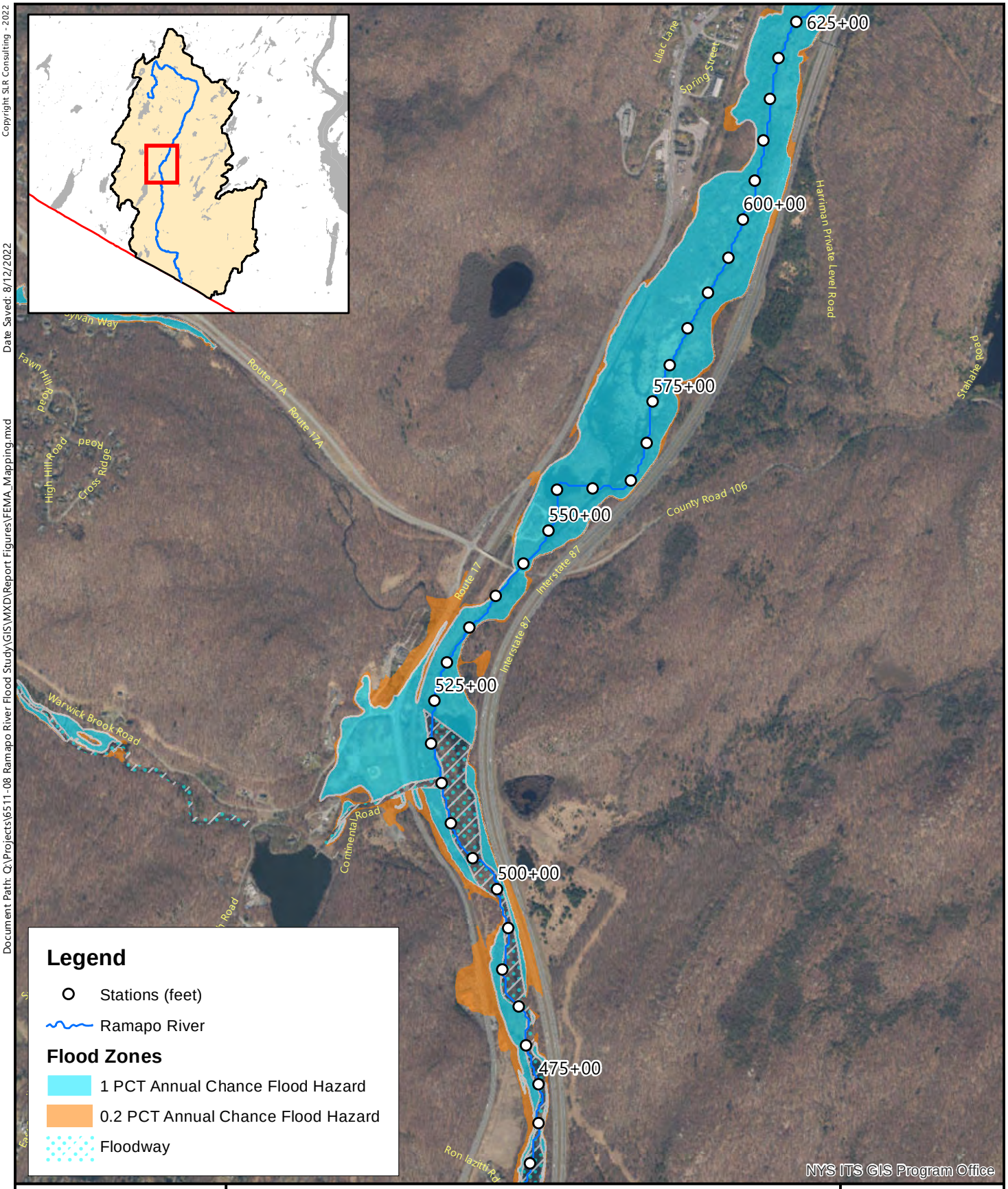
FIG. 3-4



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FEMA MAPPING: RAMAPO RIVER 4

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N
0 500 1,000
Feet

SCALE 1 " = 1,500 '
DATE 8/12/2022
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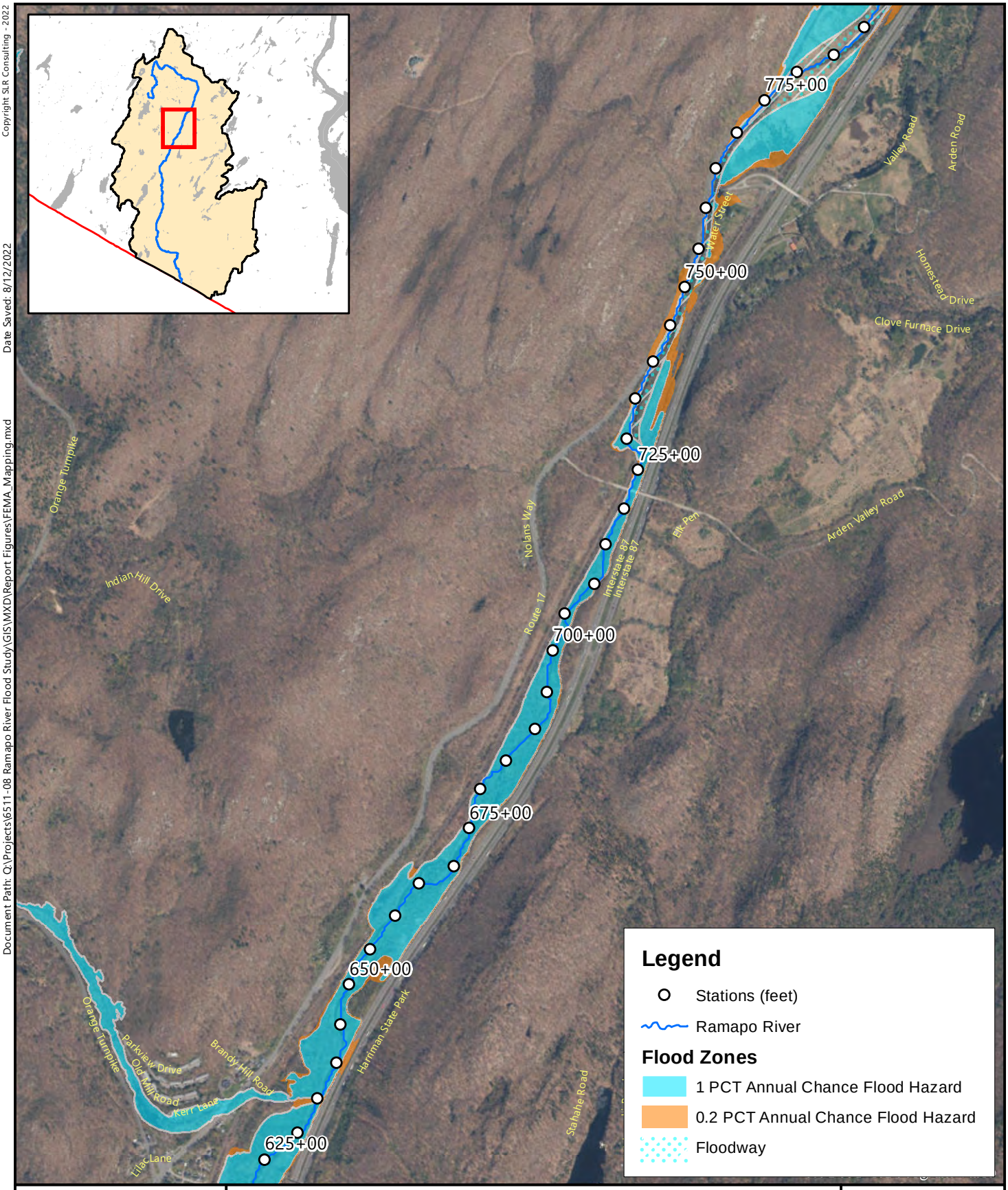
FIG. 3-5



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FEMA MAPPING: RAMAPO RIVER 5

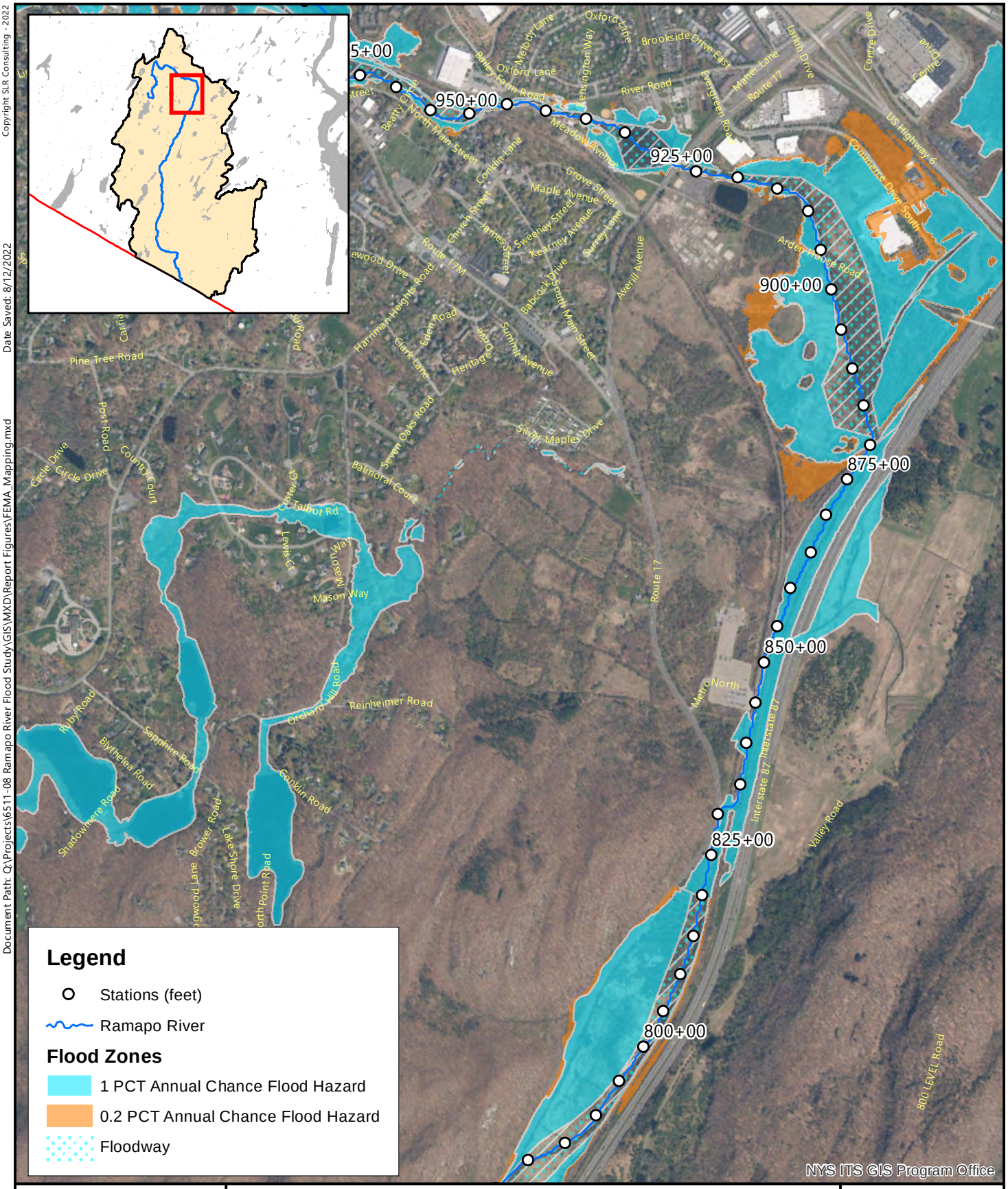
RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N

0 500 1,000
Feet

SCALE 1 " = 1,500 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 3-6



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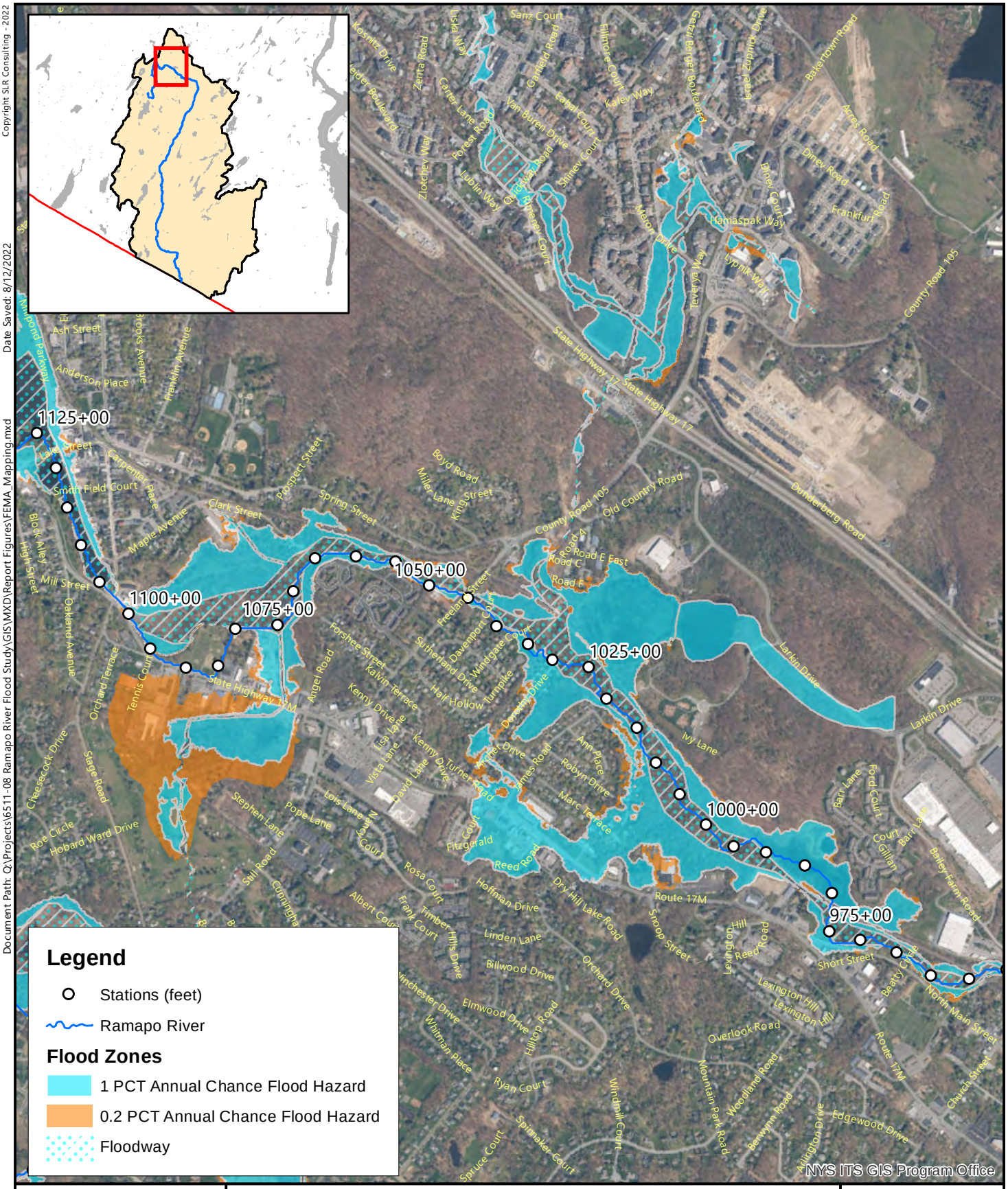
FEMA MAPPING: RAMAPO RIVER 6

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N
0 500 1,000
Feet

SCALE 1 " = 1,500 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 3-7



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FEMA MAPPING: RAMAPO RIVER 7

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

N
0 500 1,000
Feet

SCALE 1 " = 1,500 '
DATE 8/12/2022
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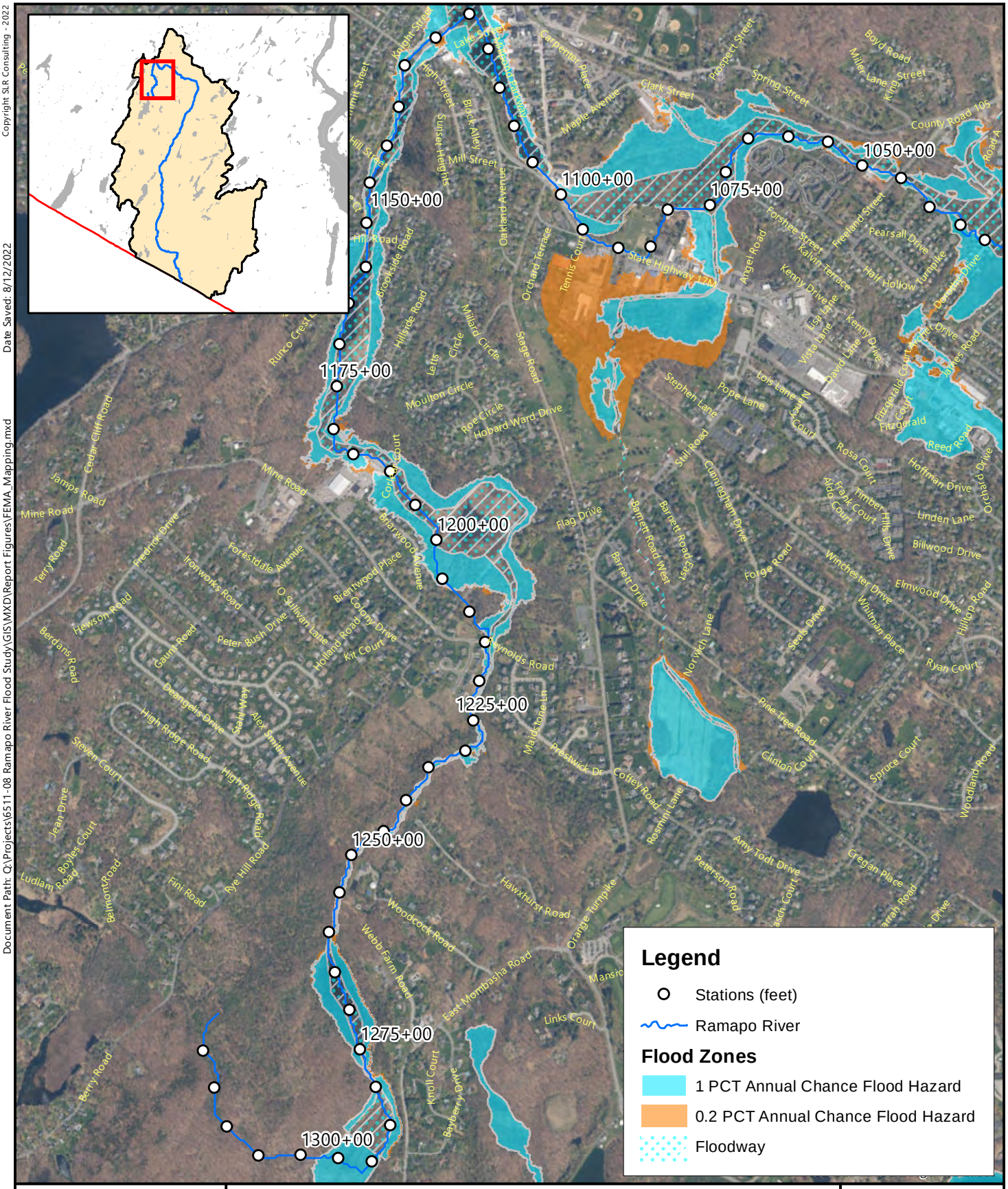
FIG. 3-8



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FEMA MAPPING: RAMAPO RIVER 8

RAMAPO RIVER FLOOD & RESILIENCE STUDY
SD 113
ROCKLAND COUNTY
NEW YORK

SCALE 1 " = 1,500 '
DATE 8/12/2022
PROJ. NO. 16511.00008

FIG. 3-9

4. FLOOD MITIGATION ANALYSIS

In this section, flood-prone areas within the Ramapo River watershed are identified as HRAs, and an analysis of flood mitigation considerations within each HRA is undertaken. Factors with the potential to influence more than one HRA are also evaluated and discussed. Figure 4-1 shows the locations of the five HRAs identified within the Ramapo River watershed.

Overall, HRAs are located at population centers in communities, including Suffern and Hillburn (HRA 1), Sloatsburg (HRA 2), Harriman (HRA 4), and Monroe (HRA 5). In the town of Tuxedo, the hamlets of Southfields and Arden are encompassed by HRA 3, but this HRA also includes a relatively long reach of the Ramapo River outside these more developed areas.

For the majority of its length through the study area, the Ramapo River is paralleled by the NY Thruway, NY Route 17, and the Norfolk Southern/Metro-North railroad tracks. Construction of these features impacted the river in several ways, including floodplain encroachment, channel realignment, and bridge crossings. The highways running alongside the Ramapo River are often farther from the river and higher up the valley wall than the railroad but, elsewhere, is more flood-prone where sections of highway traverse the floodplain at low elevation. Compared to the highways, the relatively strict alignment and gradient tolerances of the railway result in long sections of embankment in the floodplains and numerous bridge crossings as the railroad follows a straight path through the Ramapo River's meanders. Several of these railroad bridges are undersized for flood flows and, with longitudinal floodplain connectivity interrupted by the railroad embankment, can significantly exacerbate upstream flooding; often this results in inundation of the railroad and, in some cases, impacts other infrastructure or developed areas as well. By contrast, NY-17 crosses the river once through the study area (discussed in Section 4.1.3), although this bridge is undersized; the two Thruway/I-87 crossings of the Ramapo River (Section 4.1.1) appear to be adequately sized. While construction of these three transportation corridors has undoubtedly affected geomorphologic and hydrodynamic conditions on the river, this report focuses on identification and mitigation of flood hazards and generally only addresses these features in that context.

New York State has announced the release of draft criteria developed by the Climate Justice Working Group for identifying disadvantaged communities. The draft criteria will guide the equitable implementation of New York's Climate Leadership and Community Protection Act. Pursuant to the Climate Act's disadvantaged community provisions, the draft includes an interactive map and a list of communities the criteria would cover for directing programs and projects to reduce air pollution and climate-altering greenhouse gas emissions, provide economic development opportunities, and target clean energy and energy efficiency investments. Portions of HRA 1, HRA 4, and HRA 5 have been identified as disadvantaged communities. The map can be viewed at the following link:

https://climate.ny.gov/Our-Climate-Act/Disadvantaged-Communities-Criteria/Disadvantaged-Communities-Map.

Portions of several HRAs have been designated as Potential Environmental Justice Areas. Potential Environmental Justice Areas are U.S. census block groups of 250 to 500 households each that, in the Census, had populations that met or exceeded at least one of the following statistical thresholds:

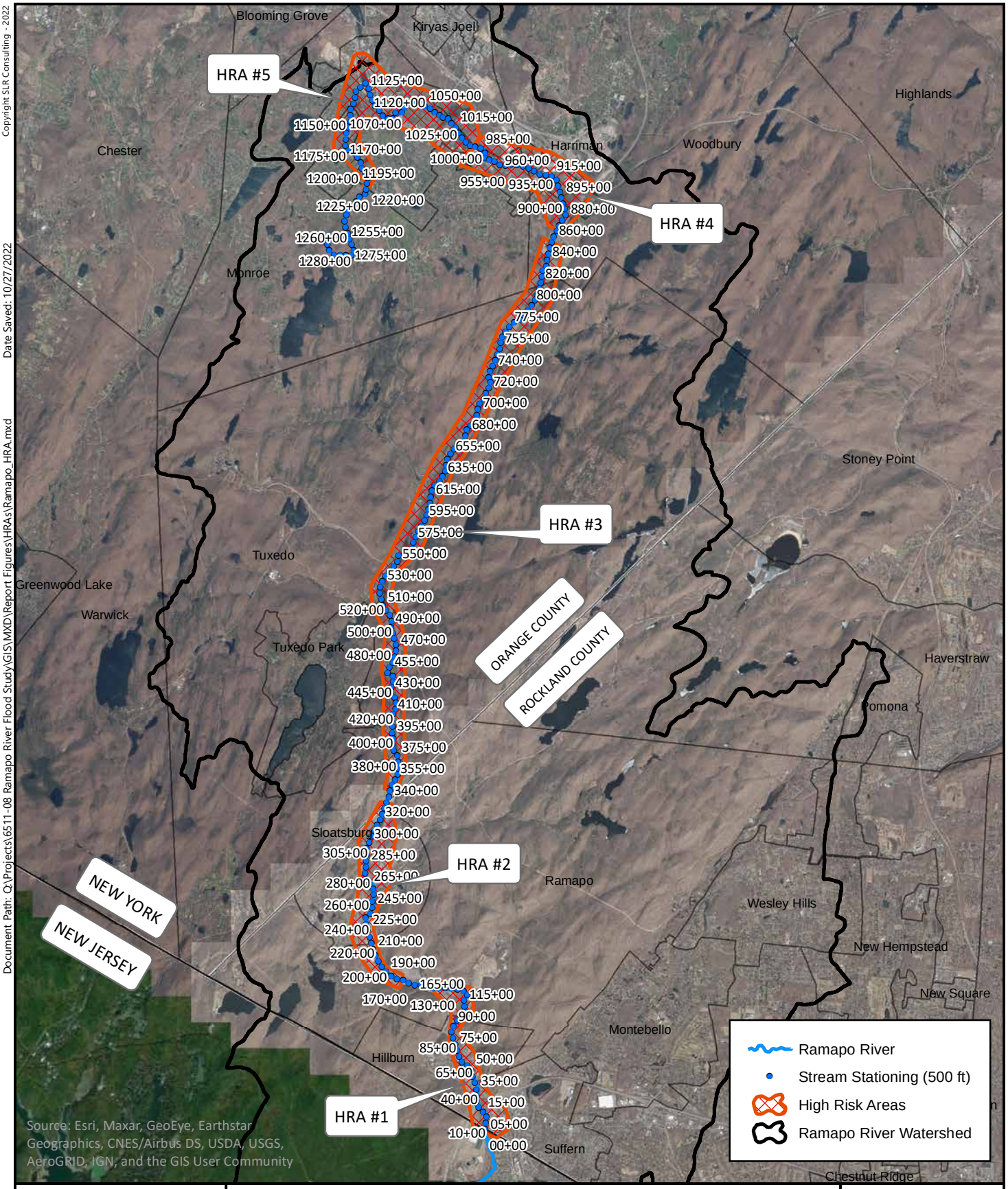
1. At least 52.42 percent of the population in an urban area reported themselves to be members of minority groups; or

2. At least 26.28 percent of the population in a rural area reported themselves to be members of minority groups; or

3. At least 22.82 percent of the population in an urban or rural area had household incomes below the federal poverty level.

The federal poverty level and urban/rural designations for census block groups are established by the U.S. Census Bureau. The thresholds are determined by a statistical analysis of the 2014-2018 American Community Survey data, which is the most recent data available as of the time of the analysis in 2020. See NYSDEC Commissioner Policy 29 on Environmental Justice and Permitting (CP-29) for more information. The following link provides a map to Potential Environmental Justice Areas throughout New York State:

https://www.arcgis.com/home/webmap/viewer.html?url=https://services6.arcgis.com/DZHaqZm9cxOD4CWM/ArcGIS/rest/services/Potential_Environmental_Justice_Area__PEJA__Communities/FeatureServer&source=sd.



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RAMAPO RIVER - HIGH RISK AREAS

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 4,500 9,000
Feet

SCALE 1 " = 10,000 '

DATE 10/27/2022

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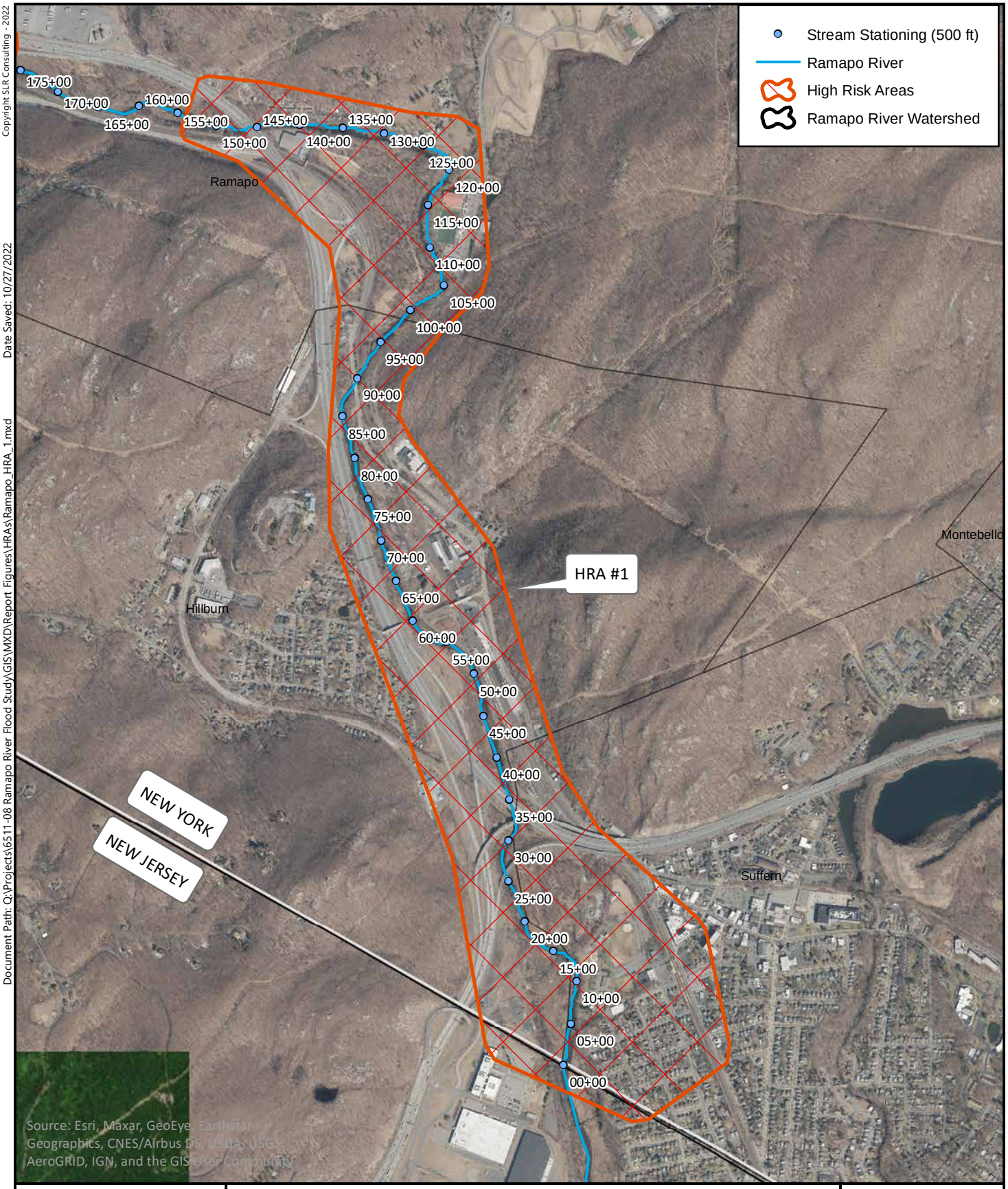
FIG. 4-1

4.1 HIGH RISK AREA 1

HRA 1 begins at the New York-New Jersey state line at STA 0+00 and includes the West Ward (the area in the village west of Orange Avenue) in the village of Suffern and extends upstream through the village of Hillburn and into the town of Ramapo, ending at the defunct Ramapo Foundry dam at STA 150+00. A map of HRA 1 is shown in Figure 4-2. Portions of HRA 1 fall within two census blocks that have been designated as a Disadvantaged Community. Portions of HRA 1 have also been designated as Potential Environmental Justice Areas.

Within HRA 1, the Ramapo River is spanned by 11 bridges: one pedestrian bridge, two railway bridges, one of which is out of service, and eight roadway and highway bridges, one of which is closed to vehicles and used as a pedestrian crossing. Two dams are located along the Ramapo River in HRA 1.

The Suffern NY Rising Community Reconstruction Plan notes in detail that the West Ward area of the village of Suffern floods frequently during storm events. Access roads into the residential area of the West Ward are flood prone as well, making it difficult to access the area in the event of an emergency if one or more of the access roads are flooded. In addition to emergency access, there are critical facilities located in the flood-prone area of the West Ward. Those facilities include a wastewater treatment plant, a water treatment plant, and the Department of Public Works garage. During Hurricane Irene, the water treatment plant was inundated, and the village was reportedly unable to supply safe water to the community for a month. In the Rockland County Hazard Mitigation Plan, it was also noted that the wastewater treatment plant flooded from a severe storm on March 13, 2010.



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RAMAPO RIVER - HIGH RISK AREA #1

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500 1,000
Feet

SCALE 1 " = 1,500 '

DATE 10/27/2022

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PROJ. NO.

FIG. 4-2

4.1.1 HRA 1 SUFFERN

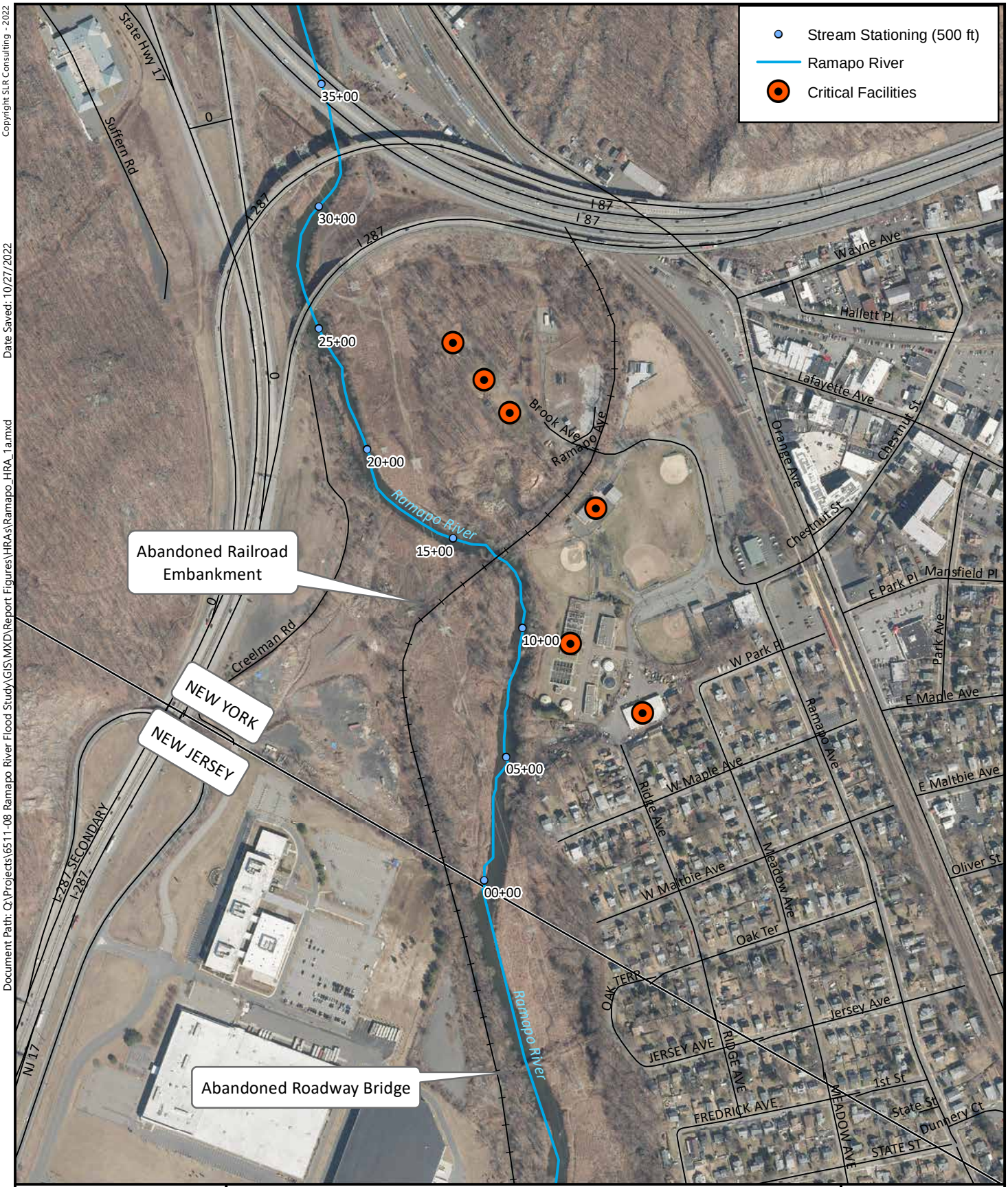
This Suffern area of HRA 1 extends from south of the New York/New Jersey line to STA 35+00 and is depicted in Figure 4-3. About 4,500 feet of the effective hydraulic modeling developed for the Bergen County, New Jersey FIS was combined with the model created for the Ramapo River from Harriman, New York, to the New Jersey state line to assess potential flood mitigation strategies in Suffern. Hydraulic modeling demonstrates that the Suffern Water Treatment Plant and Wastewater Treatment Plant in the West Ward are within the 100-year floodplain, with portions of the wastewater facility subject to flooding beginning in the 10-year flood event. Both facilities are located downstream of an approximately 10-foot-high, apparently abandoned railroad embankment that traverses the floodplain in this low-lying area between the I-87/I-287 interchange and the New York-New Jersey state line; the bridge structure associated with this crossing is still in place at STA 13+00. Modeling shows that in the 100-year flood event this rail embankment and bridge increase upstream inundation depths by up to nearly 5 feet.

The abandoned railroad embankment downstream of its floodplain traverse continues south along the right bank of the Ramapo River into New Jersey. Once it crosses the state line, the old railway is bordered to the west by several commercial facilities that are elevated about 12 feet to 15 feet above the floodplain. There is between about 150 feet to 200 feet of undeveloped land between the railroad and the adjacent buildings.

A large floodplain enhancement was modeled along the right bank in this area, which included removal of the old rail embankment and lowering of the undeveloped area by up to about 12 feet along roughly 4,000 feet paralleling the Ramapo River, which does not require any modification to the development to the west (buildings or parking lots). At STA (-)7+50 (in New Jersey), an archaic roadway bridge increases upstream 100-year flood depths by up to about 1 foot. This bridge and its approach embankment are recommended for removal as either a stand-alone project or as part of the floodplain enhancement described above.

When combined with removal of the abandoned roadway bridge at STA -7+50, the proposed floodplain reclamation results in more than 4 feet of reduction in 100-year flood event elevations in the Suffern West Ward downstream of the abandoned railroad embankment crossing where the wastewater treatment plant (WWTP) is located. Upstream of the abandoned rail crossing, this depth reduction is limited to about 1 foot if the embankment is left in place. With the rail embankment removed as well, 100-year flood elevations upstream, where three of Suffern's municipal drinking water wells are reportedly located, are reduced by almost 5 feet. It is not known to what elevations the WWTP facility or the municipal drinking water wells are currently floodproofed.

Under projected future flood scenarios, 100-year flood event depths are modeled as increasing about 1.5 feet downstream of the abandoned railway and by about 3 feet upstream. With the proposed floodplain enhancement and abandoned road and railway removals, future 100-year flood event depths are modeled as increasing by about 0.7 feet in the West Ward, which is between 5 feet and 7 feet less than modeled future 100-year flood depths under existing conditions.



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RAMAPO RIVER - HRA #1 - SUFFERN WEST WARD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 500 '
DATE 10/27/2022
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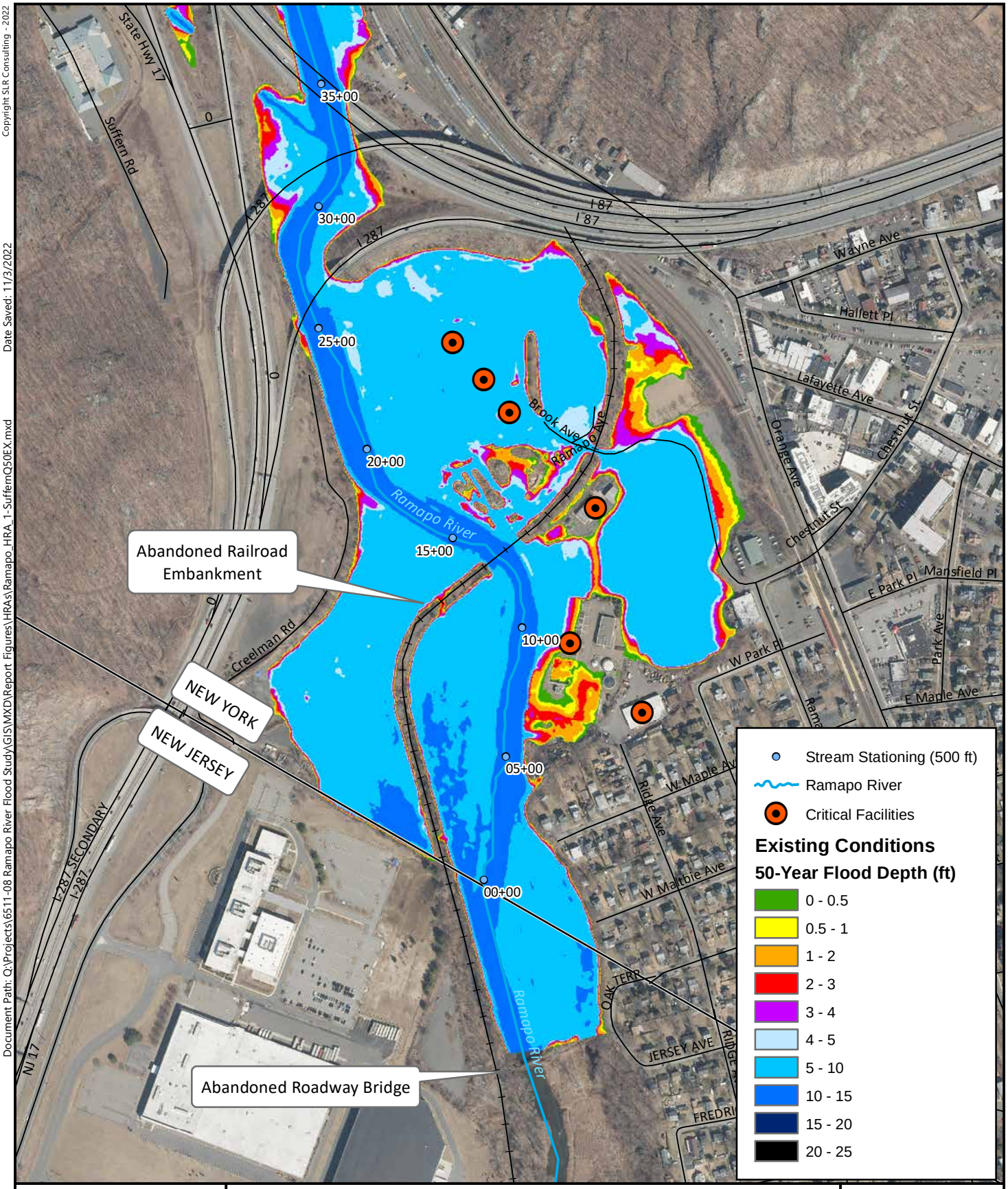
PROJ. NO.

FIG. 4-3

It is recommended that the bridge across the Ramapo River at STA 13+00 and the approximately 2,500-foot-long, 10-foot-tall, abandoned railroad embankment traversing the floodplain be removed. In New Jersey, removal of the old roadway bridge at STA -7+50 (just west of the terminus of Jersey Avenue/Oak Terrace in Mahwah, New Jersey) and floodplain enhancements on the Ramapo River's right bank between the state line and the NJ-17 bridge are recommended. Until these improvements are undertaken, it is recommended that the critical facilities in the West Ward receive floodproofing according to New York State Flood Risk Management Guidance of the CRRA, which recommend a minimum of 3 feet of freeboard in the projected future 100-year flood, and functionality during the 500-year flood.

Figure 4-4 depicts modelled flooding depths under existing conditions in the 50-year flood event. Figure 4-5 depicts the 50-year flood event with the above recommendations implemented. Figures 4-6 and 4-7 depict existing and proposed conditions, respectively, during the 100-year flood event. Figure 4-8 is a conceptual layout of the recommended flood mitigation measures.



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HRA #1 - EXISTING CONDITIONS 50-YEAR FLOOD

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Rockland and Orange Counties, NY

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N

0 500
Feet

SCALE 1 " = 500 '
DATE 11/3/2022
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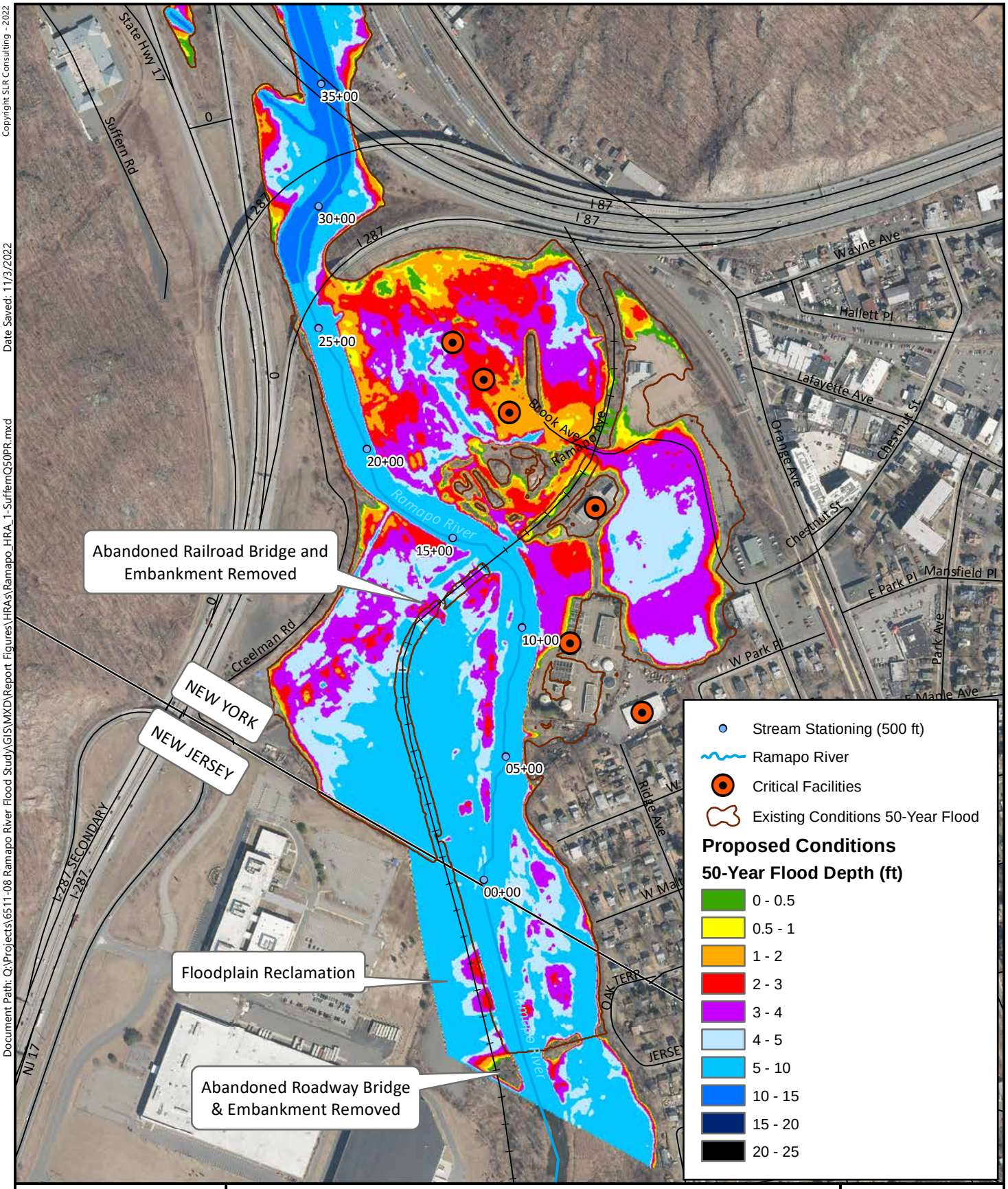
FIG. 4-4



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HRA #1 - PROPOSED CONDITIONS 50-YEAR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 500 '
DATE 11/3/2022
16511.00008
PROJ. NO.

FIG. 4-5

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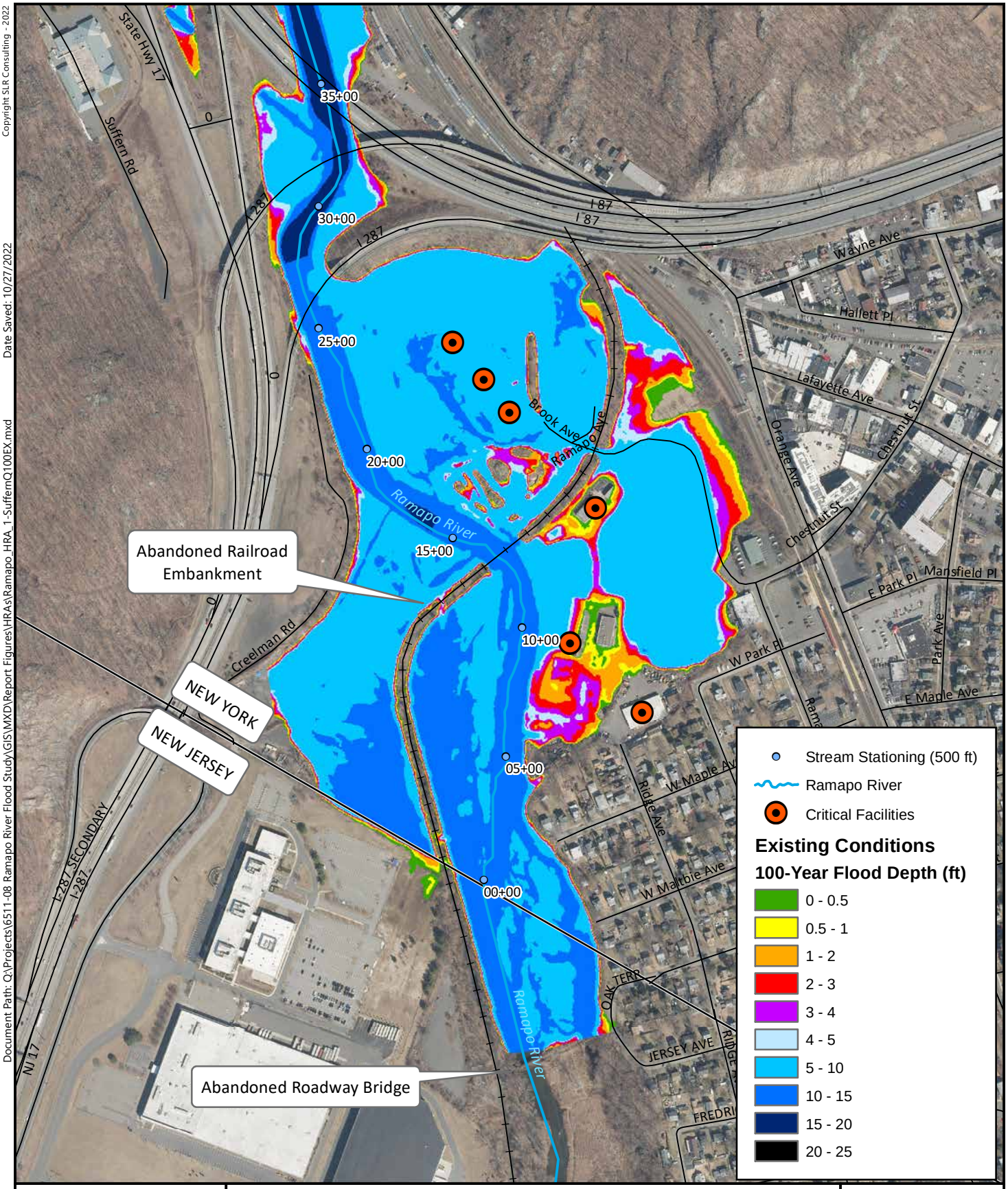

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HRA #1 - EXISTING CONDITIONS 100-YEAR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

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Feet

SCALE 1 " = 500 '
DATE 10/27/2022
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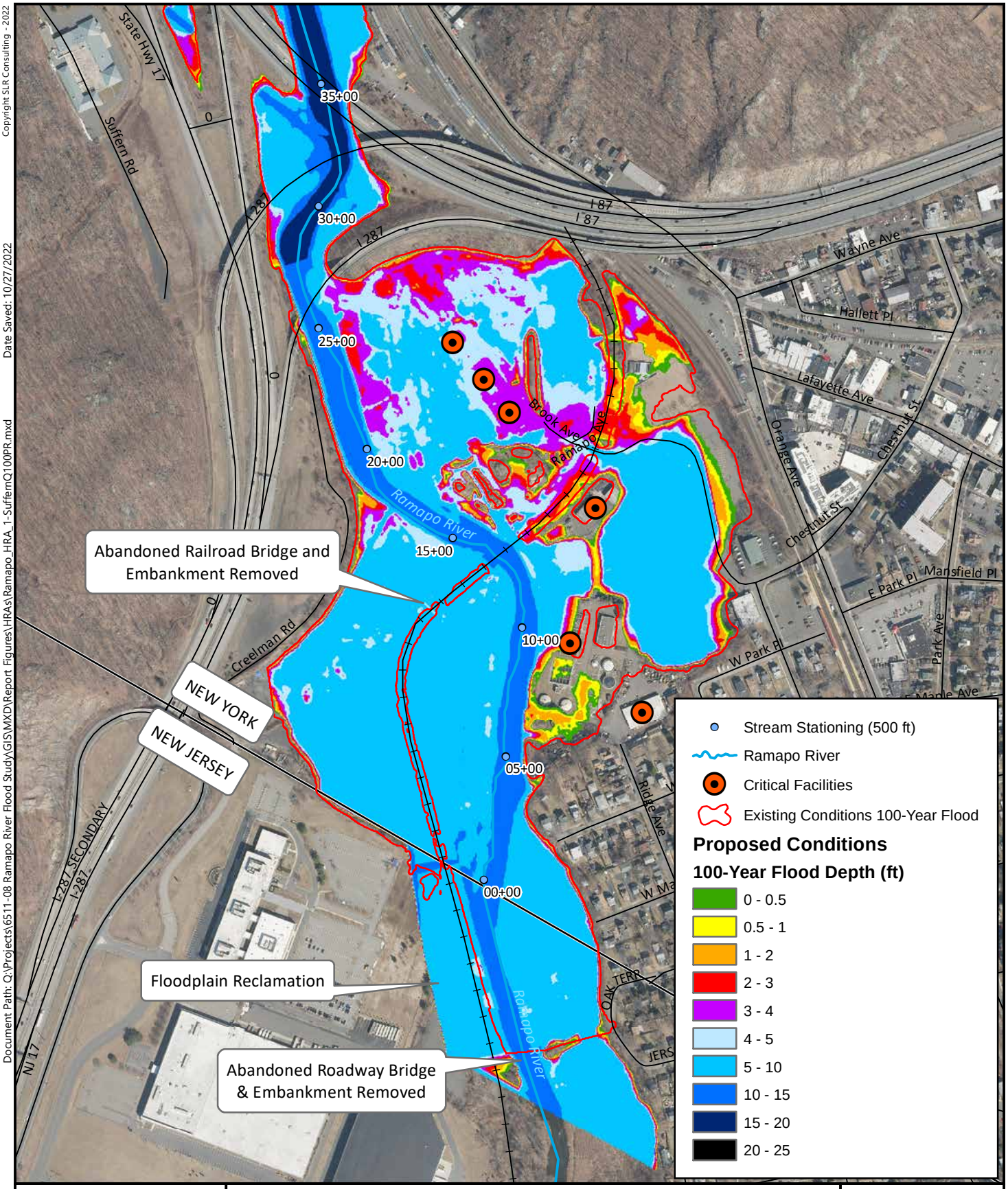
PROJ. NO.

FIG. 4-6



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HRA #1 - PROPOSED CONDITIONS 100-YEAR FLOOD

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SD113

Rockland and Orange Counties, NY

N

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Feet

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DATE 10/27/2022
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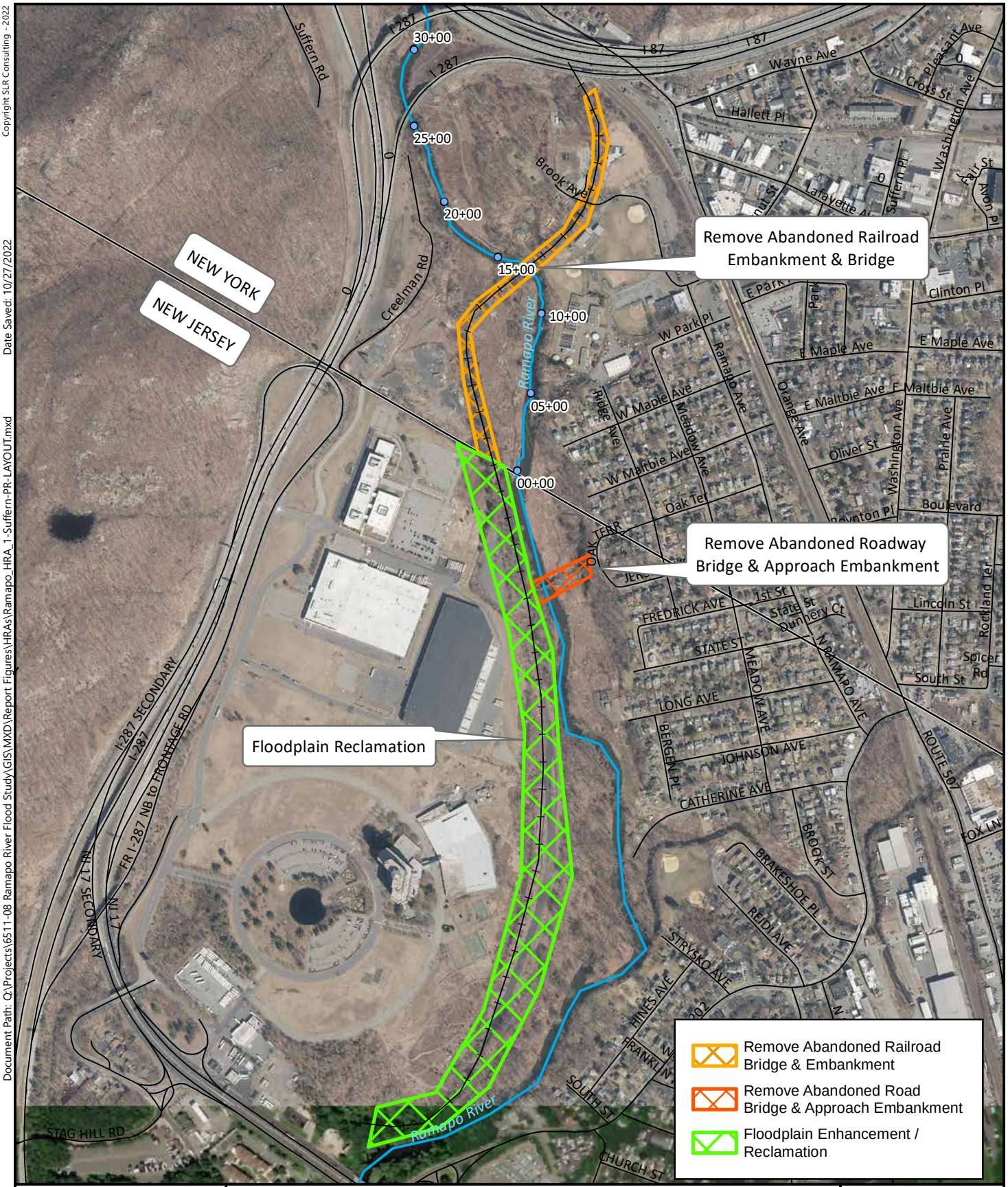
FIG. 4-7



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HRA #1 - PROPOSED LAYOUT

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 800 '

DATE 10/27/2022

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FIG. 4-8

4.1.2 HRA 1 HILLBURN

The Hillburn area of HRA 1 extends from STA 55+00 to STA 90+00 and is depicted on Figure 4-9. According to the Rockland Hazard Mitigation Plan, Fourth Street bridge at STA 60+00 was closed due to flash flooding during a shower and thunderstorm event on July 25, 2015. Through outreach and stakeholder engagement, it was learned that during Tropical Storm Irene, at Fourth Street bridge, NYS Interstate 87, on the right bank of the Ramapo River, flooded across all six lanes and was closed. Where it crosses the Ramapo River at STA 60+00, Fourth Street also has bridge crossings of I-87 (right bank), seen in Figure 4-10, and the Metro-North/Norfolk Southern Railroad (left bank). Otherwise, the road is elevated on an embankment that traverses the floodplain.

Hydraulic modeling indicates that under existing conditions in the 100-year flood event, backwaters generated by the Fourth Street crossing result in up to about 4.5 feet of additional upstream flood depths, leading to inundation of a commercial park and an electrical substation on the left bank. I-87 is modeled as flooding to depths of as much as 8 feet in this area, with the railroad overtopped by more than 2 feet. Natural conditions modeling (i.e., with the Fourth Street bridge and embankment removed from the model) indicates that without the crossing – or with a hydraulically unobtrusive replacement – 100-year flooding of the railway is alleviated; however, the interstate is still inundated by up to about 4 feet or more of water. This is largely a consequence of the highway's elevation, particularly the northbound lanes, being below the elevation of the riverbanks upstream of the Fourth Street bridge. Thus, the highway floods when flows overtop the riverbanks. A berm between the river and the interstate extends some 450 feet upstream of the Fourth Street bridge where the highway elevation is lowest; however, it then terminates and does not provide any meaningful flood reduction benefits as the highway remains accessible to floodwaters that spill over the riverbanks just upstream of the berm (6 feet in existing conditions 100-year flood event, 3 feet in natural conditions).

Increasing the span of the Fourth Street bridge from 100 feet to 160 feet can reduce upstream flooding depths by up to about 3.1 feet in the 100-year flood event and about 2.4 feet in the projected future 100-year flood event. This is recommended at a minimum, although a more ambitious alternative could further reduce upstream flooding and improve infrastructure resilience: replacing the bridge with a 240-foot total span along with creation of an approximately 100-foot-wide, 400-foot-long floodplain bench on the left bank can reduce 100-year floodwater surface elevations upstream by about 4.5 feet and projected future 100-year flood depths by 3.9 feet. The proposed 400-foot-long created floodplain would tie into an existing 300-foot-long left bank low terrace downstream of the bridge. This scenario virtually eliminates the bridge's contribution to upstream flooding, and the remaining flooding would essentially be comparable to a natural conditions scenario. Significant flood depth reductions are modeled at a critical facility in this bridge replacement scenario, with much of the 100-year flooding at the electrical substation alleviated and reduced by more than 4 feet elsewhere. Some of the flooding that would persist is due to waters that are modeled as spilling out of the channel upstream of the Hillburn Dam. For this alternative bridge and floodplain configuration, there are two entrance drives off of Fourth Street that would require relocation.

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RAMAPO RIVER - HRA #1 - HILLBURN

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 500 '
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FIG. 4-9

Figure 4-10: The Fourth Street bridge at STA 60+00, looking west. Bridge over the Ramapo River in center of image; bridge over I-87/NY-17 can be seen in the background.

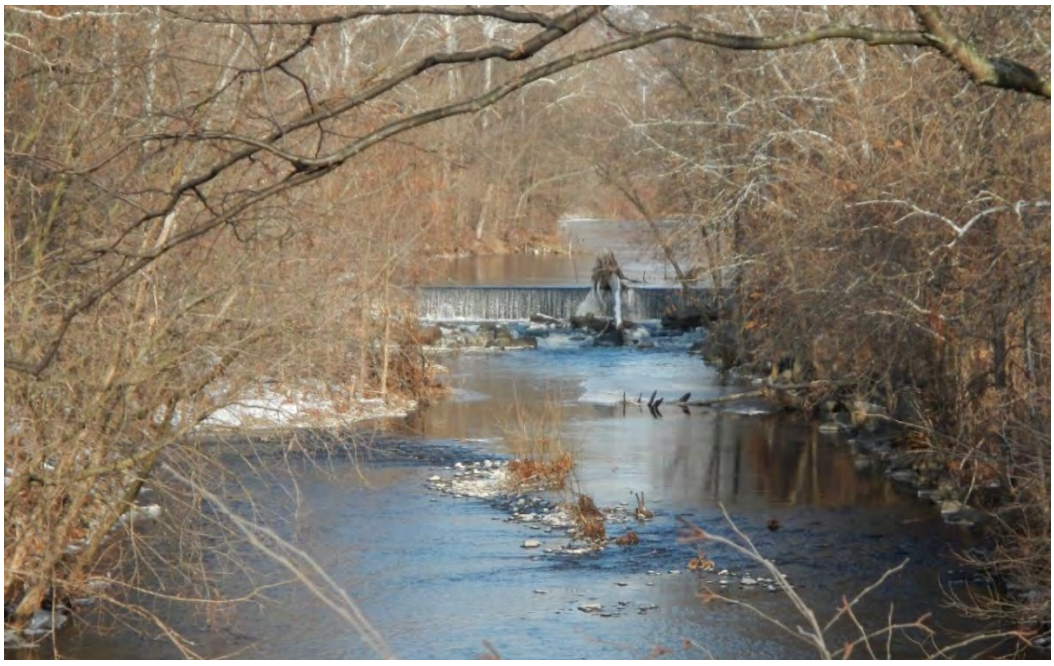

Figure 4-11: The Hillburn Dam at STA 67+50

An alternative scenario at the Fourth Street bridge crossing was evaluated, which involved installation of a group of floodplain relief culverts beneath the 4th Street embankment to provide supplemental floodwater conveyance; however, this would not provide significant upstream flood mitigation. This is because the area where the embankment could feasibly be perforated with culverts, on the left overbank east of the access roads to the electric substation to the north and railyard to the south, is not flooded under natural conditions modeling (other than ponding in the ditch on the north side of Fourth Street), so the critical area would already have been flooded by the bridge's backwater before water even reached the culverts. With the existing bridge and terrain, these culverts would only be accessible beginning between the 50- and 100-year floods. Once flooded, for any appreciable downstream conveyance through the culverts, significant headwater depths would be necessary, so there is only marginal improvement over existing conditions and the upstream substation would be completely inundated regardless. This option was not explored further.

The Hillburn Dam (NYSDEC 196-2665; Federal NY13262) is a Class A, low hazard dam located at STA 67+50, shown in Figure 4-11. It is an 8-foot-high, 100-foot-long concrete gravity dam constructed in 1958 and owned by Orange & Rockland Utilities. According to the NYSDEC dam inventory database, the structure was last inspected in 1975 and is used for hydroelectric power generation, although this site is reportedly no longer used for this purpose. The dam is located about 750 feet upstream of the Fourth Street bridge at STA 67+50, increases backwater flood depths, and contributes to flooding of I-87 as well as the electrical transmission substation with flows that spill out of the channel upstream of the dam. Assuming that the dam is still operated for hydroelectric power generation, it is recommended that Orange & Rockland Utilities explore options for better containing floodwaters where the riverbanks overtop upstream of the dam and/or modifications to the dam that can reduce upstream flooding. One potential alternative is to reduce the spillway elevation to improve flood capacity and install collapsible flashboards that maintain the pool elevation during normal flows. If the dam in fact no longer serves a purpose, the feasibility of removal should be explored.

Figure 4-12 shows modelled flooding depths in Hillburn under existing conditions in the 50-year flood event. Figure 4-13 depicts the 50-year flood event with the recommendations described above implemented. Figures 4-14 and 4-15 depict existing and proposed conditions, respectively, during the 100-year flood event.

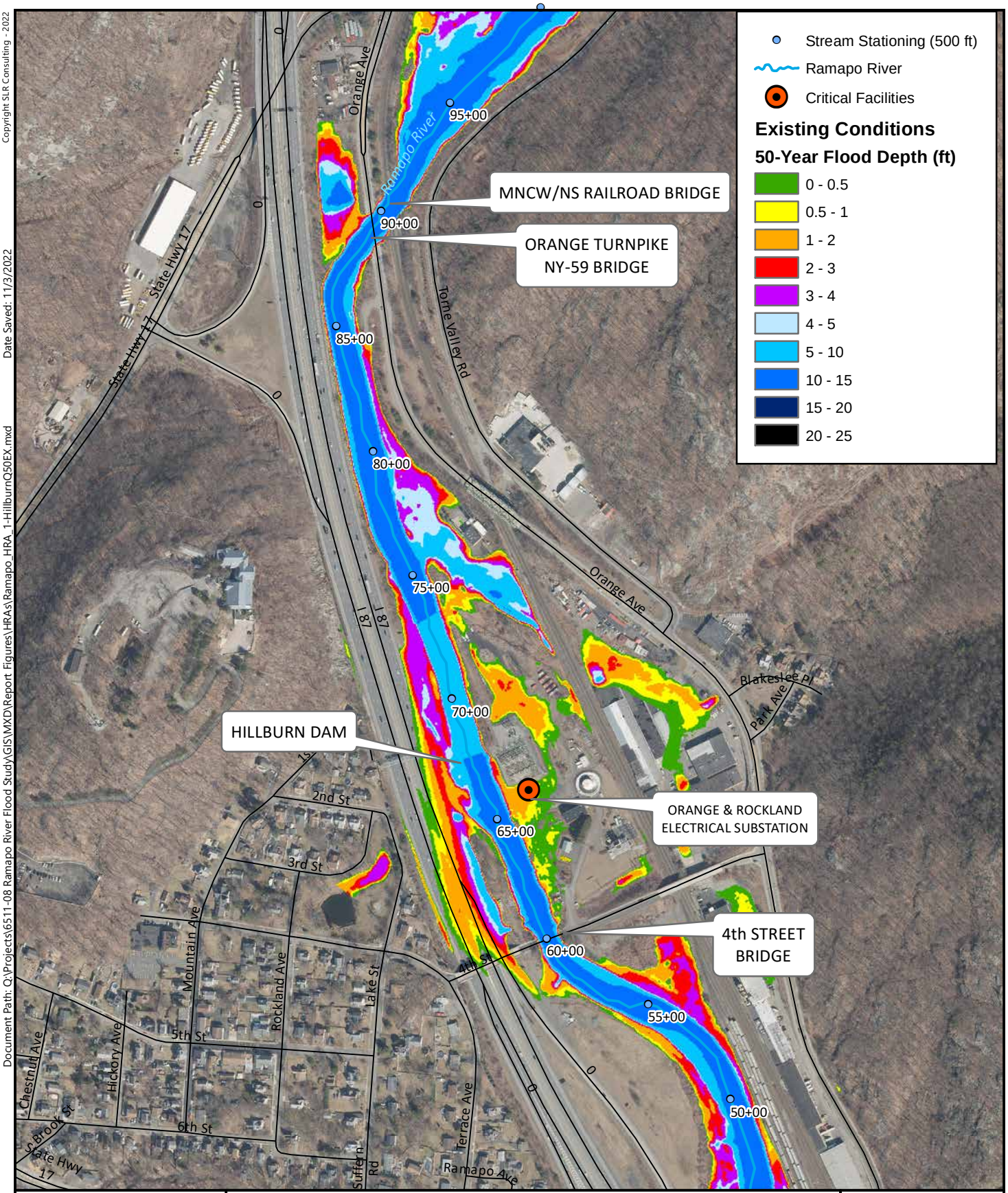

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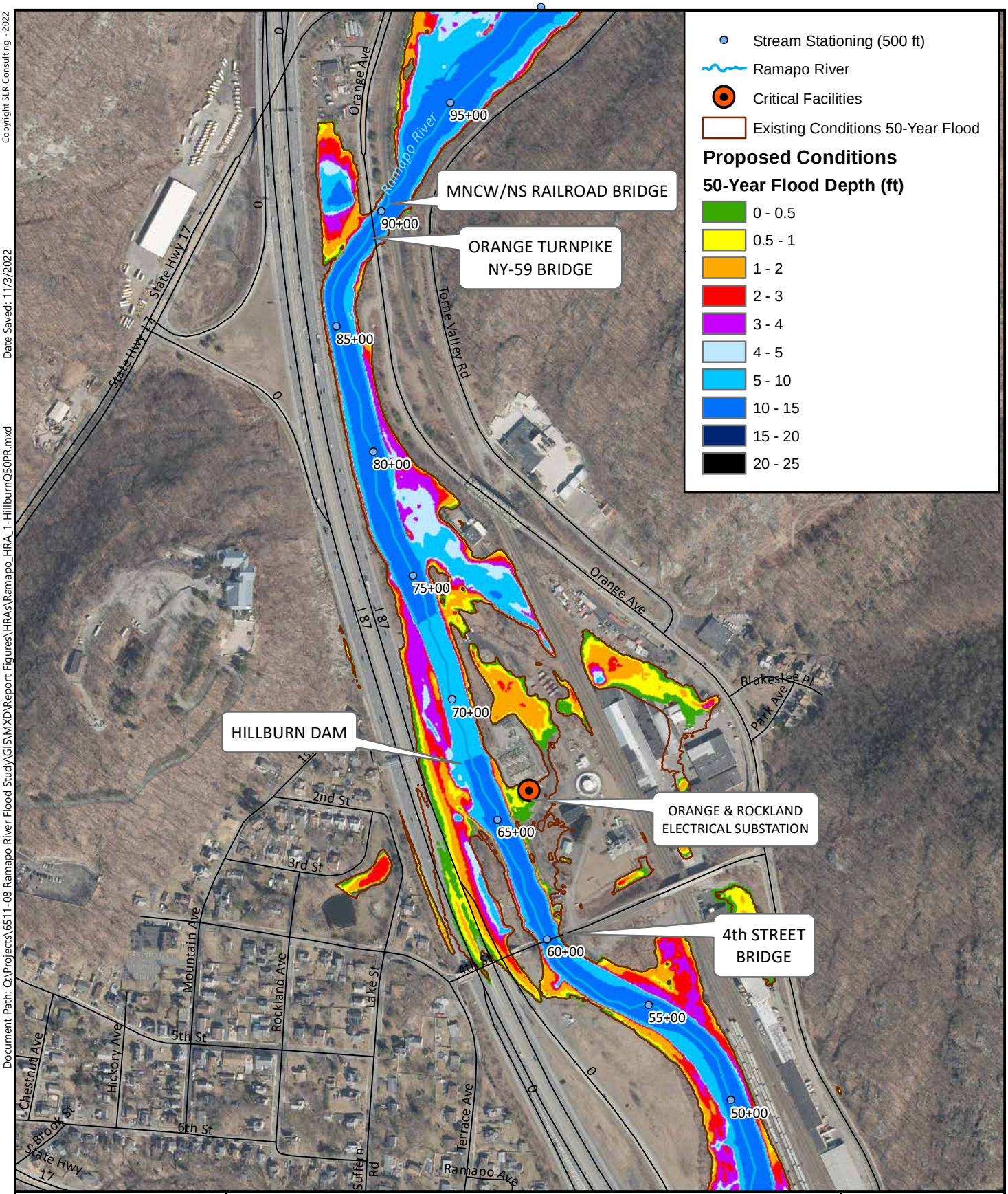
FIG. 4-12



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HRA #1 - HILLBURN - PROPOSED CONDITIONS 50-YEAR FLOOD

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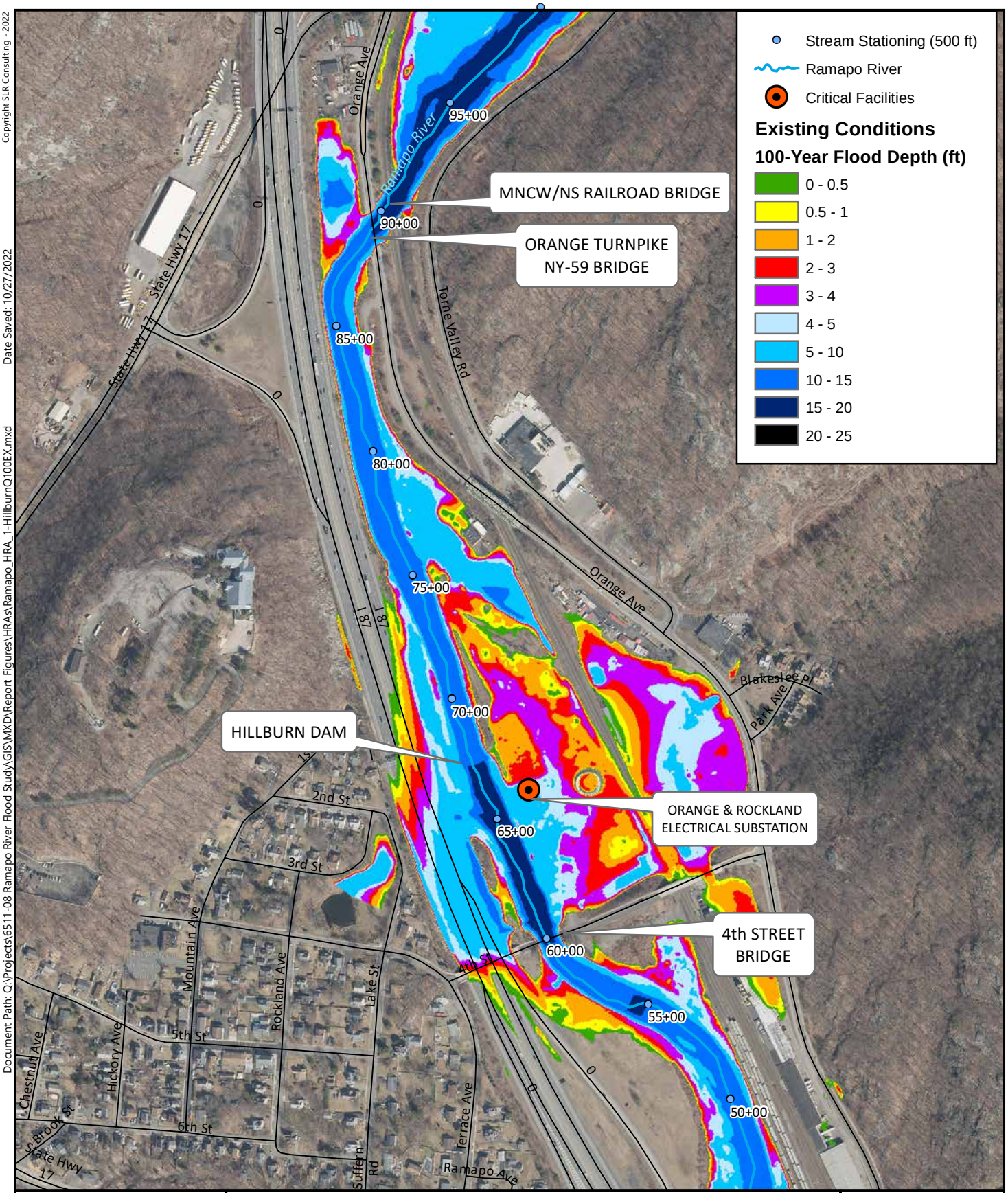
FIG. 4-13



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HRA #1 - HILLBURN - EXISTING CONDITIONS 100-YEAR FLOOD

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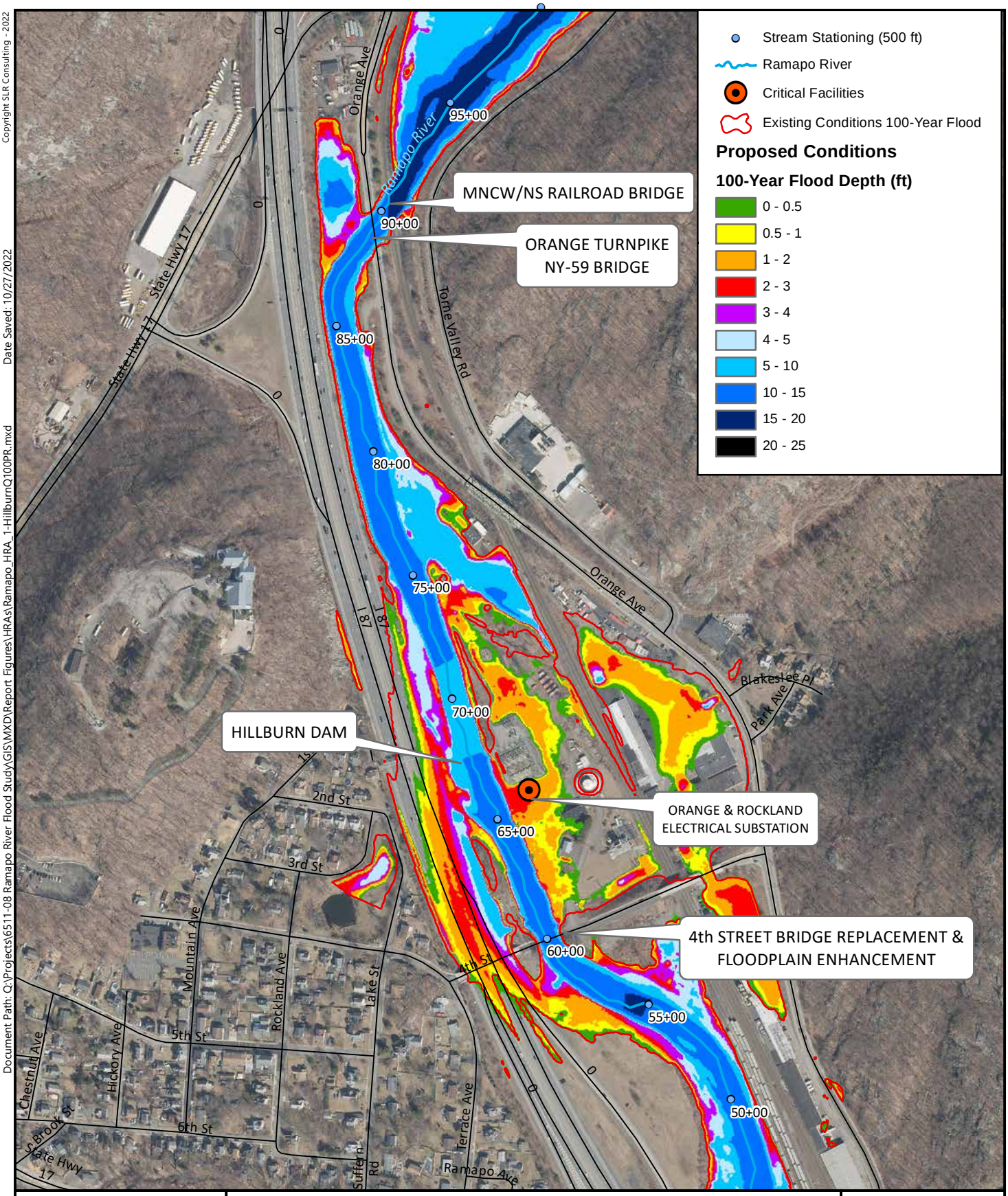
FIG. 4-14



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HRA #1 - HILLBURN - PROPOSED CONDITIONS 100-YEAR FLOOD

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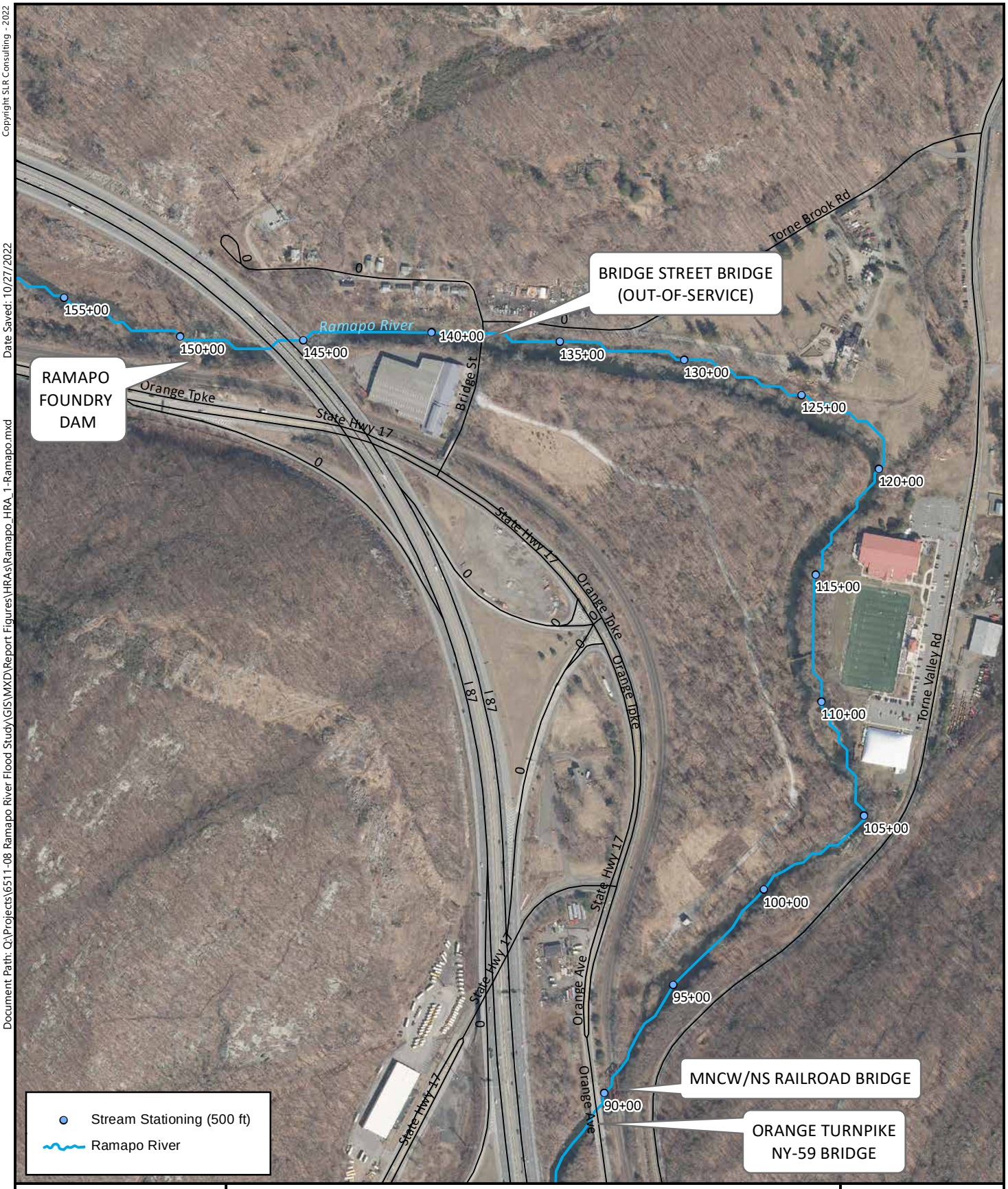
FIG. 4-15

4.1.3 HRA 1 RAMAPO

The Ramapo area of HRA 1 extends from STA 90+00 to STA 155+00 and is depicted on Figure 4-16. Under existing conditions, about 900 feet of Torne Valley Road is modeled as overtopping by as much as 3 feet as it runs alongside the river from STA 103+00 to STA 112+00. The backwaters from the Orange Turnpike bridge at STA 89+50 and Metro-North/Norfolk Southern railroad bridge immediately upstream at STA 90+50 combine to generate up to 2.5 feet of additional upstream 100-year flood depths, which dissipates to about 2 feet where it exacerbates flooding of Torne Valley Road and a community center and sports complex upstream. The two bridges are more adequately sized for lesser floods and do not generate significant excess backwater flooding in the 50-year flood event and smaller. Modeling indicates that these bridges are influenced by the backwaters from the Fourth Street bridge beginning in the 100-year flood event and by the Hillburn Dam beginning in the 50-year flood event, so flood-mitigating improvements to this bridge and dam can reduce the necessary size of potential replacements for the Orange Turnpike and railroad bridges upstream. When they are due for replacement, bridge spans of approximately 200 feet are recommended to alleviate excess backwater flooding upstream. Longer bridge spans may have diminishing returns as the valley narrows to approximately 160 feet in width downstream of these crossings as it is confined between the embankments of I-87 and the Orange Turnpike.

The out-of-service Bridge Street bridge at STA 138+00, shown in Figure 4-17, contributes to up to about 0.8 feet of additional upstream 100-year flood depths. This impacts a commercial facility on the right bank, although flooding up to 4 feet deep is modeled at this building under a natural conditions scenario with the bridge removed. Relocation or possibly floodproofing measures should be explored for this business. Backwater flooding from the bridge does not appear to impact the homes on the left bank upstream, although two houses may experience flooding in the 500-year flood event. If the bridge, which is currently closed to vehicles, is considered to be a valuable asset by the community as a pedestrian crossing, it should be regularly inspected and maintained in good condition, and consideration should be given to a replacement pedestrian bridge with improved hydraulic performance.



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HRA #1 - RAMAPO

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FIG. 4-16

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Figure 4-17: Out of service but pedestrian-accessible Bridge Street bridge at STA 138+00

The Ramapo Foundry Dam (NYSDEC 196-0302; Federal NY13245) is located at STA 150+00, about 260 feet upstream of the Interstate 87/NY Thruway bridge crossing. This 15-foot-high, 122-foot-long Hazard Class D dam was constructed in 1907 for hydroelectric power generation; however, it no longer forms an impoundment; while much of the structure remains in place, the Ramapo River appears to have flanked the dam to the left (north), confining the river between the dam's remnants and the approach embankment for the I-87 southbound bridge. According to the NYSDEC dam inventory database, the Ramapo Foundry Dam was last inspected in 1984 and is presently owned by the Pierson Lake Homeowners Association. Modeling indicates that the structure generates up to about 4.8 feet of additional upstream 100-year flood depths, and the existing configuration may also contribute to erosion of the I-87 embankment. Removal of this dam's remnants is recommended.

Figure 4-18 shows modelled flooding depths in the Ramapo section of HRA 1 under existing conditions in the 50-year flood event. Figure 4-19 shows flooding depths under existing conditions in the 100-year flood event.

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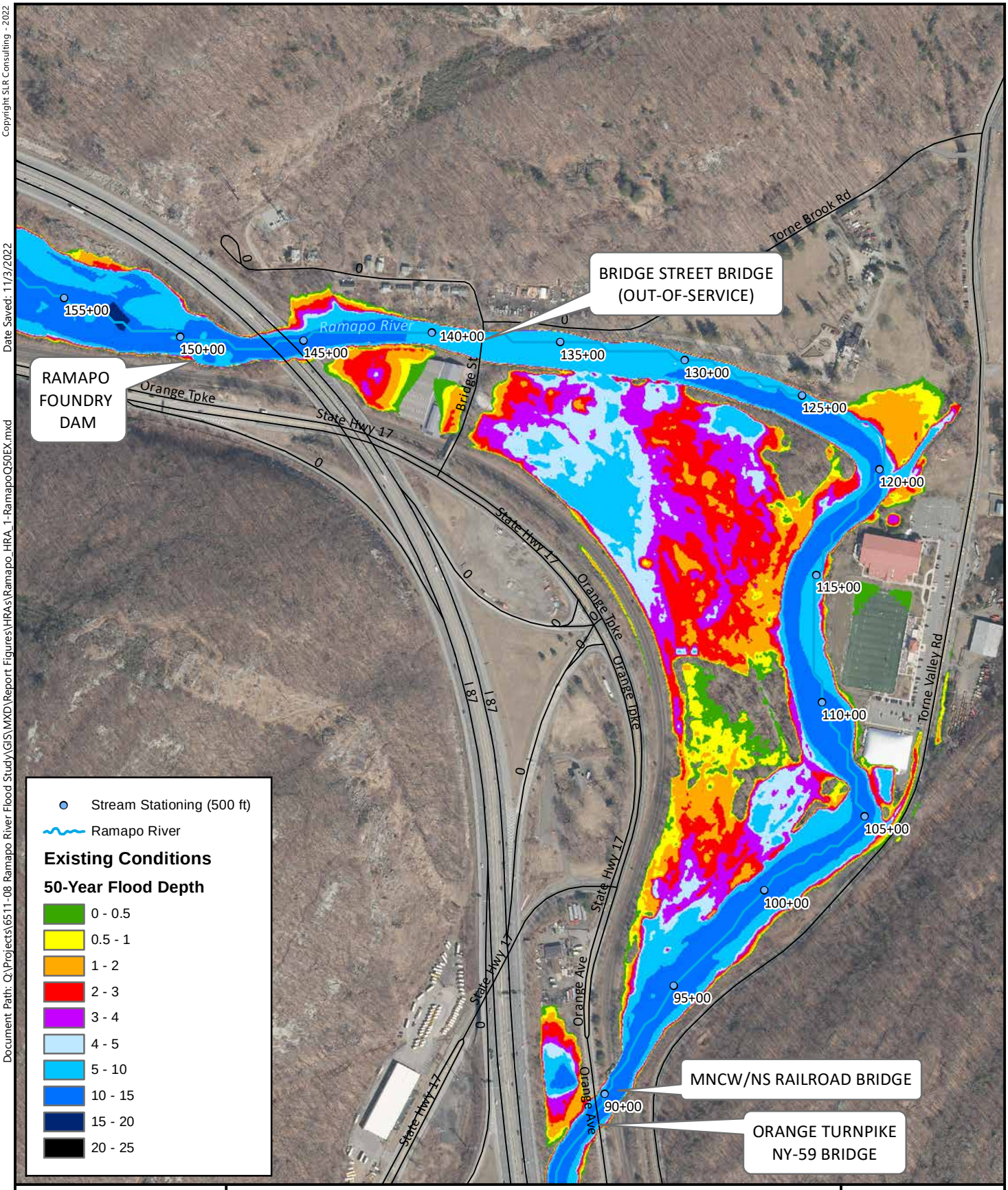

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HRA #1 - RAMAPO - EXISTING CONDITIONS 50-YEAR FLOOD

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SD113

Rockland and Orange Counties, NY

N

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Feet

SCALE 1 " = 500 '

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FIG. 4-18

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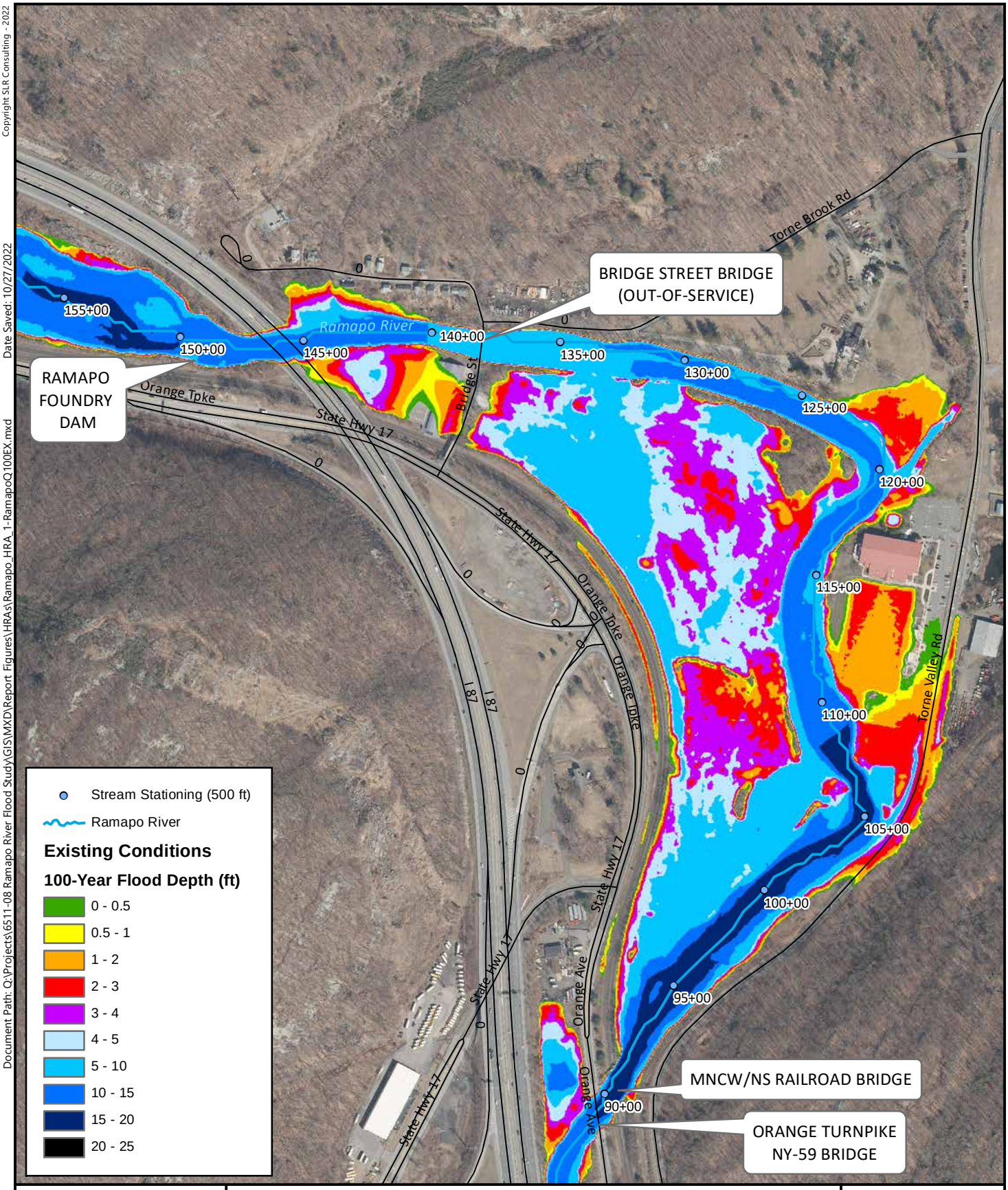

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HRA #1 - RAMAPO - EXISTING CONDITIONS 100-YEAR FLOOD

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N

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Feet

SCALE 1 " = 500 '

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FIG. 4-19

4.2 HIGH RISK AREA 2

HRA 2 is located in and around the village of Sloatsburg, extending from approximately STA 170+00 to the Orange – Rockland County line at STA 335+00. Portions of HRA 2 have been designated as a Potential Environmental Justice Area. A map of HRA 2 is presented in Figure 4-20, and a closer view is presented in Figure 4-21.

The Ramapo River is spanned by three bridges in HRA 2, two of which are on Seven Lakes Drive at approximately STA 262+00 where the river is bifurcated by an island with a bridge across both channels. The left (easterly) bridge, shown in Figure 4-22, is a single 100-foot span constructed in 2011 while the right (westerly) bridge, shown in Figure 4-23, consists of two approximately 30-foot-span concrete arches and was constructed in 1929. The two bridges are roughly 100 feet apart, and the split channels of the Ramapo River converge about 150 feet downstream of the bridges. Stony Brook joins the Ramapo River from the east immediately downstream of the Seven Lakes Drive crossing.

Hydraulic modeling indicates that in the 100-year flood event the Seven Lakes Drive bridges generate as much as about 5 feet of additional flooding depths upstream and that about 850 feet of Seven Lakes Drive and about 150 feet of Allen Lane are overtopped by up to over 4 feet, with backwater inundation impacting 12 homes and businesses. Under projected future flow scenarios, 100-year flood depths are modeled as increasing by about 0.5 feet. Existing conditions 50- and 100-year flood mapping is shown in Figures 4-20 and 4-21, respectively.

Replacement of the older twin concrete arch bridge over the right (westerly) channel with a 100-foot single-span bridge, similar to the newer left (easterly) bridge, is modeled as reducing upstream 100-year flood depths by about 2.3 feet, which would reduce flooding severity at ten properties and alleviate flooding at one. However, even with this additional flow capacity, the crossing would still constrict flows and generate up to 2.8 feet of backwater in the 100-year flood, the bridge low chords would be impacted by floodwaters, and Seven Lakes Drive would still overtop by as much as about 2.5 feet, rendering the crossing susceptible to damage and out of service in such an event, although the Washington Avenue bridge to the north provides an alternative crossing if a detour is necessary. This replacement bridge configuration would also reduce 50-year flood depths by about 2.6 feet. Upstream flood reductions increase along with replacement bridge length and the amount of the embankment on the central island that can be removed and restored to floodplain.

The approximately 100-foot-long, 9-foot-high roadway embankment between the two bridges obstructs flows as it traverses the island between the Ramapo River's two channels. Removing this center embankment and replacing both bridges with a single 300-foot bridge can reduce modeled 100-year flood depths by up to about 4.3 feet compared to existing conditions. Projected future flood modeling indicates that the bridge low chord would also need to be raised by about 1 foot or more, depending on pier configuration, to meet current NYSDOT freeboard requirements (see Section 2.6). Given that the left (easterly) bridge was recently constructed (2011), this may not be a practical alternative currently but should be considered when it is ultimately due for replacement in the future. In this scenario, six properties on the upstream side of Seven Lakes Drive would remain within the 100-year floodplain.

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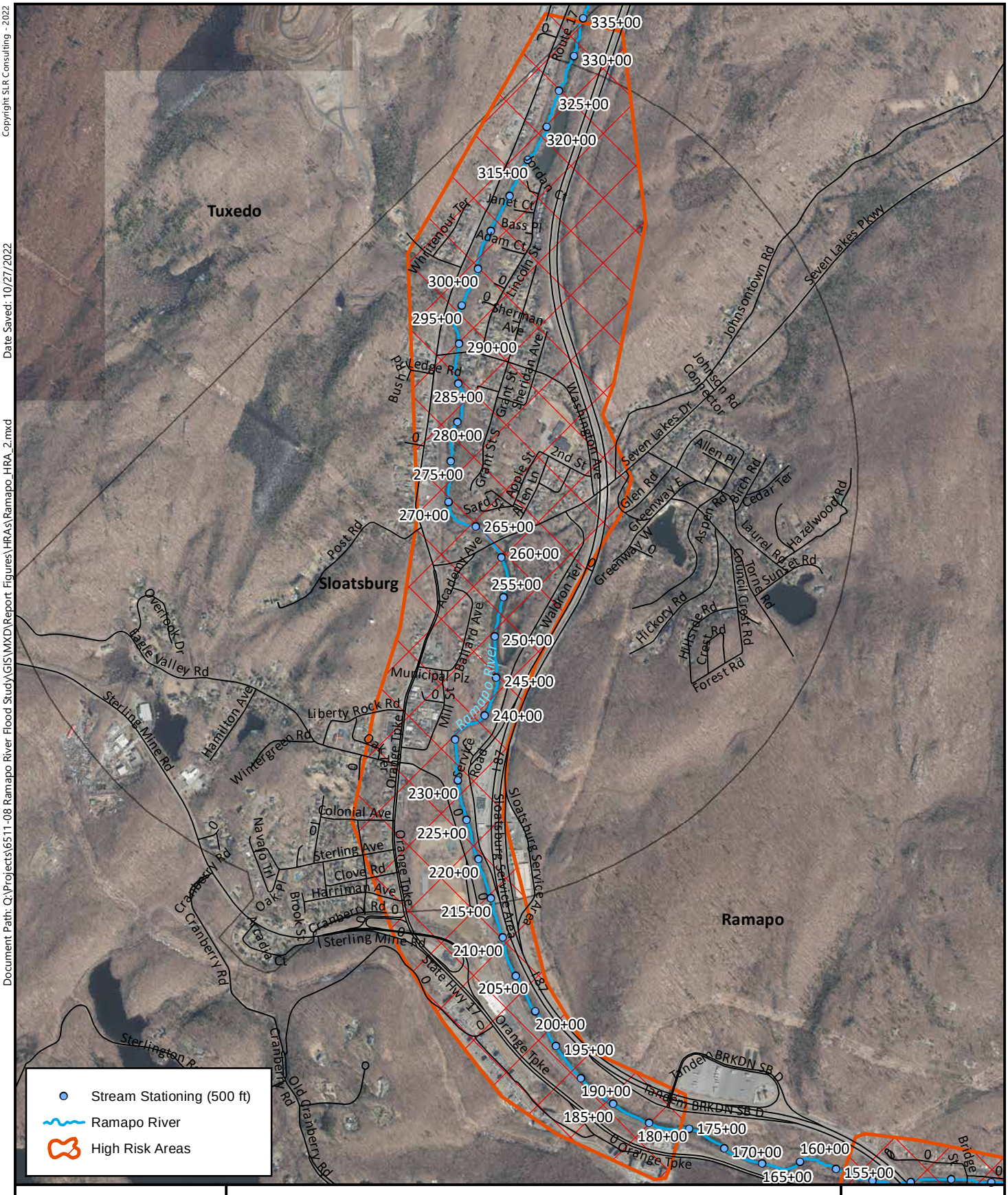

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RAMAPO RIVER - HIGH RISK AREA #2

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Rockland and Orange Counties, NY

N

0 500 1,000
Feet

SCALE 1 " = 1,600 '

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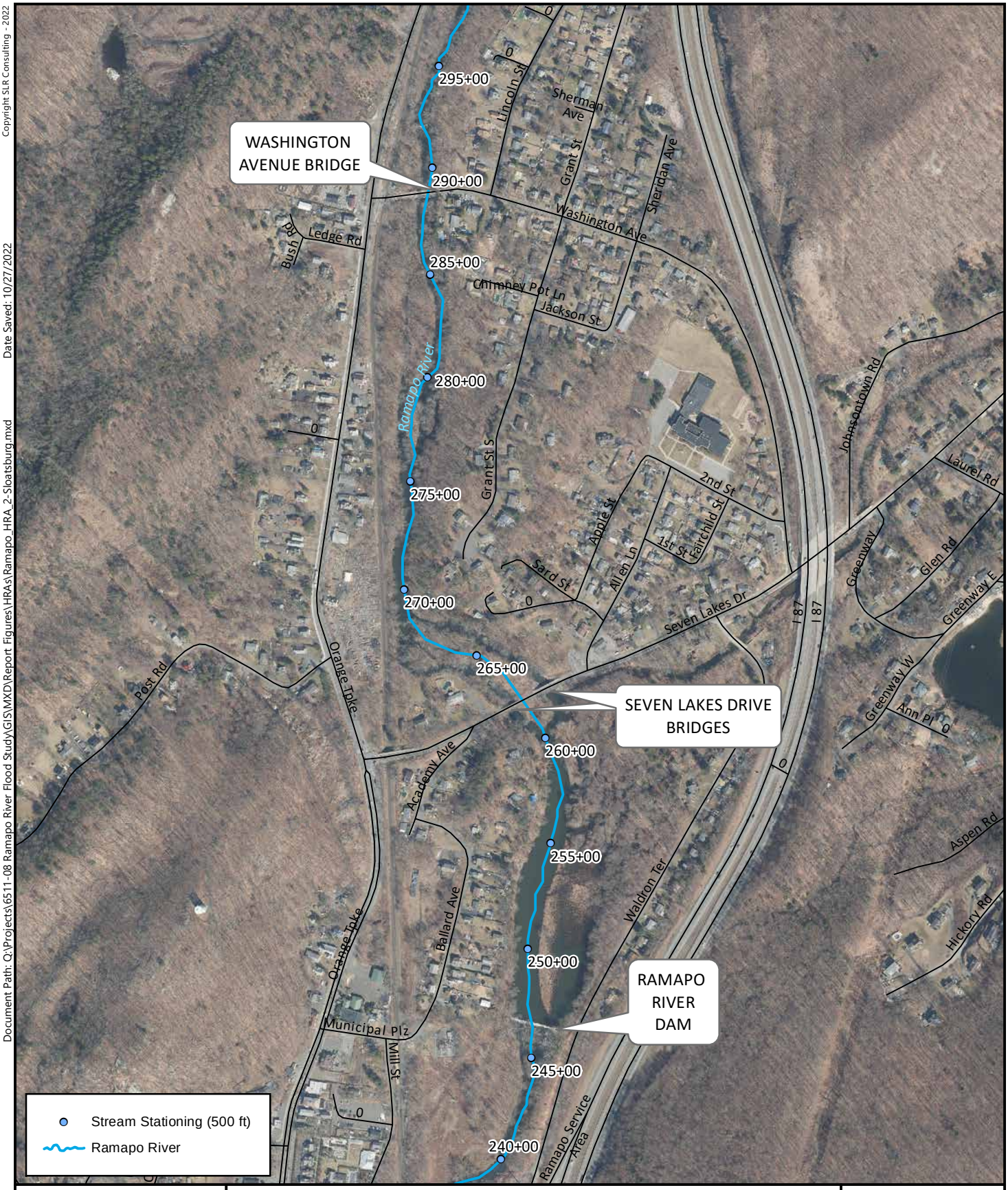
FIG. 4-20



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RAMAPO RIVER - HRA #2 - SLOATSBURG

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N

0 500
Feet

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FIG. 4-21

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Figure 4-22: Newer steel beam bridge carrying Seven Lakes Drive over Ramapo River's left (easterly) channel

Figure 4-23: Older concrete arch bridge carrying Seven Lakes Drive over Ramapo River's right (westerly) channel

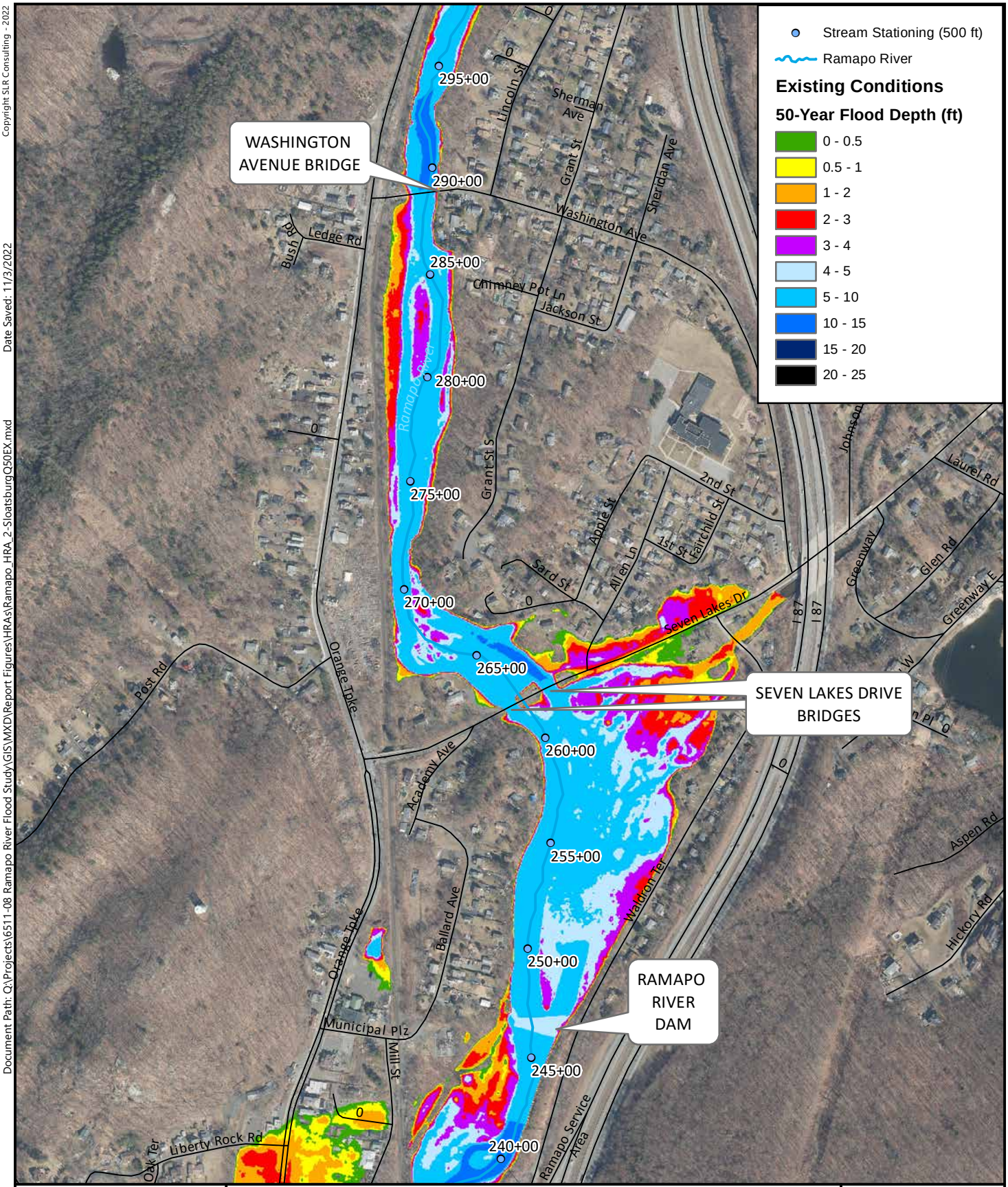
About 0.3 miles downstream of the Seven Lakes Drive bridges, the Ramapo River Dam sits at STA 246+50 (NYSDEC ID: 196-5495; Federal ID: NY16114). According to the NYSDEC dam inventory (April 2022 revision), this Class A (Low Hazard) concrete and masonry gravity dam is 6 feet high and 300 feet long. No data are available concerning ownership of this dam, date of construction, or date of most recent inspection. It is recommended that NYSDEC ascertain the current owner of the dam and/or update this database entry and conduct inspections as appropriate.

Modeling indicates that this dam raises 100-year water surface elevations upstream by up to about 4.5 feet, although no properties appear to be impacted that are not flood prone otherwise. This backwater diminishes with distance upstream to about 0.2 feet where it reaches Seven Lakes Drive bridge, although the existing bridge configuration generates a more substantial reduction in conveyance than the dam's minor backwater, so flooding depths upstream of the Seven Lakes Drive crossing cannot be significantly mitigated by removal or modification of the Ramapo River Dam.

While conditions can be improved, eliminating flooding at all properties along Seven Lakes Drive by improving bridge hydraulic performance and/or dam removal or modification does not appear to be possible since several buildings are located at low elevations within the alluvial outwash delta at the confluence of Stony Brook, an area that is naturally prone to flooding. This area is inundated when the Ramapo River floods and may be susceptible to flooding from Stony Brook as well, although that watercourse was not evaluated in detail for this study. In natural conditions modeling, with the Seven Lakes Drive bridge and crossing as well as the Ramapo River Dam removed, five properties on the left (east) bank remain vulnerable to 100-year flooding from the Ramapo River (four on the north side of Seven Lakes Drive and one on the south). Voluntary buyout and/or relocation of the existing flood-prone properties along Seven Lakes Drive is a more effective flood mitigation alternative.

The Washington Avenue bridge at STA 289+00 does not meet current NYSDOT bridge freeboard criteria but is not modeled as overtopping in the 100-year flood and does not appear to contribute to flooding of upstream property or infrastructure. The valley is about 200 feet wide where this 160-foot-span bridge crosses, with the right (western) approach embankment making up most of the difference. An increased and elevated span that meets DOT standards would improve infrastructure resiliency, especially considering that the Washington Avenue bridge is the nearest crossing to the more flood-prone Seven Lakes Drive bridge.

Figure 4-24 depicts modelled flooding depths under existing conditions in the 50-year flood event. Figure 4-25 depicts the 50-year flood event with the replacement of the older, right (westerly) Seven Lakes Drive bridge with a 100-foot span. Figures 4-26 and 4-27 depict existing and proposed conditions, respectively, during the 100-year flood event. Areas near the Seven Lakes Drive bridge that are naturally susceptible to 100-year flooding are shown in Figure 4-27A; affected properties should be prioritized for voluntary buyout or relocation.



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HRA #2 - SLOATSBURG - EXISTING CONDITIONS 50-YEAR FLOOD

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N

0 500 Feet

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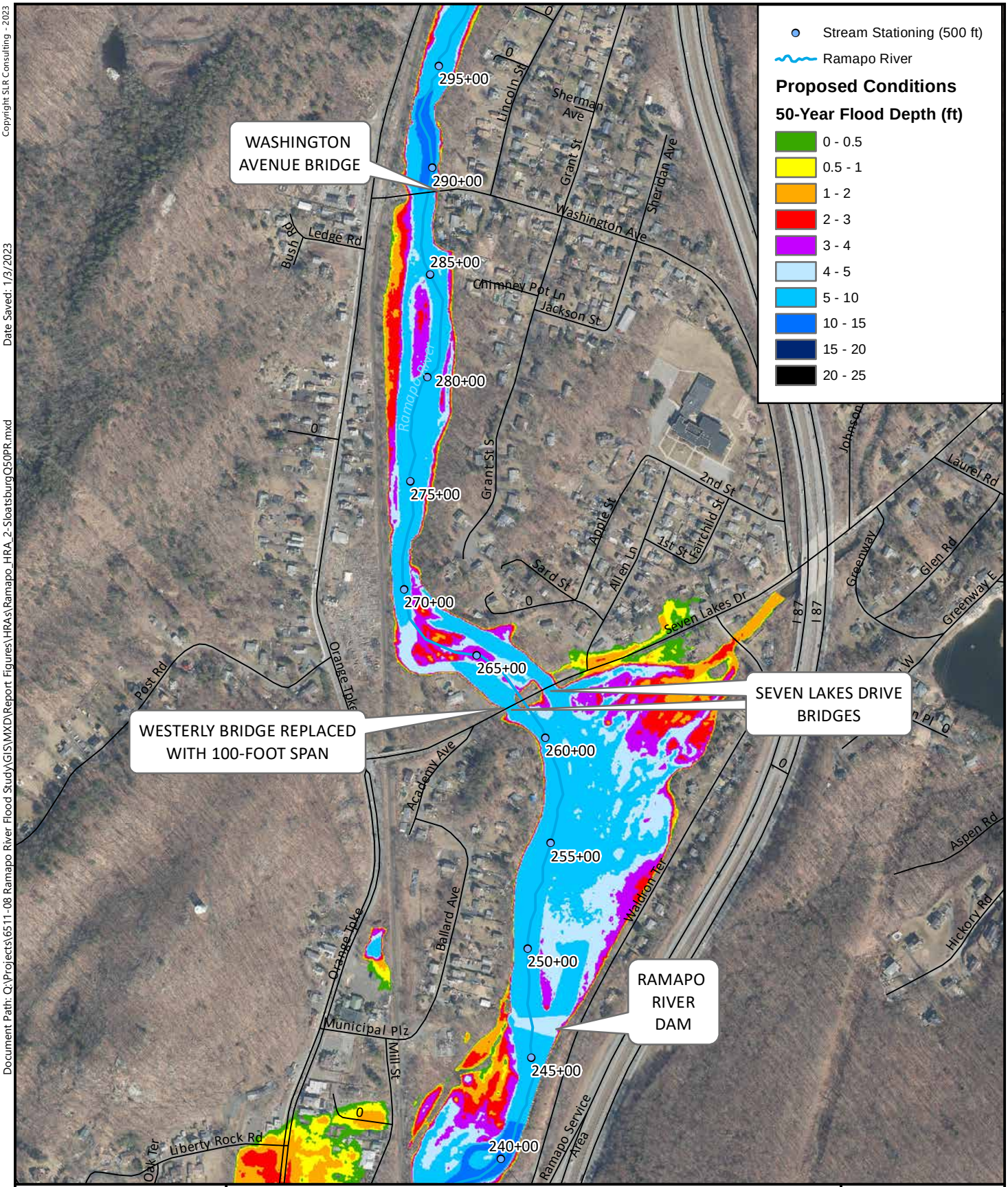
FIG. 4-24



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HRA #2 - SLOATSBURG - PROPOSED CONDITIONS 50-YEAR FLOOD

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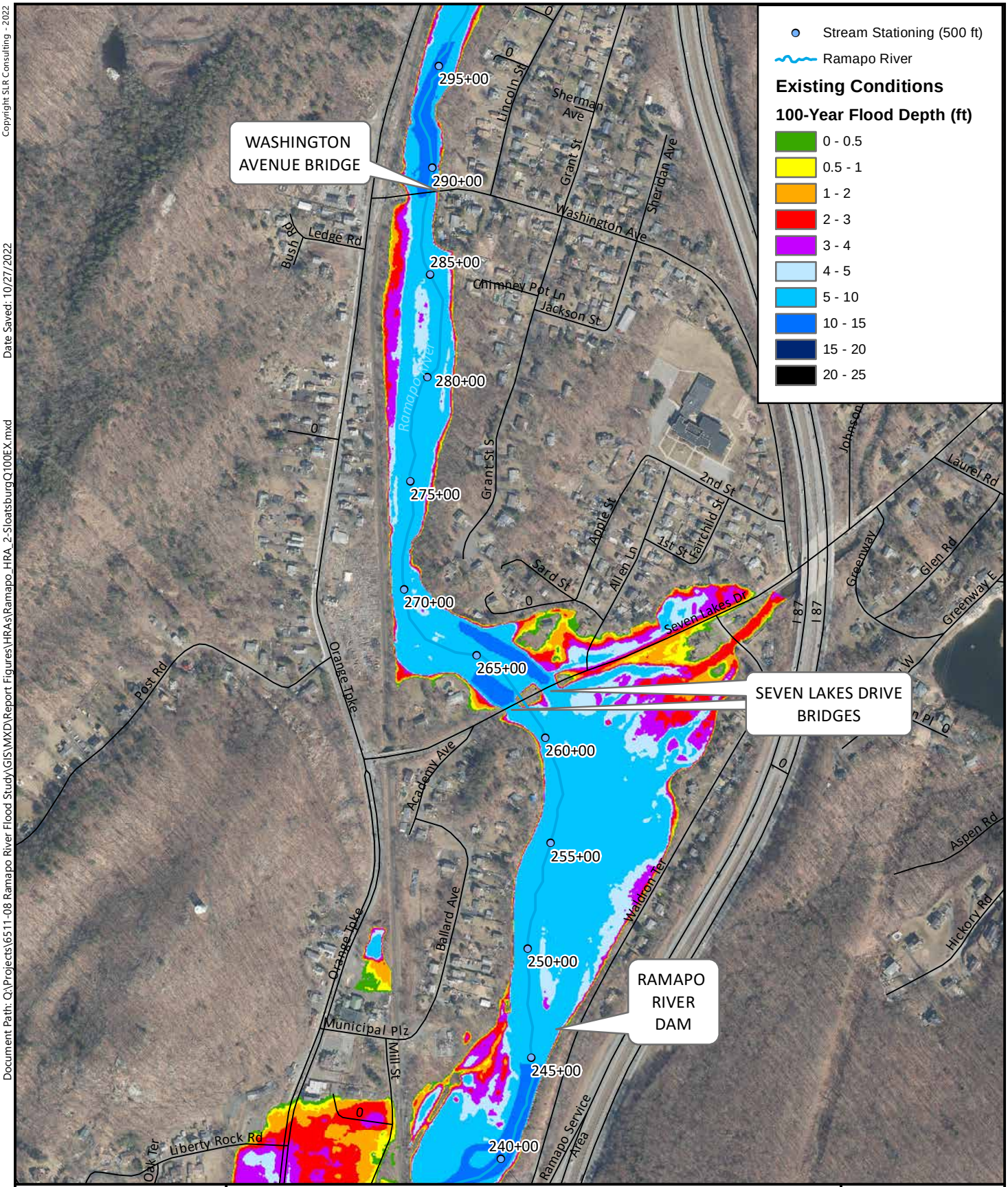
FIG. 4-25



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HRA #2 - SLOATSBURG - EXISTING CONDITIONS 100-YEAR FLOOD

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SCALE 1 " = 600 '

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FIG. 4-26

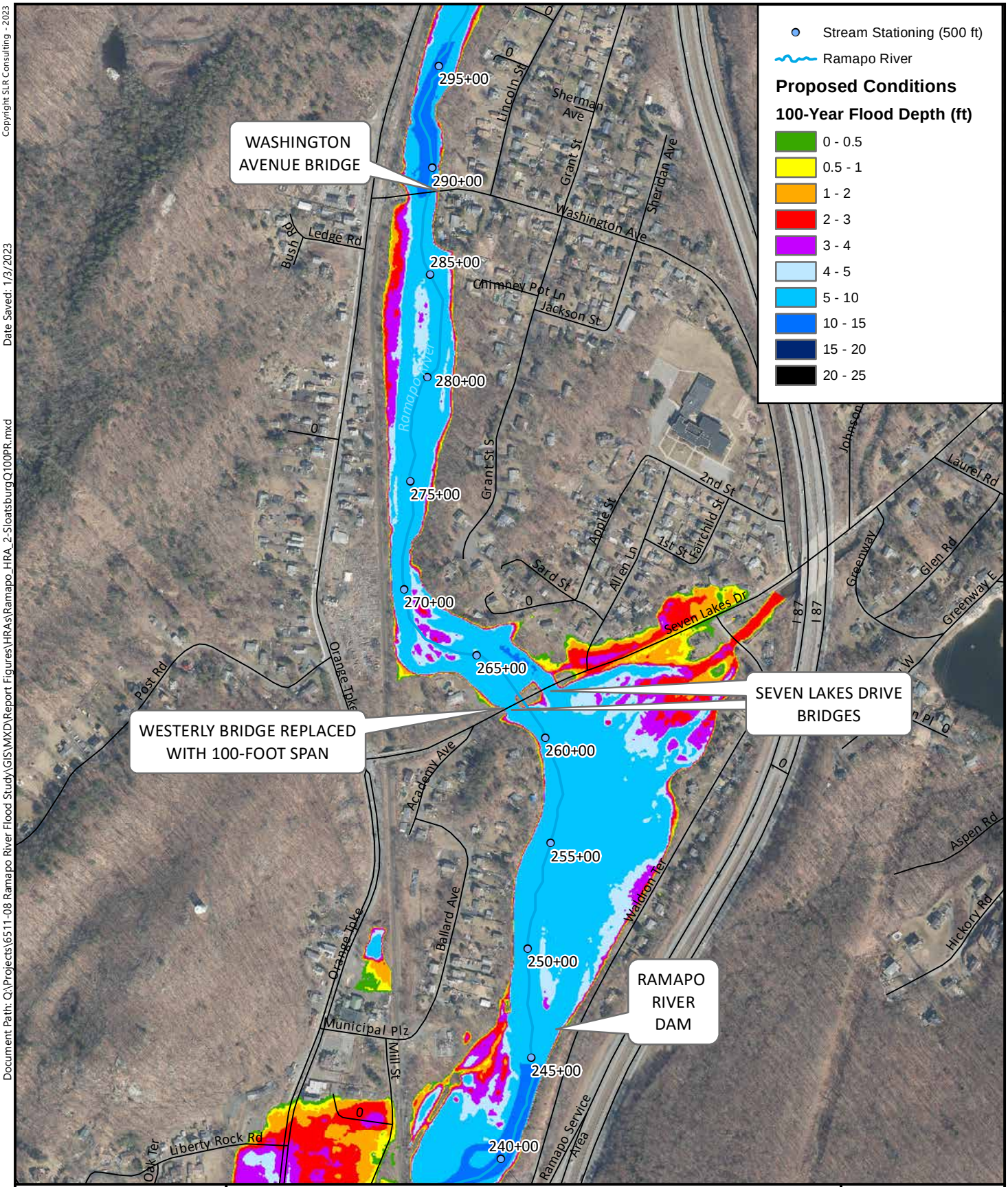

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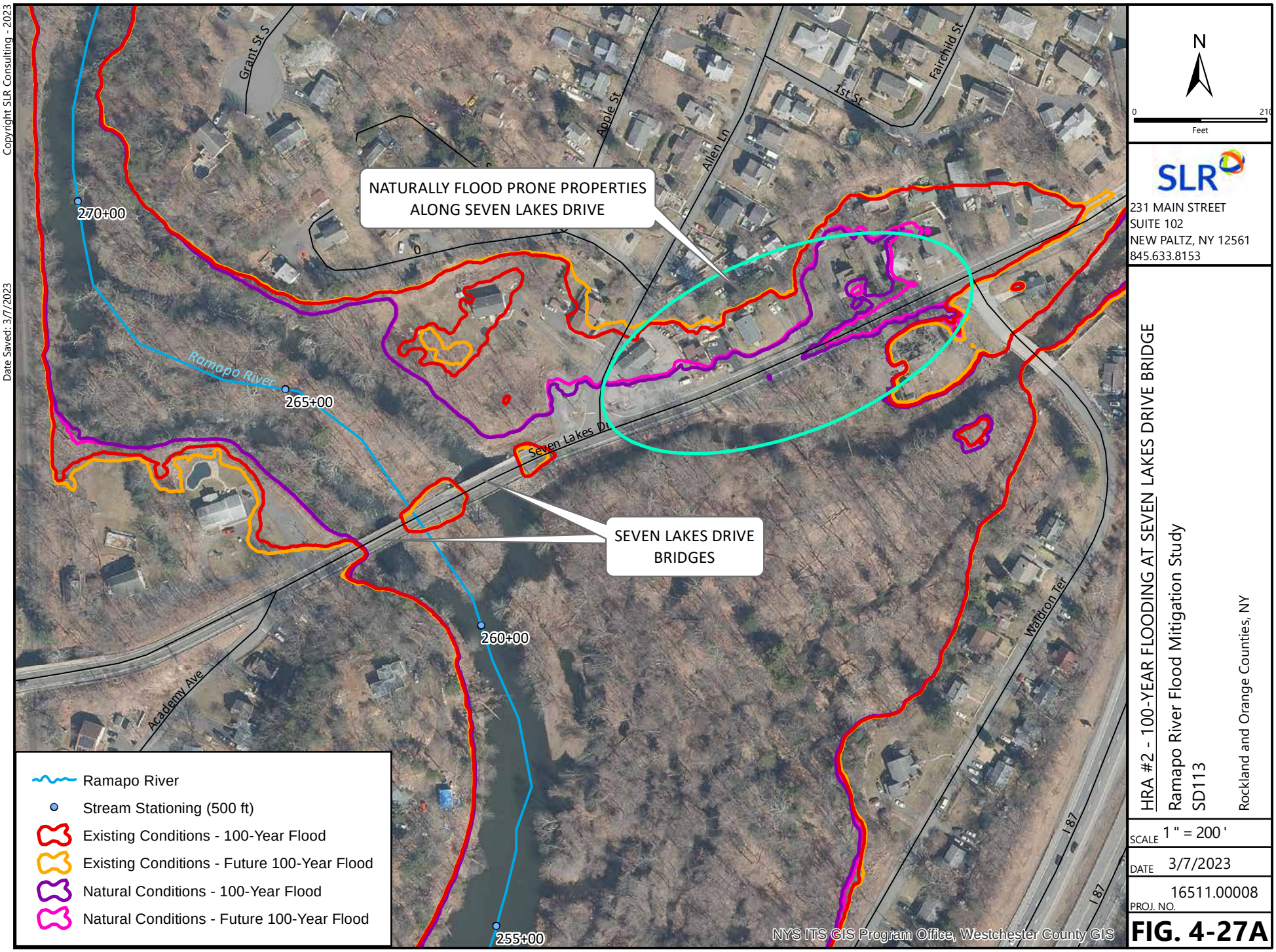
FIG. 4-27



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N

0 210
Feet

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HRA #2 - 100-YEAR FLOODING AT SEVEN LAKES DRIVE BRIDGE

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FIG. 4-27A

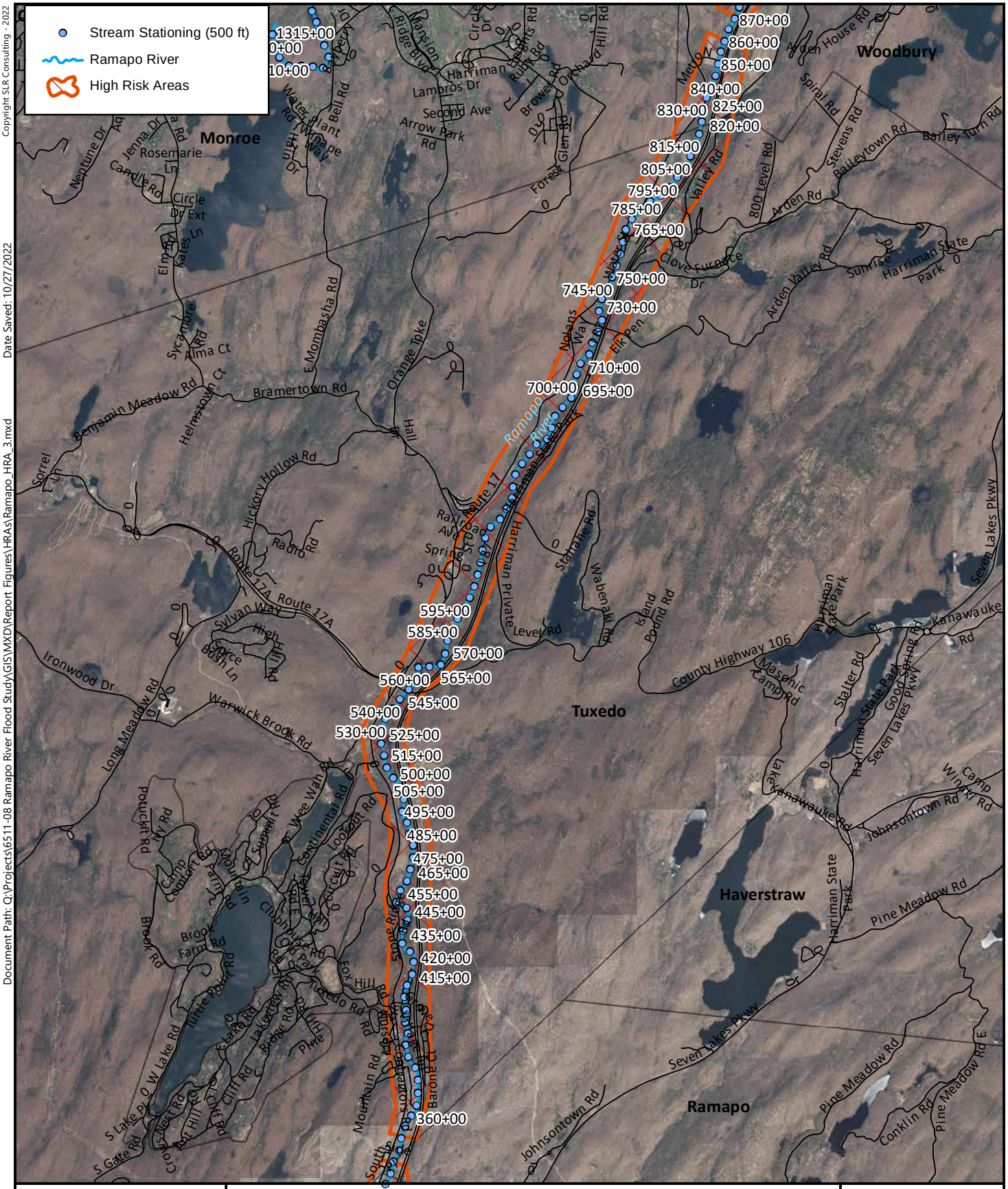
4.3 HIGH RISK AREA 3

As shown in Figure 4-28, HRA 3 is located primarily in the town of Tuxedo, from STA 360+00, upstream through the hamlets of Southfields and Arden, and reaches a little over half a mile into the town of Woodbury, ending at STA 855+00. Portions of HRA 3 have been designated as Potential Environmental Justice Areas.

4.3.1 HRA 3 EAST VILLAGE ROAD

There are seven repetitive loss properties in Tuxedo and Tuxedo Park, all in the vicinity of the East Village Road bridge at STA 402+50, shown in Figure 4-29. 50- and 100-year flood mapping is presented in Figures 4-30 and 4-31, respectively. The approximately 50-foot-long, two-span bridge was replaced in 2019 with a 102-foot single span. The relatively low-lying bridge is modeled as being impacted by the estimated 10-year flood event and possibly overtopping, and overtopping in the 25-year and greater flood events. Depending on flood magnitude, the bridge can generate up to about 1 foot of additional backwater depths; however, the properties impacted by flooding under existing conditions would still be vulnerable to flooding under a natural conditions scenario with the bridge removed. East Village Road is near to the floodplain elevation as it crosses the valley, so reducing the flood hazard to the bridge and road infrastructure would require significant modification to the approach roadway to facilitate a further increased and raised span. This is constrained by the intersection with River Road and access to public and private properties. Voluntary buyout or relocation of properties in this naturally flood-prone area is recommended.

There is also a neighborhood on East Village Road on the east side of I-87; backwaters from flooding on the Ramapo River are modeled as entering this neighborhood via the East Village Road underpass adjacent to STA 392+00. This is modeled as impacting properties in the area beginning in the 100-year flood event.



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RAMAPO RIVER - HIGH RISK AREA #3

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N

0 2,000 4,000
Feet

SCALE 1 " = 5,000 '

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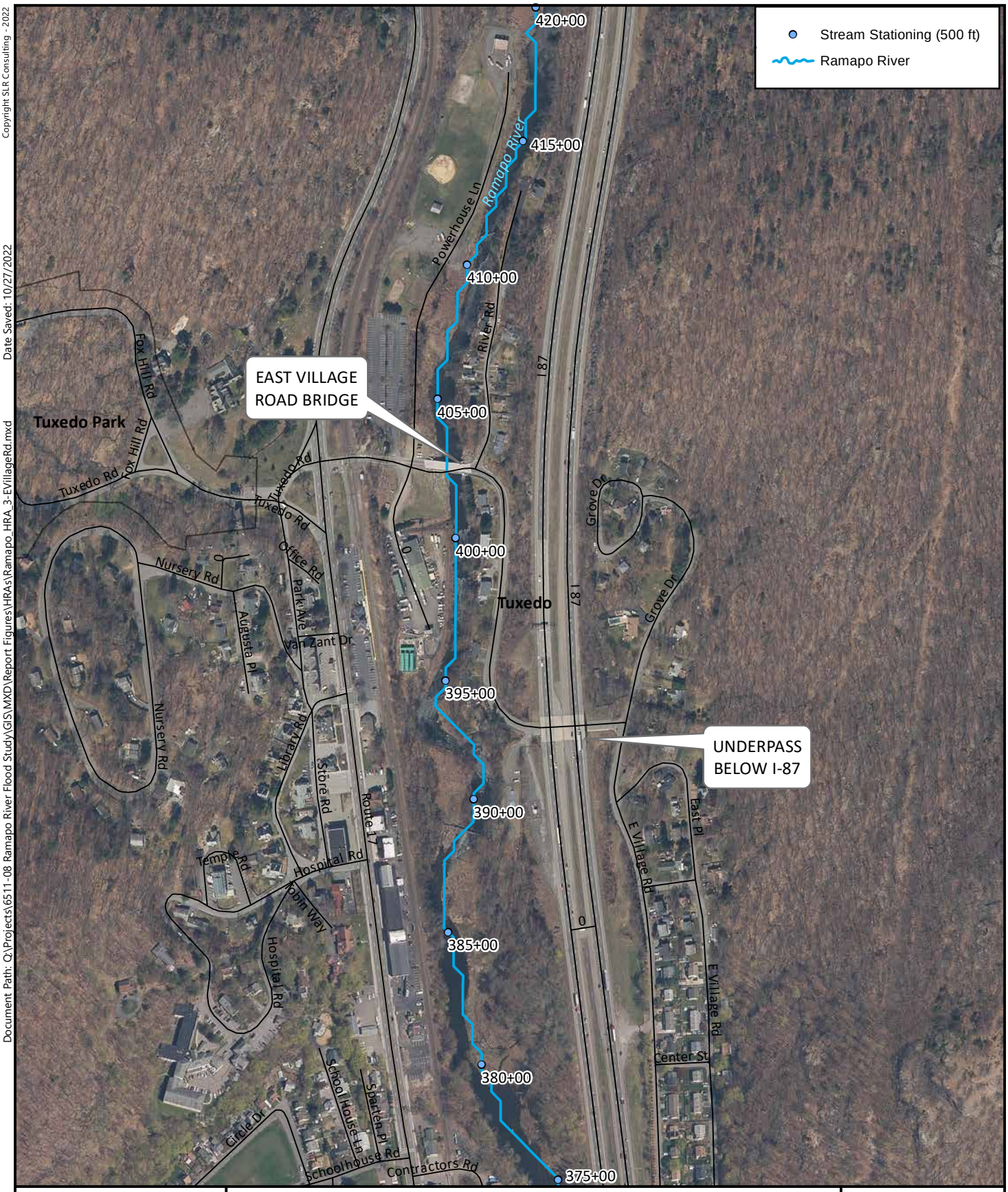
FIG. 4-28



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HRA #3 - EAST VILLAGE ROAD

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N

0 470
Feet

SCALE 1 " = 450 '

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FIG. 4-29

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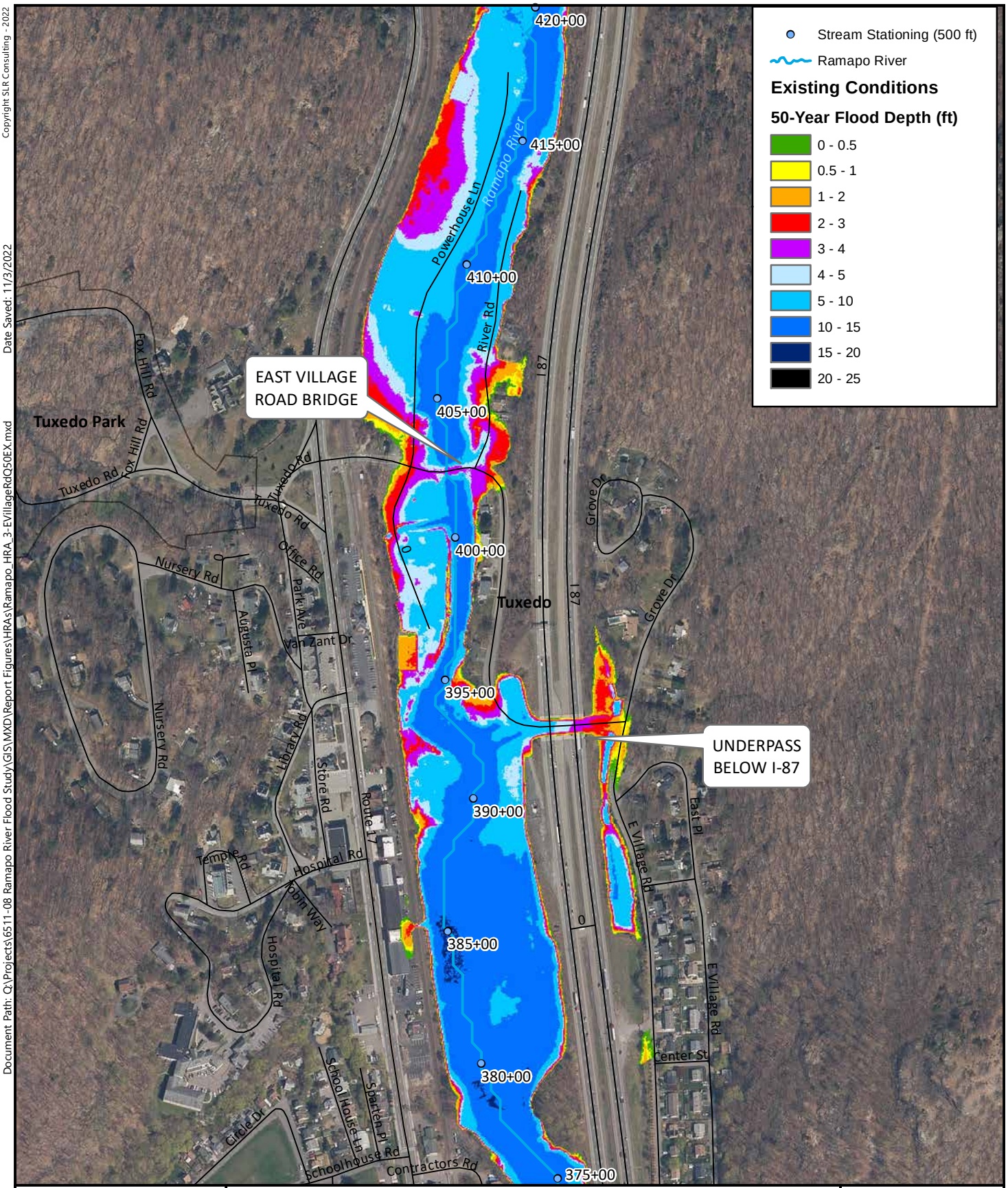

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HRA #3 - EAST VILLAGE ROAD - EXISTING CONDITIONS 50-YEAR FLOOD

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Rockland and Orange Counties, NY

N

0 470
Feet

SCALE 1 " = 450 '

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FIG. 4-30

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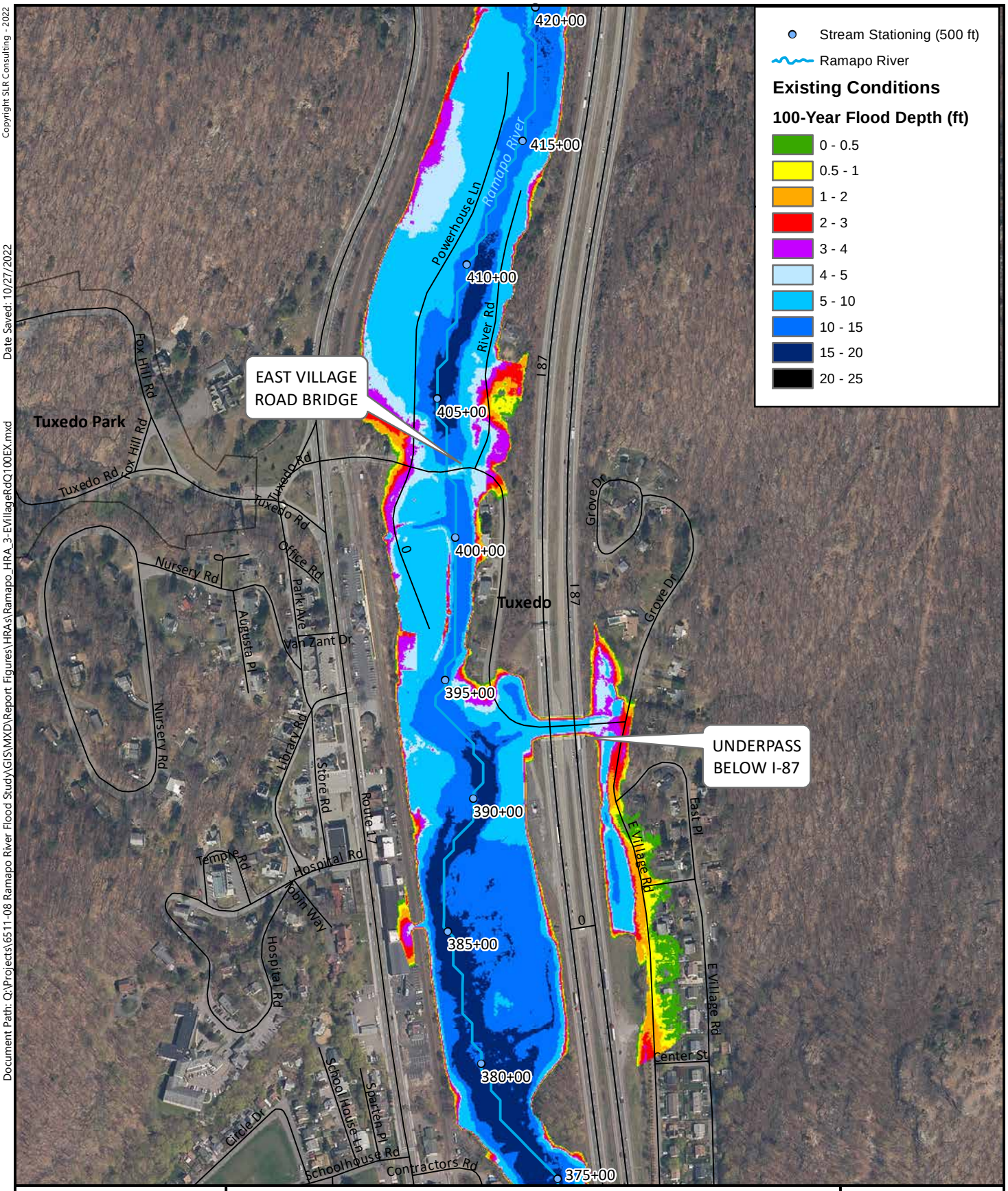

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HRA #3 - EAST VILLAGE ROAD - EXISTING CONDITIONS 100-YEAR FLOOD

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Rockland and Orange Counties, NY

N

0 470
Feet

SCALE 1 " = 450 '

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FIG. 4-31

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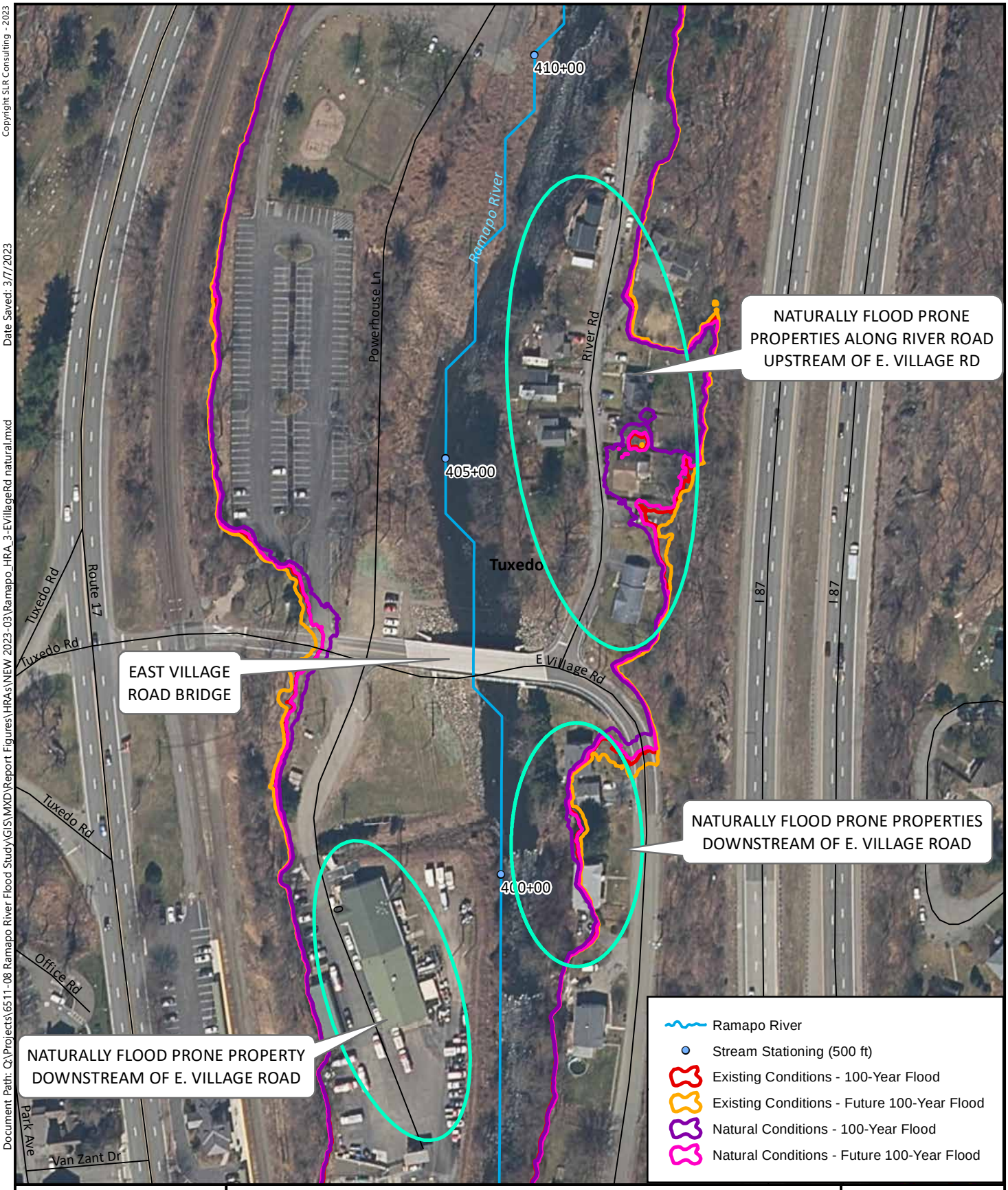

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HRA #3 - 100-YEAR FLOODING NEAR EAST VILLAGE RD BRIDGE

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N

0 150
Feet

SCALE 1 " = 150 '
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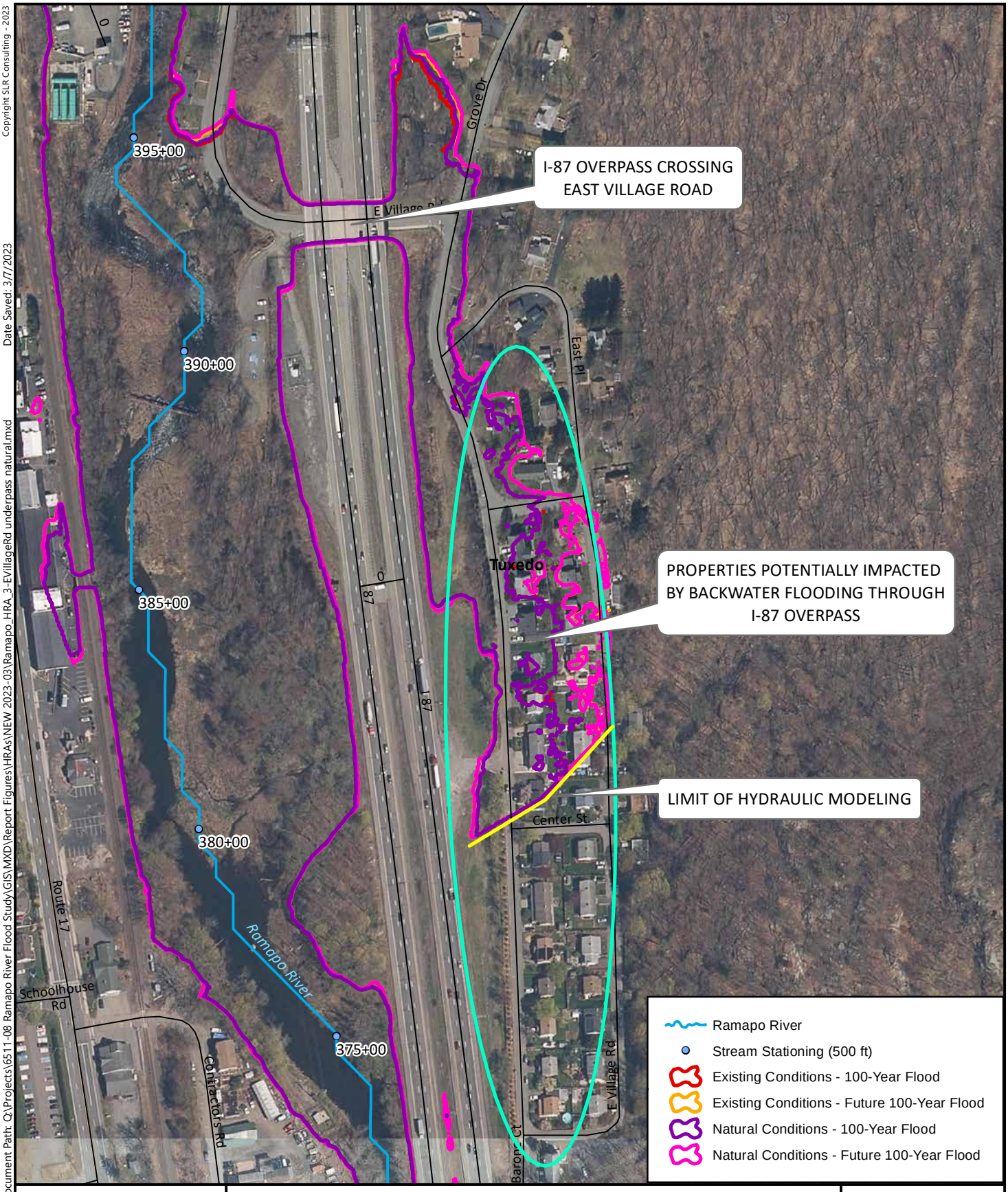
FIG. 4-31A



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HRA #3 - 100-YEAR FLOODING EAST OF I-87

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N

0 250
Feet

SCALE 1 " = 250 '

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FIG. 4-31B

4.3.2 HRA 3 RAILROAD BRIDGES

Shown in Figure 4-31C, the railroad bridges at STA 446+00 and STA 457+50 are undersized for flood flows, with overtopping modeled beginning in the 50-year flood event. The combined backwater from these bridges increases upstream flooding depths by 5 feet in the 100-year flood event and by 5.5 feet in the 50-year flood. This results in inundation of the railroad tracks upstream, with water up to 3 feet deep along about 1,200 feet of railway in the 100-year flood event. Aside from the railroad itself, no properties appear to be impacted by the excess flooding generated by these undersized bridges.

Under existing conditions, about 3,800 feet of the railway is overtopped by up to 3 feet in the estimated 100-year flood as it parallels the river upstream of the bridge from STA 457+50 to about STA 500+00. While flooding towards the downstream end of this length is due to the backwater of the railroad bridges, the remaining approximately half mile of inundated track appears to be flooded as a result of its location and elevation in the Ramapo River's natural floodplain.

Farther upstream, independent of the backwater influence of the two railroad bridges, over 1,000 feet of the southbound lanes of I-87 are also modeled as inundated by 100-year floodwaters up to about 4 feet deep between STA 487+00 to STA 501+00, and 800 feet of NY-17 between STA 485+00 and 493+00 is flooded by over 5 feet. This section of the Thruway floods beginning in the 25-year flood event while the section of NY-17 overtops beginning in the 10-year flood. A commercial park with several businesses is located on the west side of NY-17 at this location and is modeled as flooding by up to about 4 feet in the 100-year flood. This naturally flood prone area does not appear to be affected by the 10-year flood event but is inundated by up to about 2 feet in the 25-year flood event. Modeled flood depths for the 50- and 100-year floods are presented in Figures 4-31D and 4-31E.

Additional sections of NY-17, I-87, and the railroad are modeled as being susceptible to flooding upstream of STA 544+00 to the limits of HRA 2 at STA 815+00. Some of this flooding can be mitigated by improving bridge crossings and floodplain connectivity.

Exploring the feasibility of raising sections of NY-17 and I-87 and relocating businesses in naturally flood-prone areas are recommended. Railroad infrastructure resiliency can be improved by replacing the bridges at STA 446+00 and STA 457+50 with hydraulically adequate spans and elevating naturally flood-prone sections of track.

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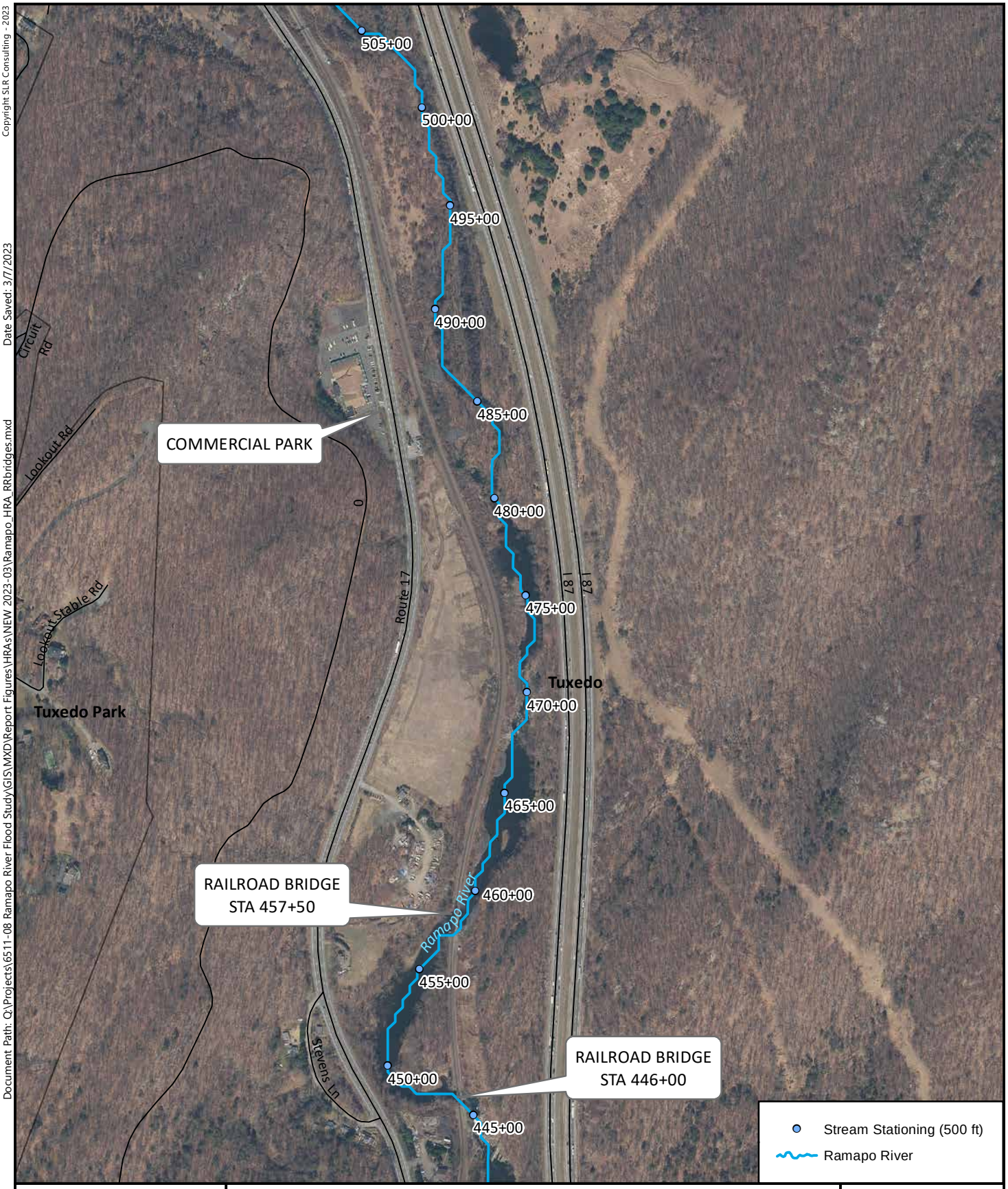

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HRA #3 - RAILROAD BRIDGES

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N

0 500
Feet

SCALE 1 " = 600 '

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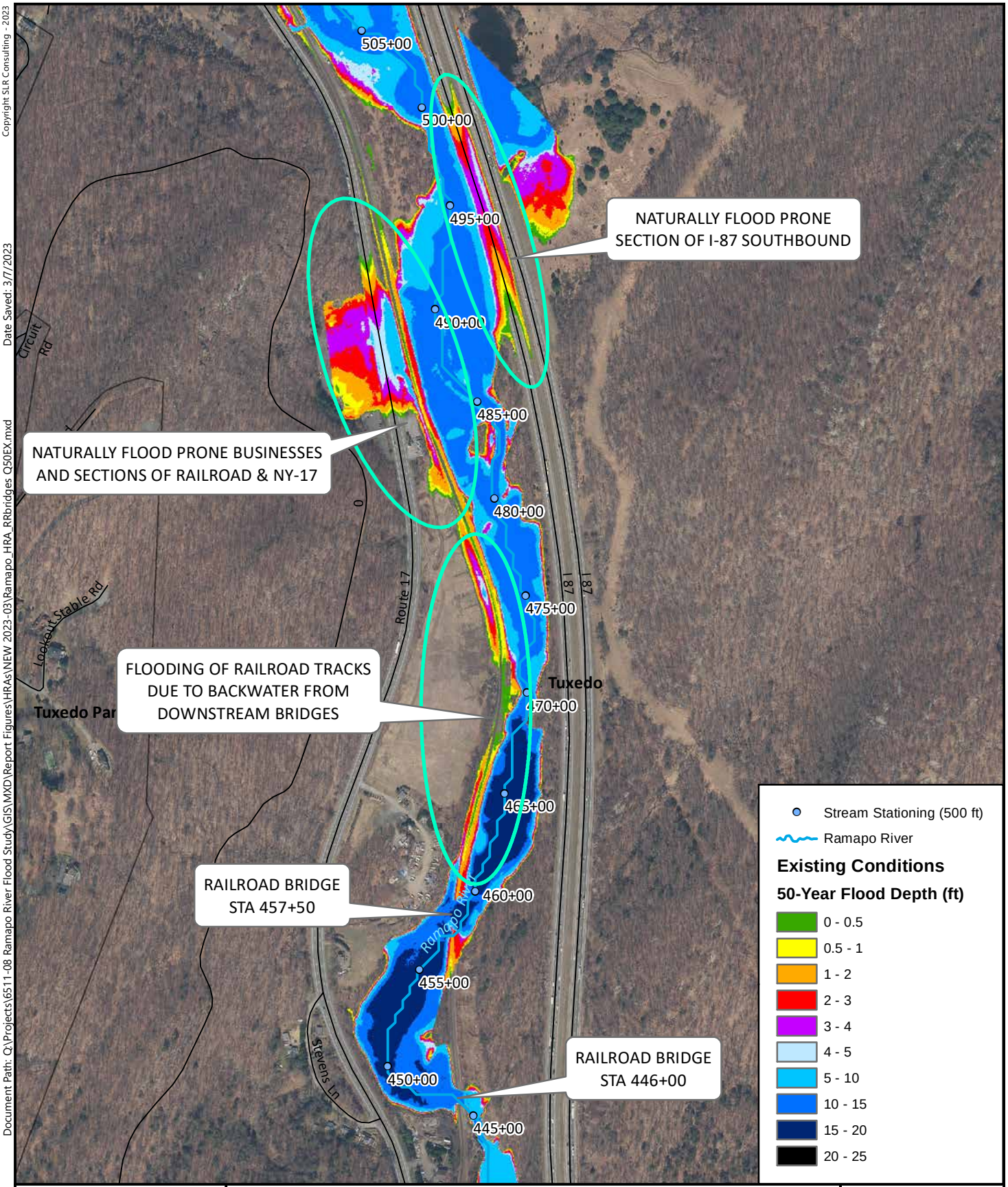
FIG. 4-31C



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HRA #3 - RAILROAD BRIDGES - EXISTING CONDITIONS 50-YEAR FLOOD

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SD113

Rockland and Orange Counties, NY

N

0 500 Feet

SCALE 1 " = 600 '

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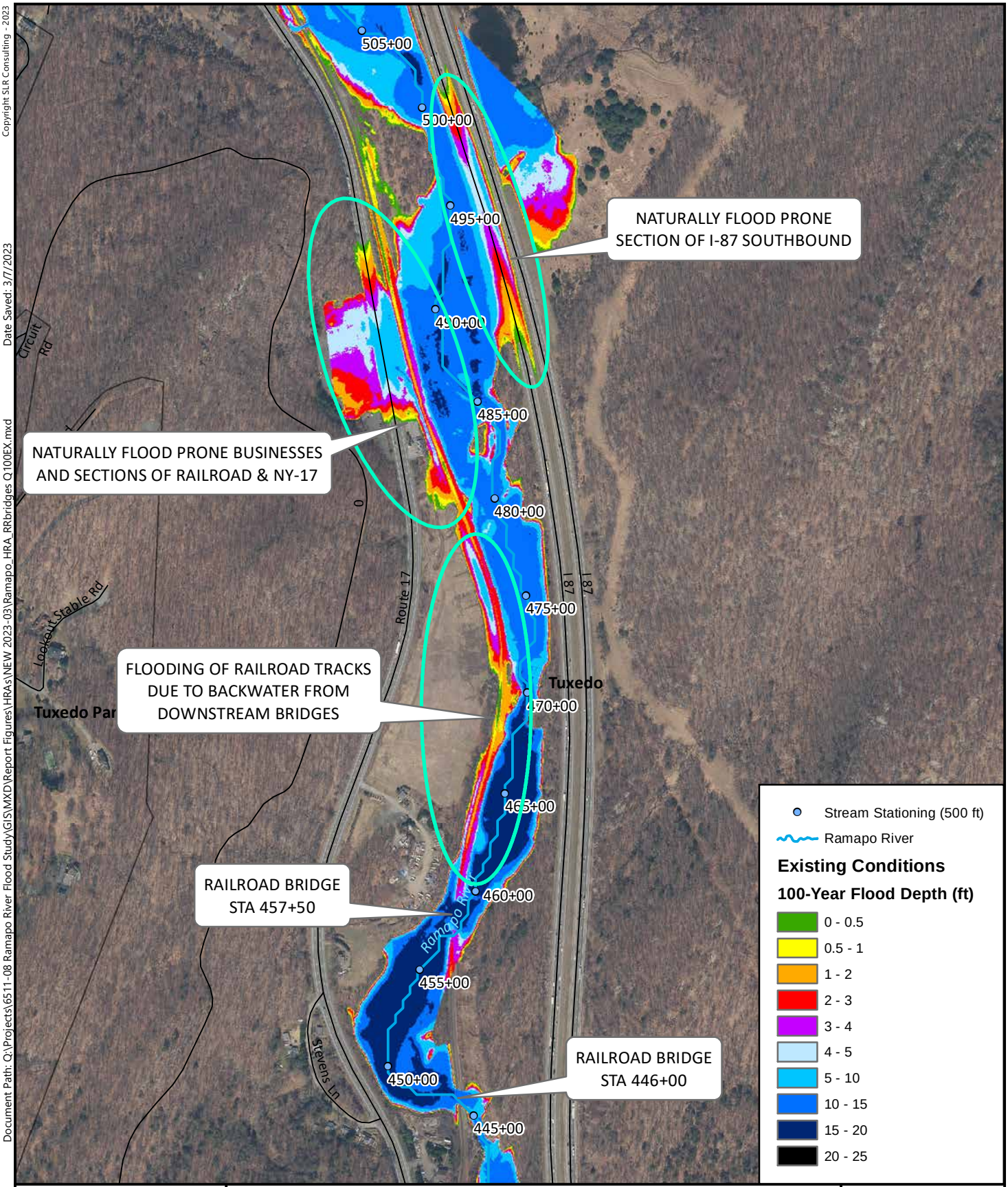
16511.00008 PROJ. NO.

FIG. 4-31D



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HRA #3 - RAILROAD BRIDGES - EXISTING CONDITIONS 100-YEAR FLOOD

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Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 600 '

DATE 3/7/2023

16511.00008
PROJ. NO.

FIG. 4-31E

4.3.3 HRA 3 KANAWAUKE ROAD BRIDGE

The Ramapo River in the vicinity of the Kanawauke Road bridge is shown on Figure 4-32. A photograph of the bridge is shown in Figure 4-33. The backwaters at the Kanawauke Road bridge crossing at STA 544+00 cause up to 3.4 feet of additional 100-year flood depths, extending about 7,500 feet upstream. Flooding of parts of NY-17, the railroad, and I-87 occur or are exacerbated as a result. The Kanawauke Road bridge does not provide much floodplain access but is elevated well above the floodplain and is relatively long at 190 feet, so the bridge itself only contributes to about half a foot of the modeled existing backwaters. Most of the upstream flooding can be reduced – by up to 2.9 feet – by improving floodplain connectivity upstream and downstream of the bridge. This would involve removing a 6-foot-tall berm along about 350 feet of the river's right bank upstream of the bridge and about 750 feet of 3- to 4-foot-high right and left bank berms downstream of the bridge, in addition to removal of the approach embankments from an archaic bridge crossing about 150 feet downstream of the Kanawauke Road bridge. These old embankments constrict the effective 100-year floodplain width to about 80 feet compared to about 120 feet at the current bridge, creating a backwater, and, along with the upstream and downstream berms, interfere with contraction and expansion of flows into and out of the Kanawauke Road bridge. This recommended alternative would alleviate 100-year flooding along about half a mile of NY-17 and the railroad and about 550 feet on the northbound lanes of I-87.

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HRA #3 - KANAWAUKE ROAD BRIDGE

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Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 700 '

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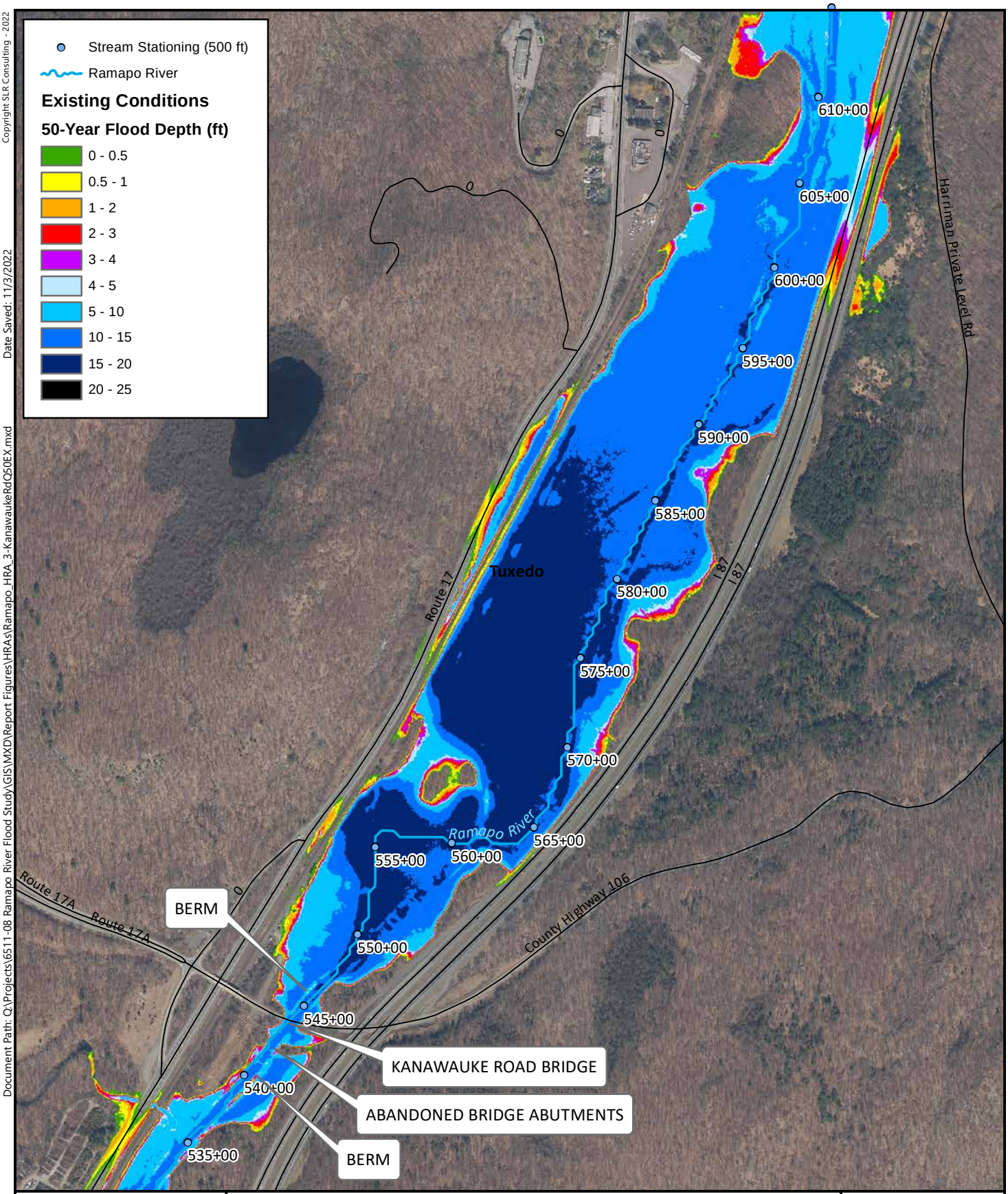
FIG. 4-32

Flooding of the southbound Thruway lanes would be reduced from up to about 7 feet to about 4 feet. This proposed berm and embankment removal and floodplain enhancement adjacent to the Kanawauke Road bridge is recommended.

Figure 4-34 depicts modelled flooding depths under existing conditions in the 50-year flood event. Figure 4-35 depicts the 50-year flood event with the above recommendations implemented. Figures 4-36 and 4-37 depict existing and proposed conditions, respectively, during the 100-year flood event.

Figure 4-33: Looking downstream towards Kanawauke Road bridge, visible through the trees in the upper-left quadrant of the image. Centered in the image is an approximately 6-foot-tall right bank berm.



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HRA #3 - KANAWAUKE RD BRIDGE - EXISTING CONDITIONS 50-YR FLOOD

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Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 700 '

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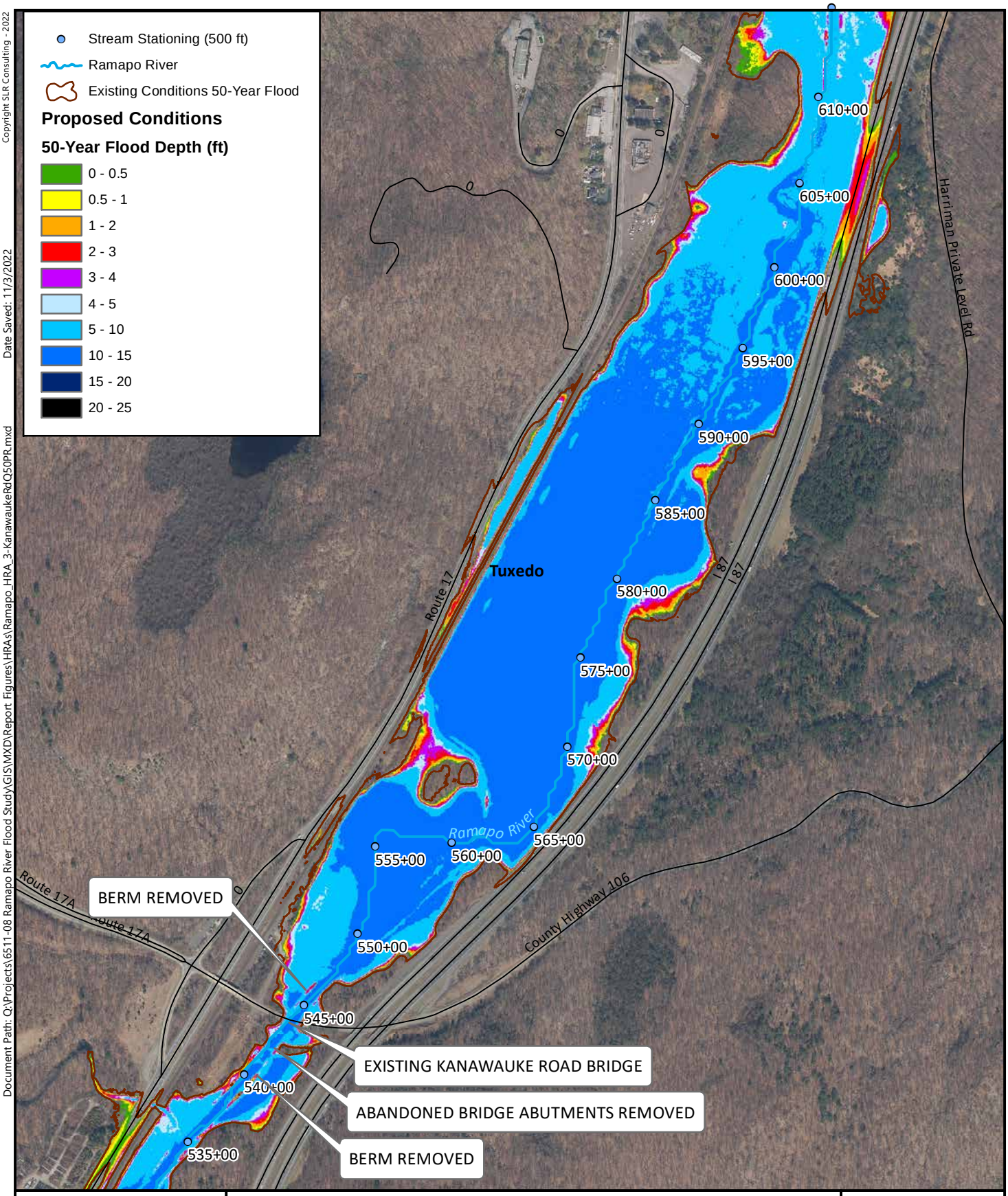
FIG. 4-34



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HRA #3 - KANAWAUKE RD BRIDGE - PROPOSED CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study

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Rockland and Orange Counties, NY

N

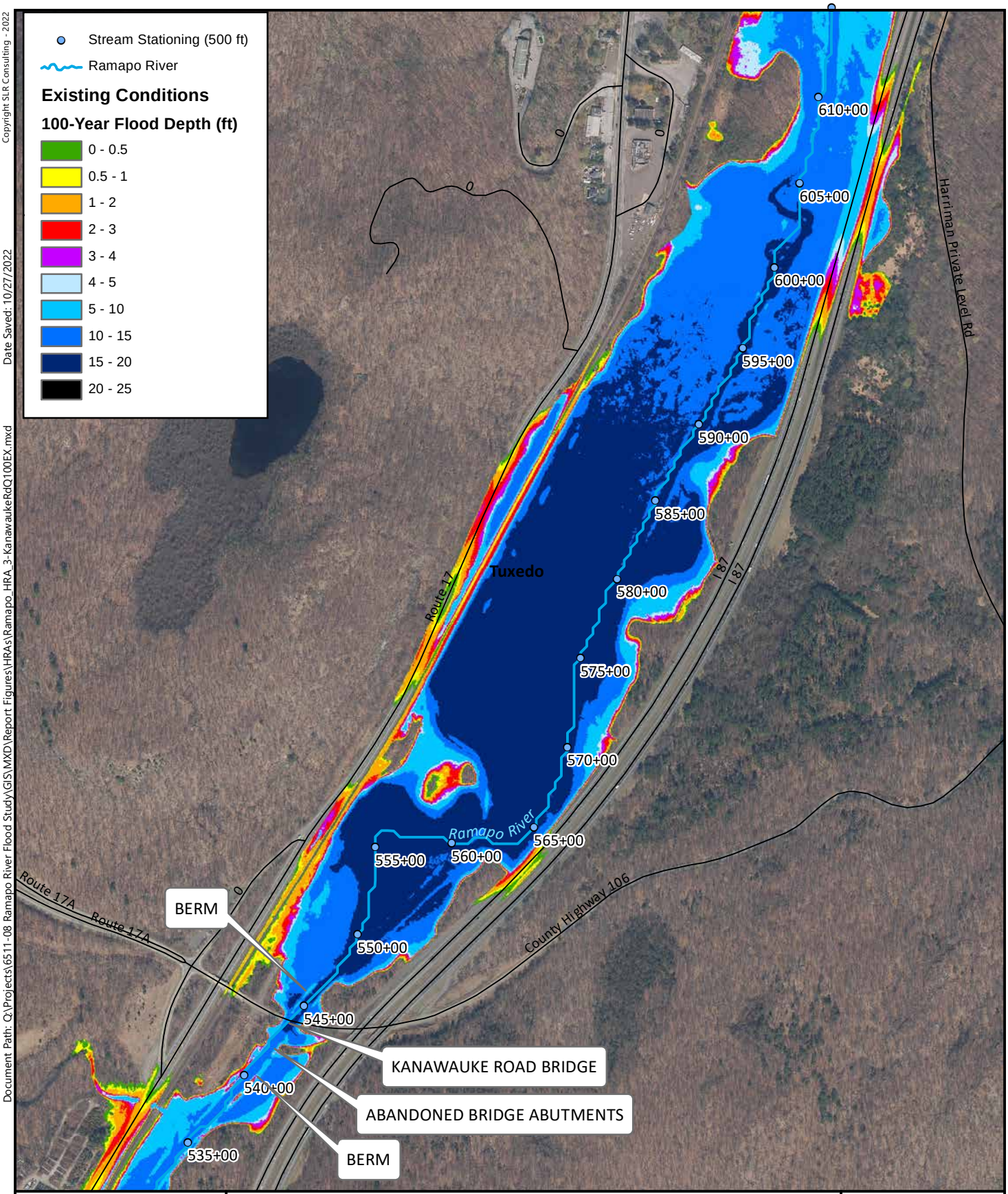
0 500 Feet

SCALE 1 " = 700 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-35



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HRA #3 - KANAWAUKE RD BRIDGE - EXISTING CONDITIONS 100-YR FLOOD

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Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 700 '

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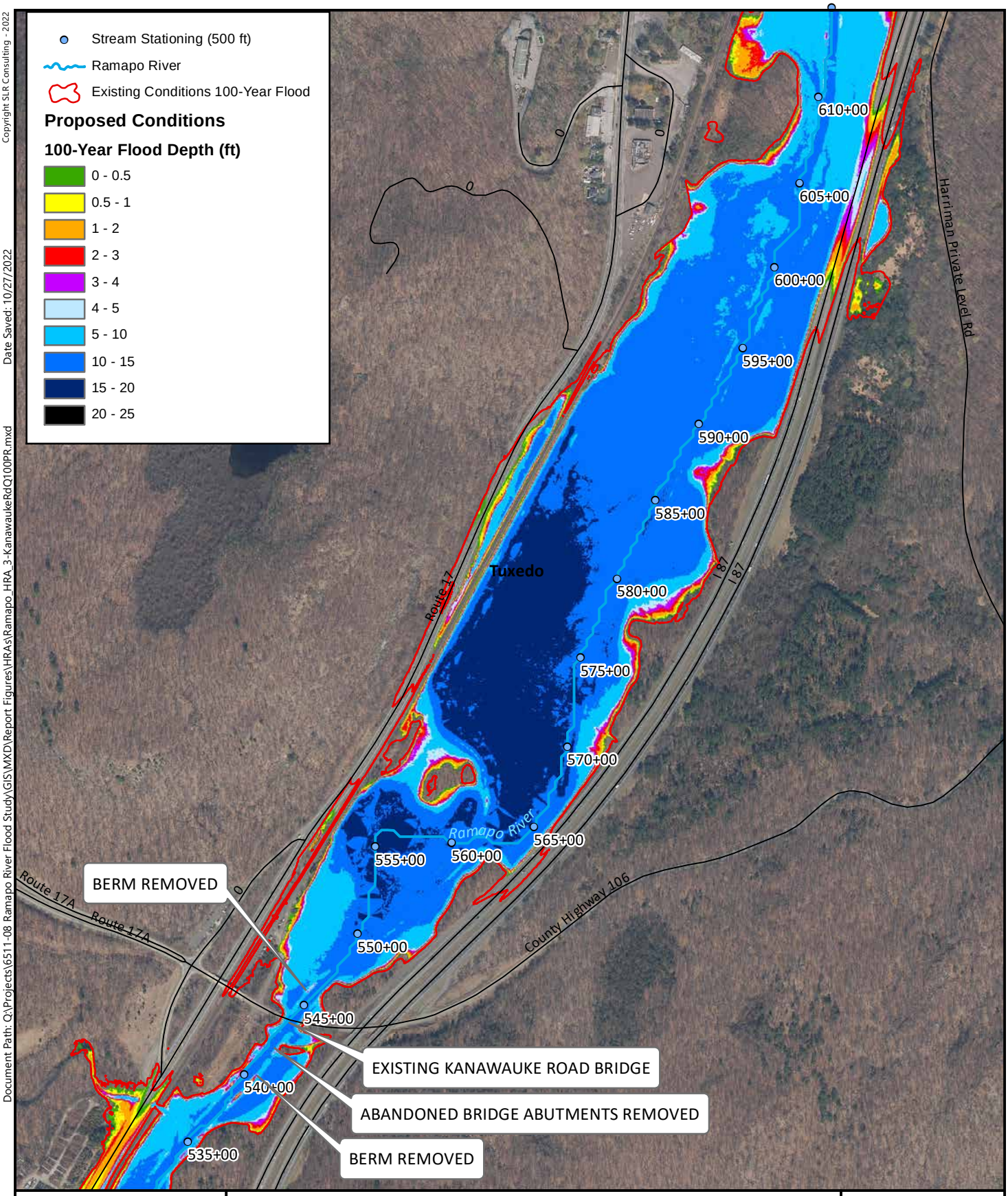
16511.00008
PROJ. NO.

FIG. 4-36



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HRA #3 - KANAWAUKE RD BRIDGE - PROPOSED CONDITIONS 100-YR FLOOD

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N

0 500 Feet

SCALE 1 " = 700 '

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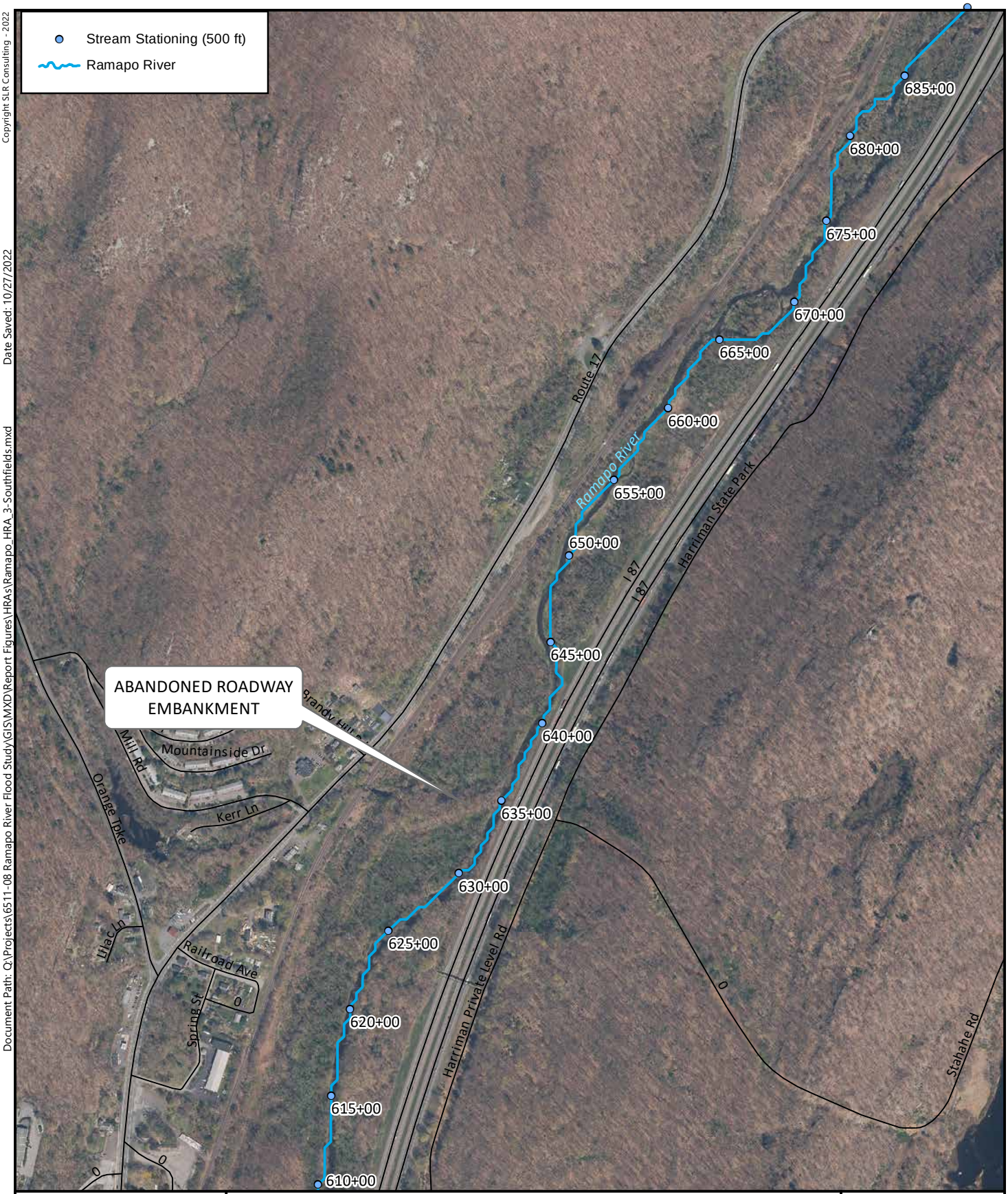
FIG. 4-37

4.3.4 HRA 3 SOUTHFIELDS

The Southfields area is depicted on Figure 4-38 and runs from STA 610+00 to 685+00. At STA 635+00, an approximately 550-foot-long, 20-foot-tall embankment traverses across the Ramapo River's entire floodplain on the right bank and forces flood flows to contract into an approximately 80-foot-wide channel between this embankment and the southbound lanes of the Thruway. The embankment appears to have been part of a road and bridge that are depicted in USGS topographic maps from the 1930s, and it generates as much as about 4.5 feet of backwaters over about 4,500 feet in the 100-year flood. Modeling indicates that removal of this archaic lateral embankment would alleviate 100-year flooding of the northbound Thruway lanes upstream and reduce flooding of the southbound lanes from depths up to 7 feet over a 2,000 foot length to depths up to 3 feet over a 1,200 foot length. Removal of the embankment is recommended.

Figure 4-39 depicts modelled flooding depths under existing conditions in the 50-year flood event. Figure 4-40 depicts the 50-year flood event with the above recommendations implemented. Figures 4-41 and 4-42 depict existing and proposed conditions, respectively, during the 100-year flood event.



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HRA #3 - SOUTHFIELDS

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N

0 500
Feet

SCALE 1 " = 700 '

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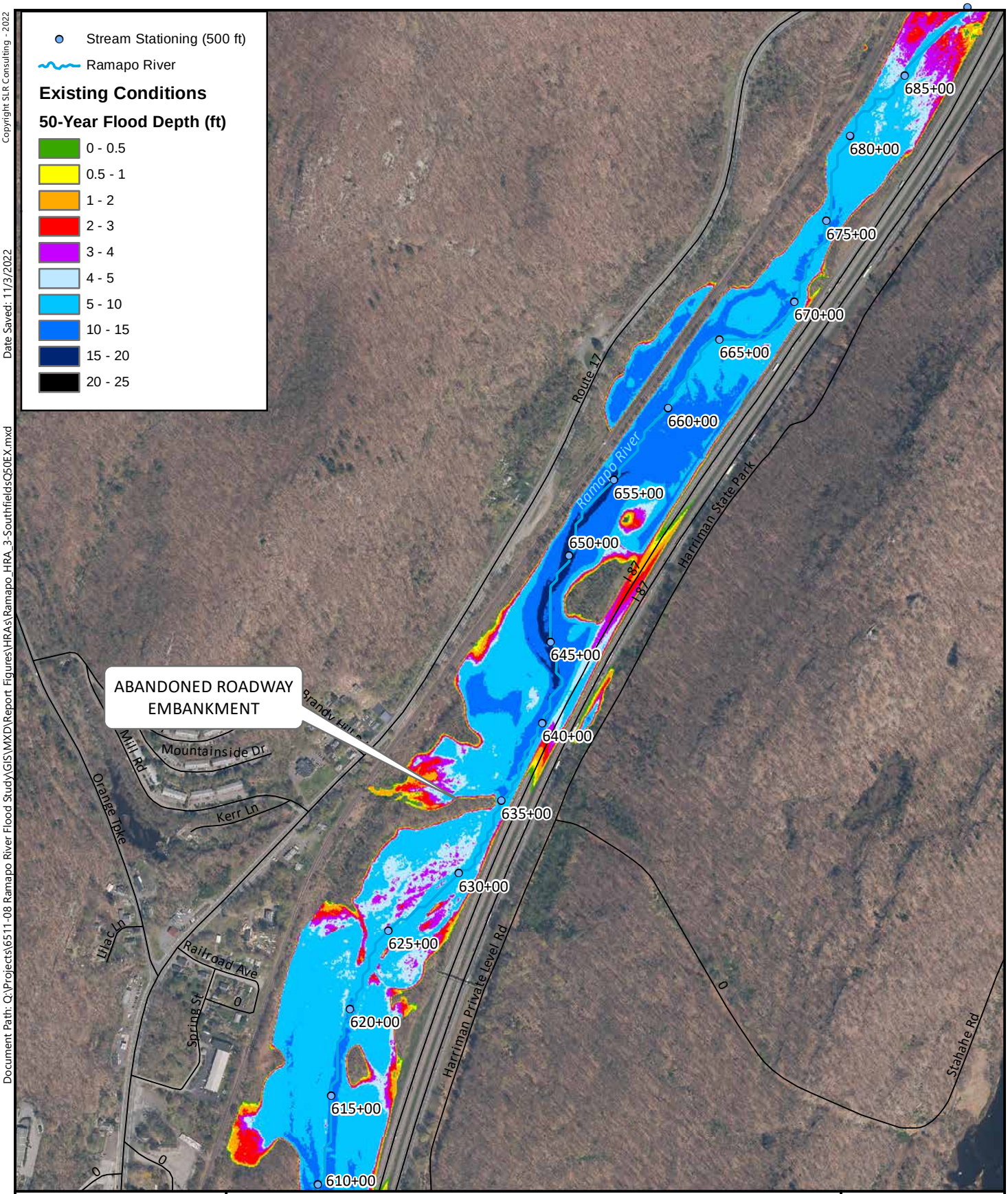
FIG. 4-38



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HRA #3 - SOUTHFIELDS - EXISTING CONDITIONS 50-YEAR FLOOD

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N

0 500
Feet

SCALE 1 " = 700 '

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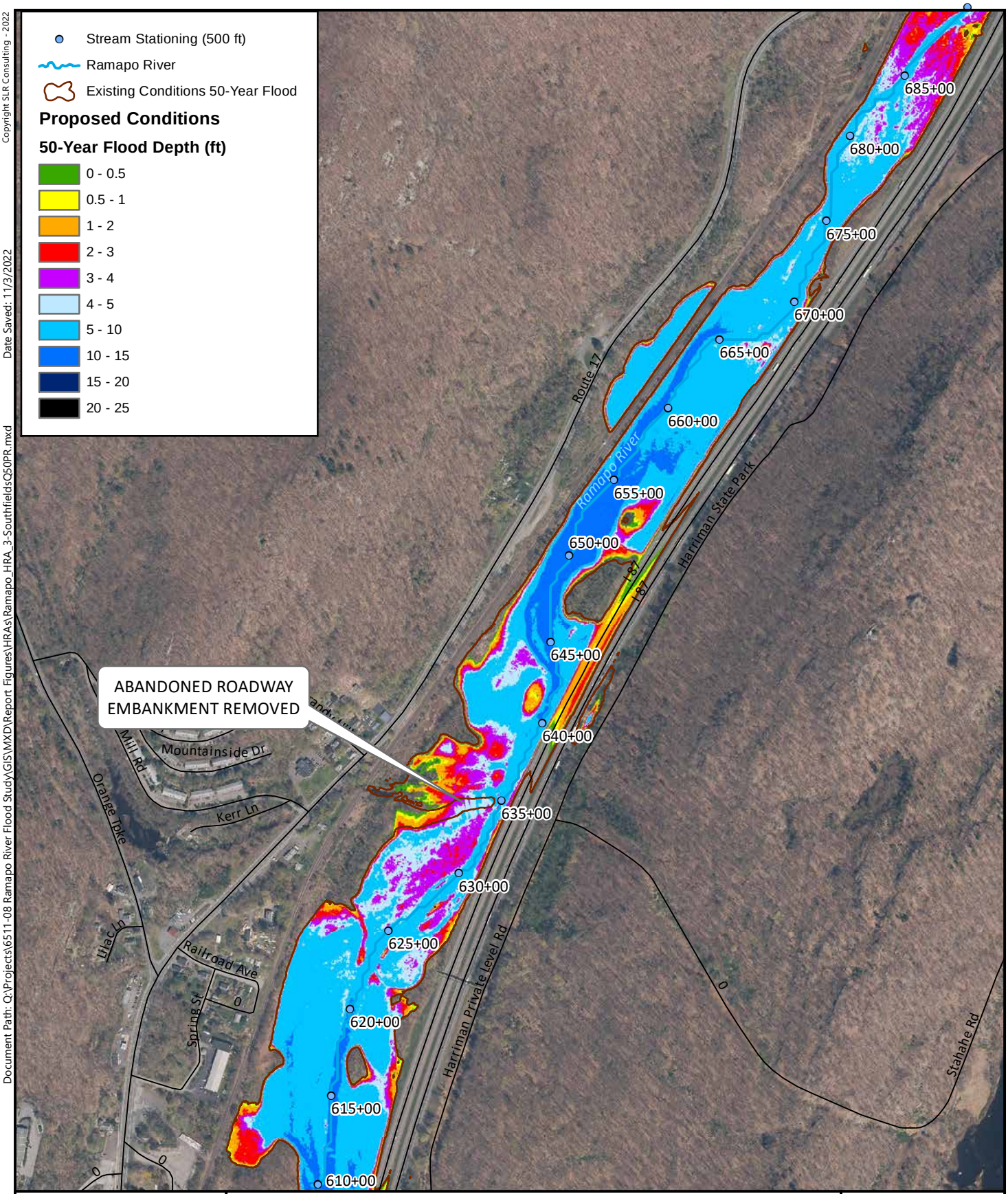
PROJ. NO.

FIG. 4-39



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HRA #3 - SOUTHFIELDS - PROPOSED CONDITIONS 50-YEAR FLOOD

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Rockland and Orange Counties, NY

N

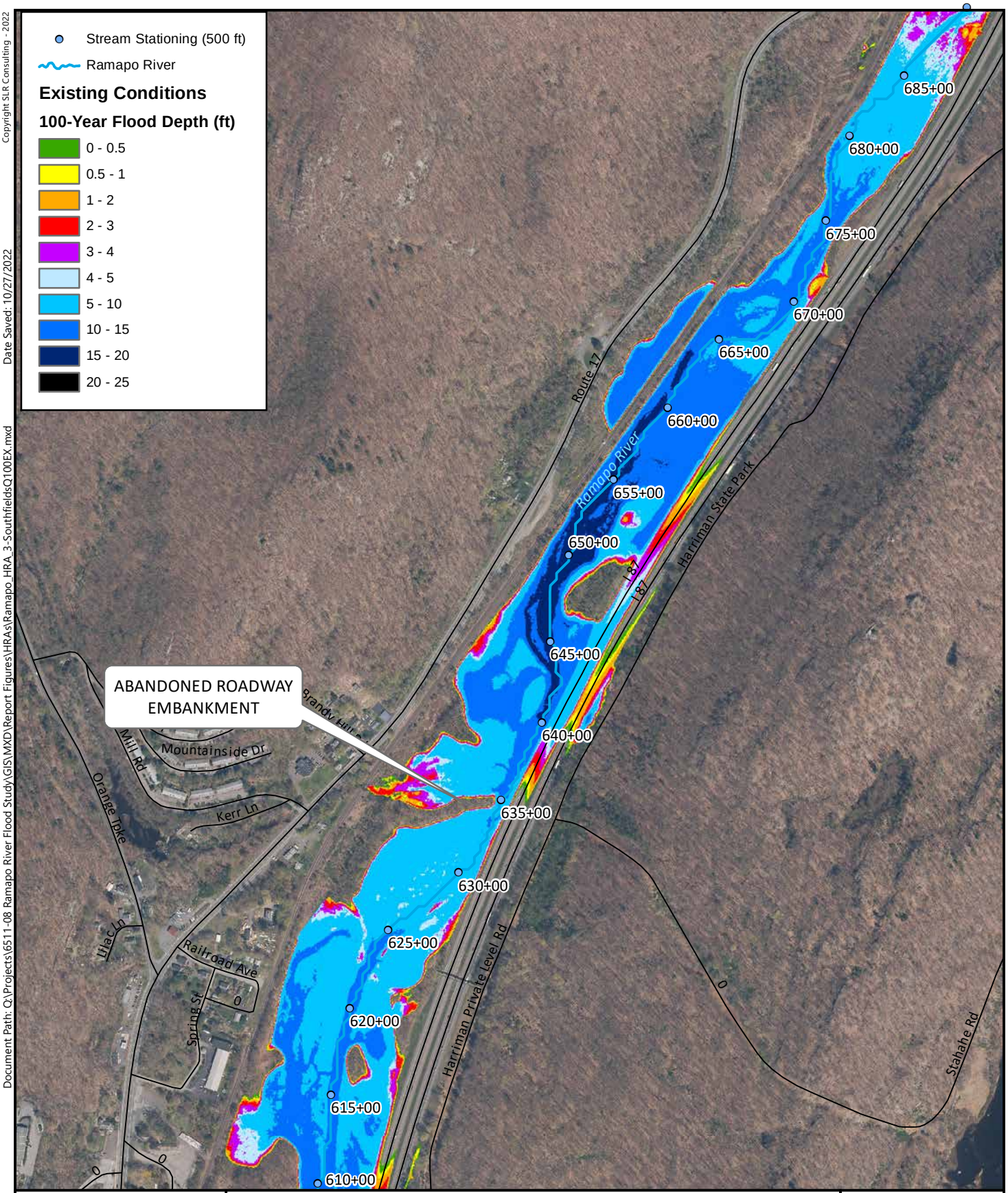
0 500 Feet

SCALE 1 " = 700 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-40



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HRA #3 - SOUTHFIELDS - EXISTING CONDITIONS 100-YEAR FLOOD

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Rockland and Orange Counties, NY

N

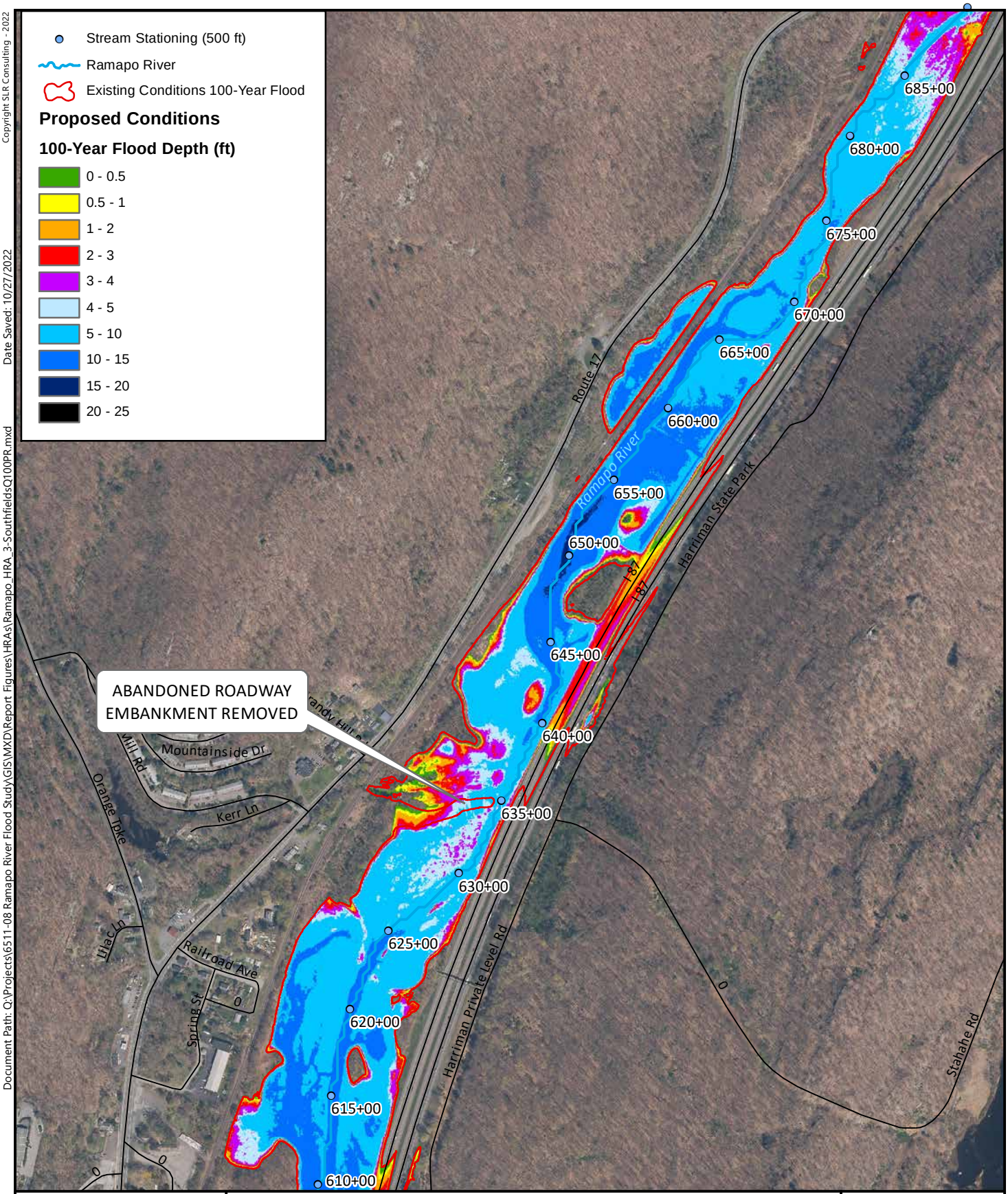
0 500
Feet

SCALE 1 " = 700 '

DATE 10/27/2022

16511.00008
PROJ. NO.

FIG. 4-41



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HRA #3 - SOUTHFIELDS - PROPOSED CONDITIONS 100-YEAR FLOOD

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N

0 500
Feet

SCALE 1 " = 700 '

DATE 10/27/2022

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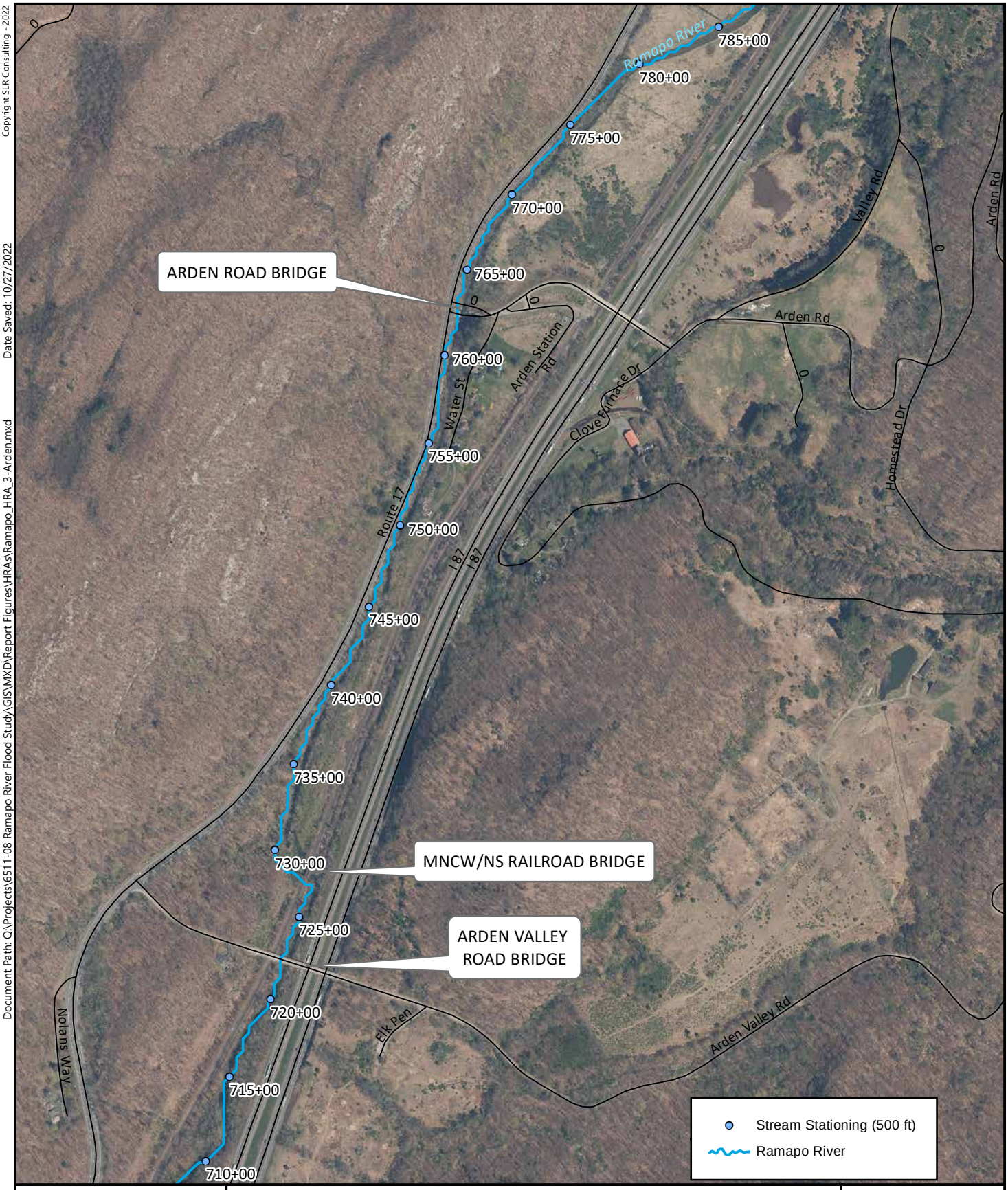
FIG. 4-42

4.3.5 HRA 3 ARDEN

The Arden area is depicted on Figure 4-43 and runs from STA 710+00 to 785+00. The Arden Valley Road bridge at STA 722+00 is a large, high bridge that crosses above the Ramapo River, I-87, and the railroad in a highly confined section of the valley (Figure 4-44). The bridge generates up to about 1 foot of backwaters in the 100-year flood, predominantly because one of the piers acts as obstruction, but the bridge is hydraulically adequate. The backwater from the Arden Valley Road bridge does not appear to significantly impact hydraulics at the railroad bridge 500 feet upstream at STA 727+00, where the railroad crosses the Ramapo River at an abrupt angle as the valley becomes confined by topography. The river takes two nearly 90-degree turns to pass perpendicularly under the railroad where it runs parallel upstream and downstream. This alignment, and the hydraulically undersized railroad bridge contribute to up to about 2.5 feet of additional 100-year flood depths upstream. This results in flooding of an about 1,200 foot length of NY-17 up to 2.7 feet deep; without the railroad bridge, about 150 feet of the road would flood up to about 0.3 feet deep. Replacement of the rail bridge with an adequately sized span is recommended; the available valley width downstream is about 130 feet. Existing conditions 50- and 100-year flood mapping in the Arden area is presented in Figures 4-45 and 4-46, respectively.

At the Arden Road bridge at STA 762+50, Arden Road crosses high above the railroad and Thruway on the left (east) side of the valley, traverses about 500 feet laterally across the floodplain on an up to 30-foot-high embankment shared with Arden Station Road, and crosses the Ramapo River with a 44-foot-span bridge. The Arden Road crossing can be seen in Figures 4-43 and 4-47. This county-owned bridge was built in 1930 and is modeled as being impacted by the 25-year flood event and generating up to 2.5 feet of additional backwater flooding in the 100-year flood event. This causes flooding of a 650-foot length of the southbound Thruway lanes and about a mile of railroad in the 100-year discharge. This also exacerbates flooding of over a mile-long stretch of NY-17 upstream; under existing conditions, most of this length of road is modeled as being under at least 4 feet of 100-year floodwaters, with some sections nearly 9 feet deep. Increasing this bridge span to 200 feet, including removal of about 150 feet of the embankment on the left (east) bank to restore floodplain connectivity through the crossing, is modeled as reducing 100-year flood elevations upstream by up to about 2.2 feet, with depths under projected future 100-year flood scenarios reduced by up to 2.4 feet. While a hydraulically adequate bridge can reduce upstream flooding substantially, NY-17 would remain impassable in its current configuration. Replacing the Arden Road bridge with a 200-foot or greater span, along with associated floodplain connectivity improvement (i.e., embankment removal), is recommended, and the feasibility of raising or relocating NY-17 should be explored. Figure 4-48 depicts modelled flooding depths under existing conditions in the 50-year flood event. Figure 4-49 depicts the 50-year flood event with the above recommendations implemented. Figures 4-50 and 4-51 depict existing and proposed conditions, respectively, during the 100-year flood event.



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HIGH RISK AREA #3 - ARDEN

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 700 '

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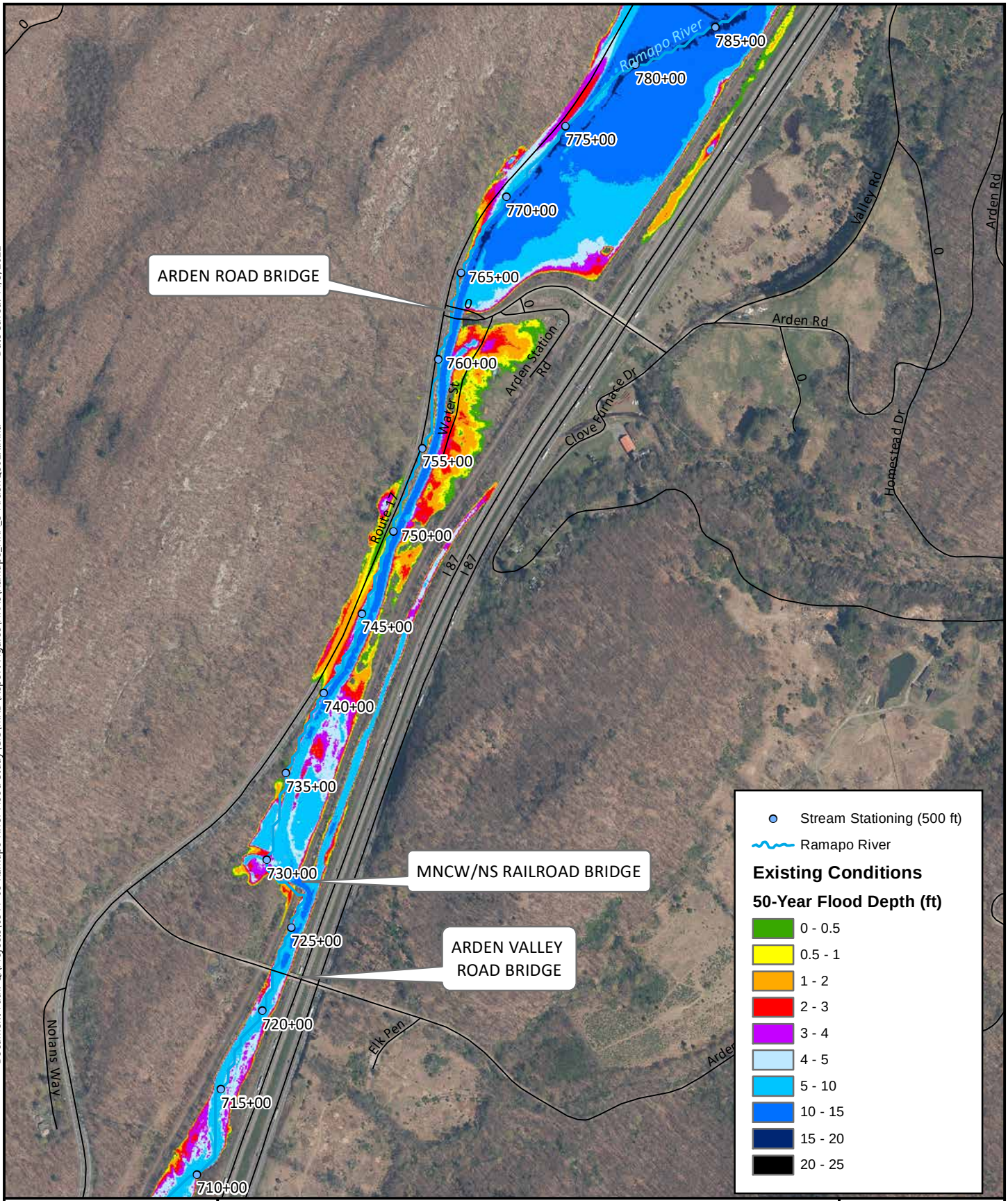
FIG. 4-43

Figure 4-44: The Arden Valley Road bridge at STA 722+00 crossing the Metro-North/ Norfolk Southern railroad, Ramapo River, and I-87

An alternative scenario was modeled at Arden Road that involved installation of a group of box culverts through the Arden Road embankment on the left overbank to provide floodplain relief while keeping the existing bridge in place. Five 5-foot-high, 10-foot-wide culverts were modeled as reducing both 50- and 100-year flood depths by about 0.6 feet, or by about 0.8 feet under projected future flood scenarios. Given the marginal flood mitigation provided by retrofitting the embankment with relief culverts compared to bridge replacement, which would come at a comparable cost, and, moreover, that the existing 93-year old bridge is likely due for replacement in the near future regardless, this option was not considered pragmatic and not advanced further.

At STA 832+00, the Ramapo River does another double dogleg to pass under the railroad. This bridge compounds the backwaters from the Arden Road bridge, adding up to 3 feet of 100-year backwater depths, exacerbating flooding of the railroad and I-87 upstream. Replacement of the existing 30-foot bridge with an approximately 120-foot span can reduce upstream 100-year flooding depths by up to about 1.8 feet and is recommended. With both the proposed Arden Road and railroad bridge replacements, flooding upstream of the railroad is reduced by up to 3 feet.



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HRA #3 - ARDEN - EXISTING CONDITIONS 50-YEAR FLOOD

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Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 700 '

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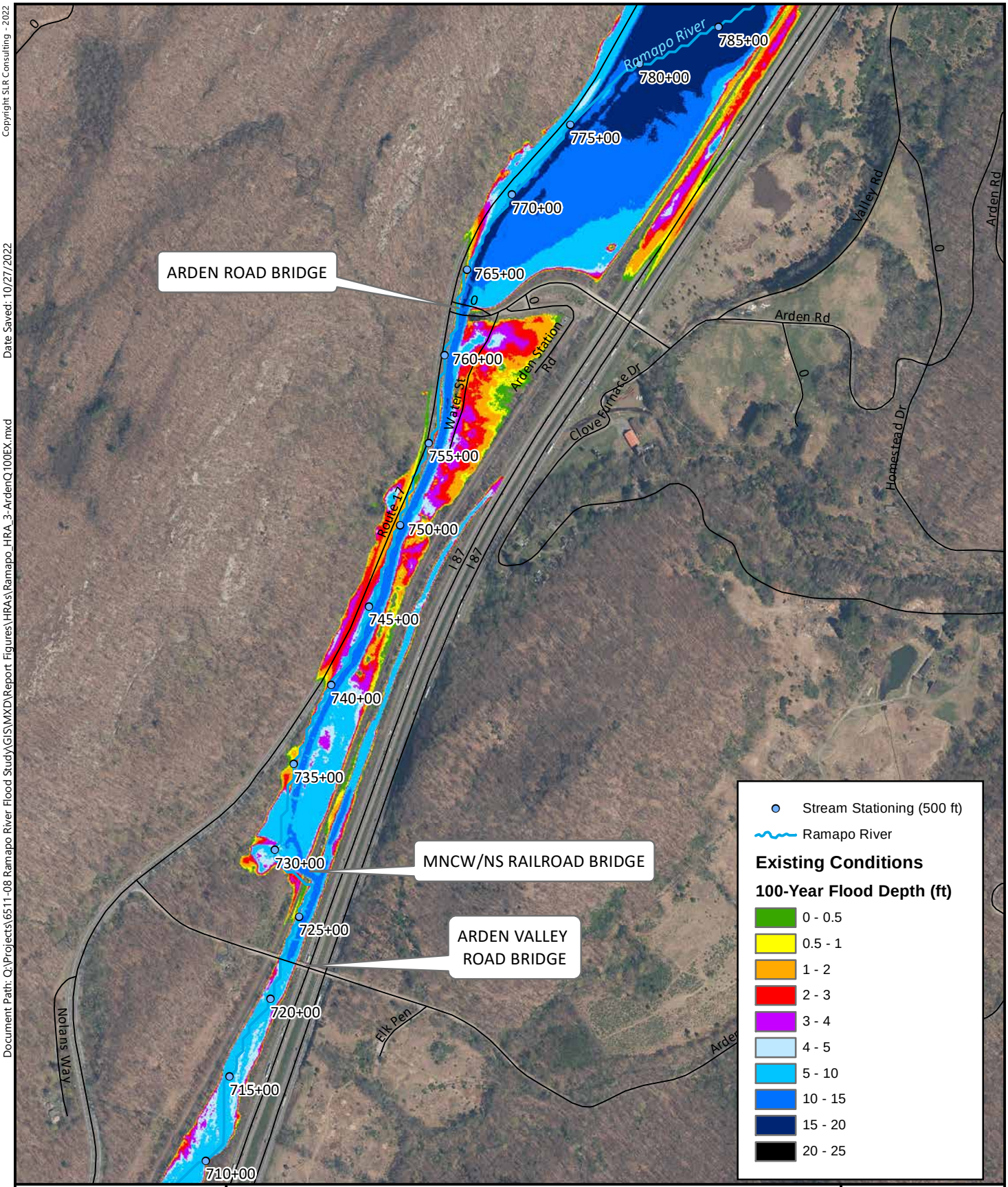
FIG. 4-45



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HRA #3 - ARDEN - EXISTING CONDITIONS 100-YEAR FLOOD

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N

0 500

Feet

SCALE 1 " = 700 '

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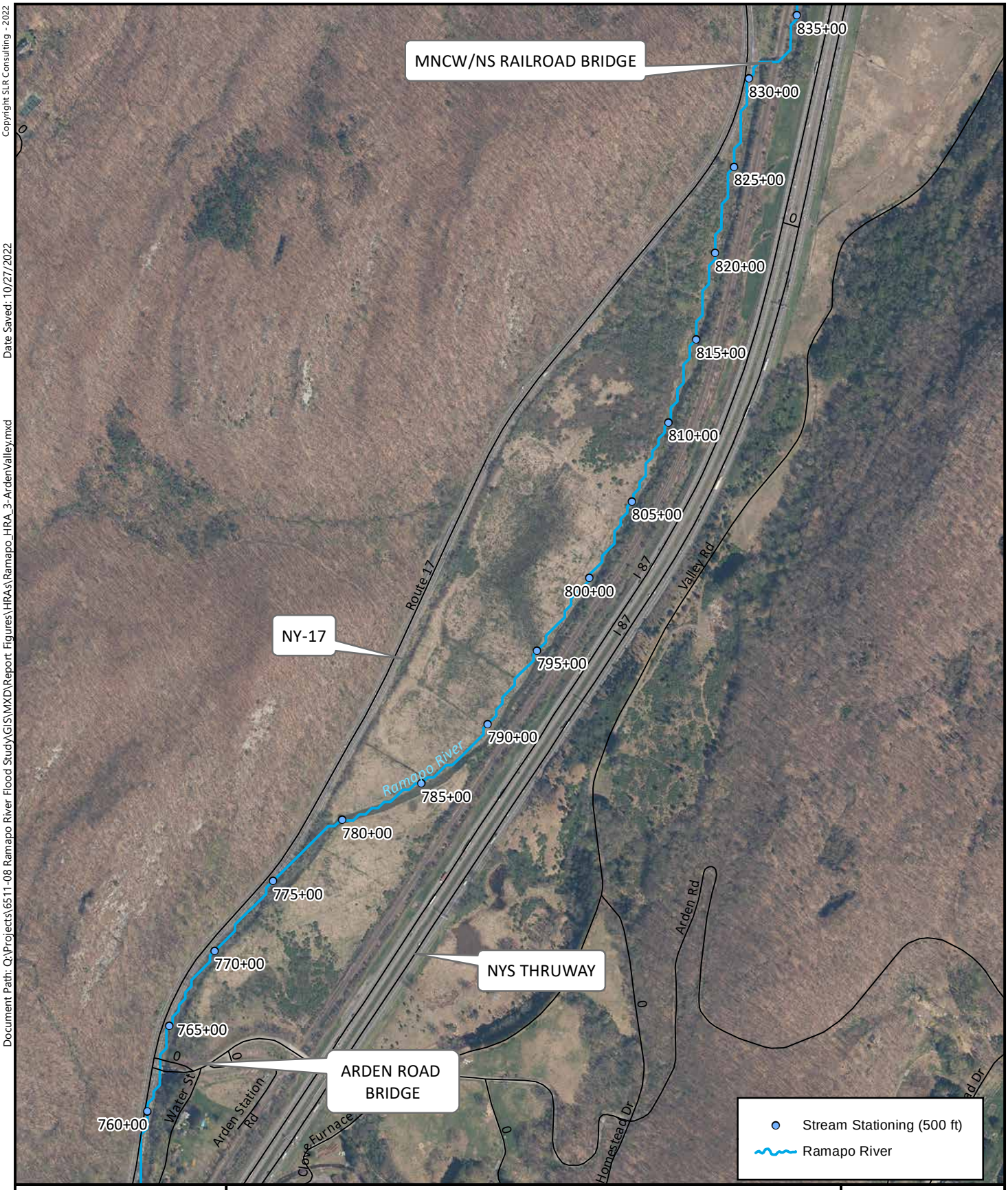
FIG. 4-46



Date Saved: 10/27/2022

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HRA #3 - ARDEN ROAD BRIDGE

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SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 700 '

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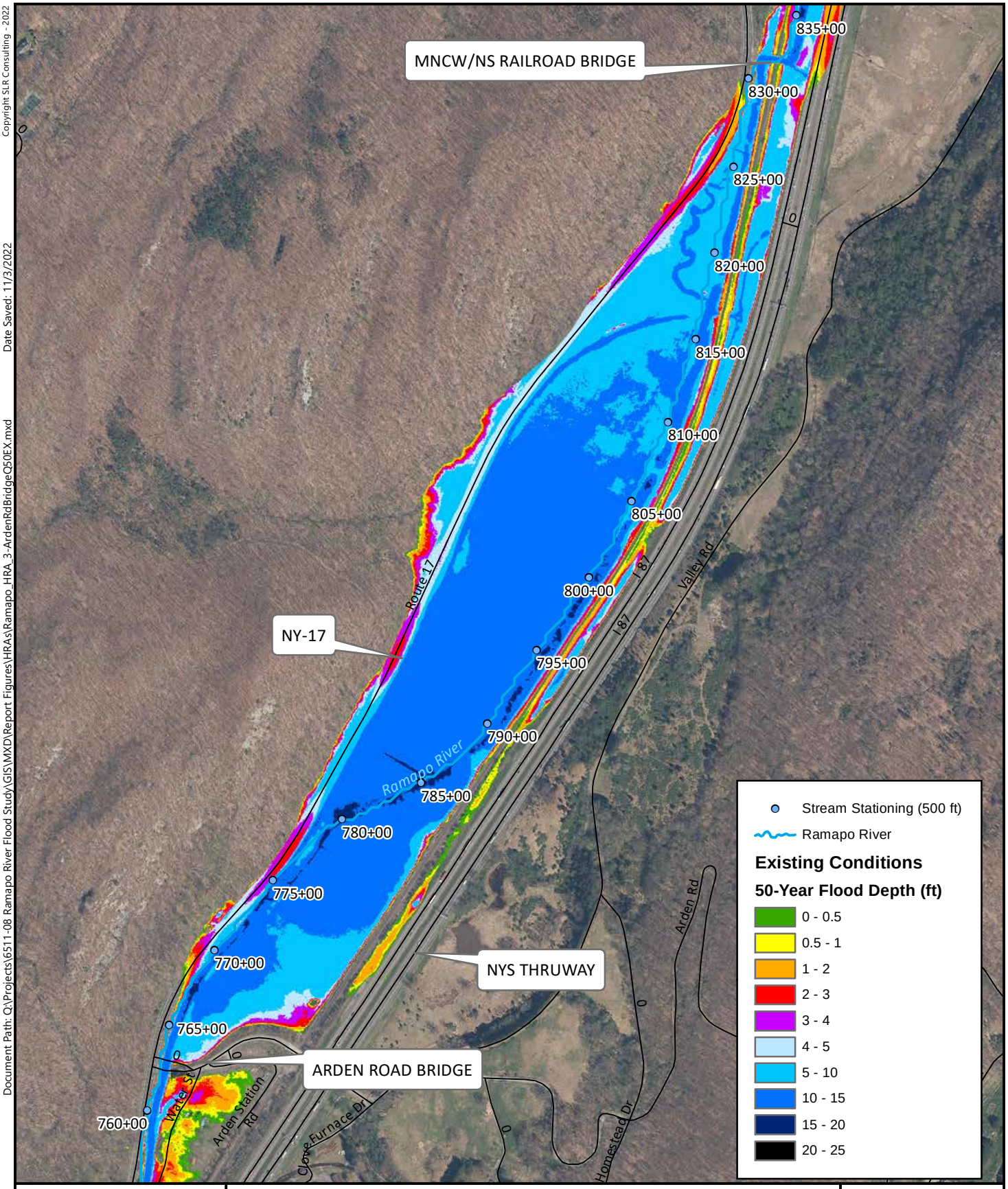
FIG. 4-47



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HRA #3 - ARDEN RD BRIDGE - EXISTING CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

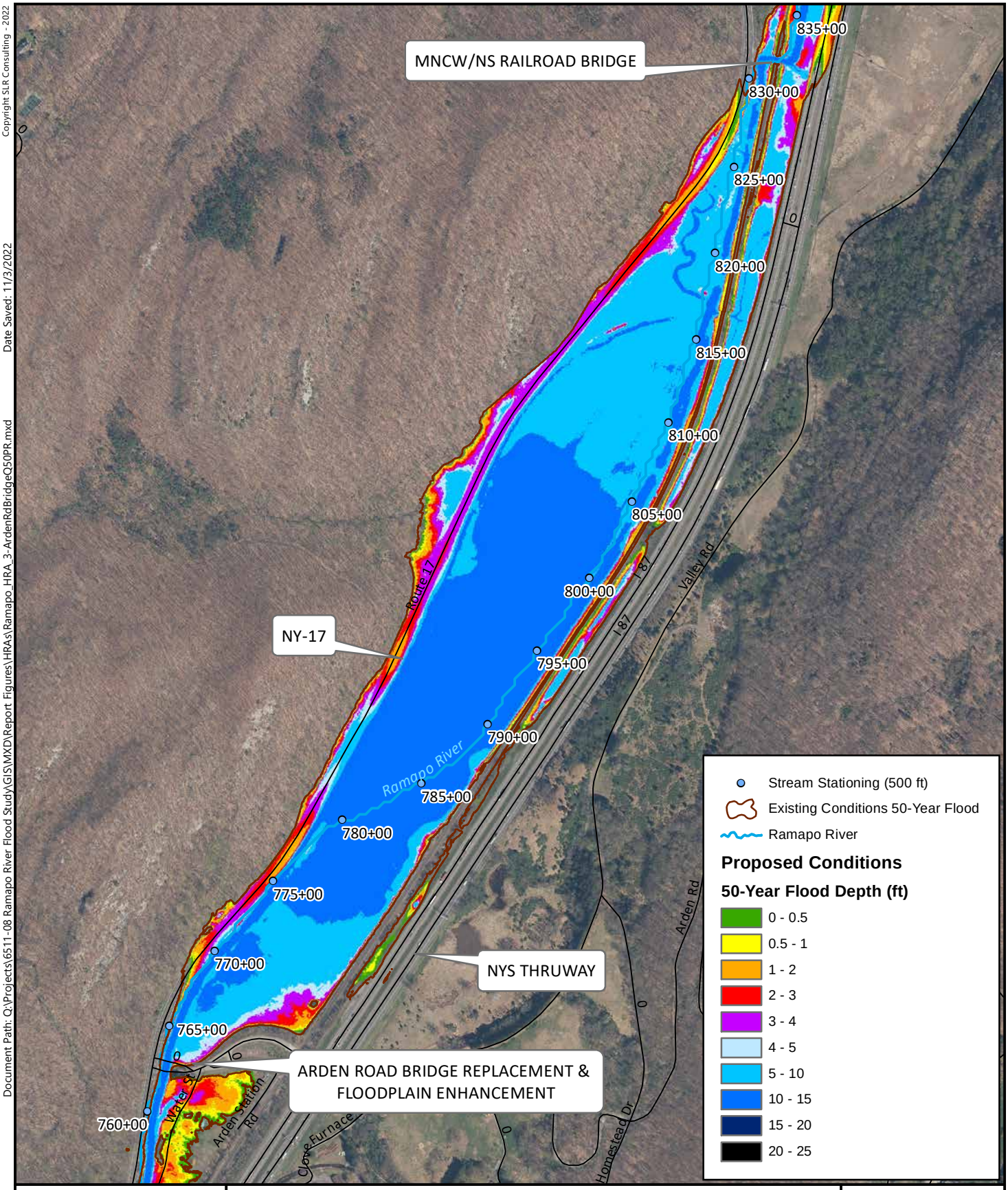
0 500 Feet

SCALE 1 " = 700 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-48



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HRA #3 - ARDEN RD BRIDGE - PROPOSED CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

0 500 Feet

SCALE 1 " = 700 '

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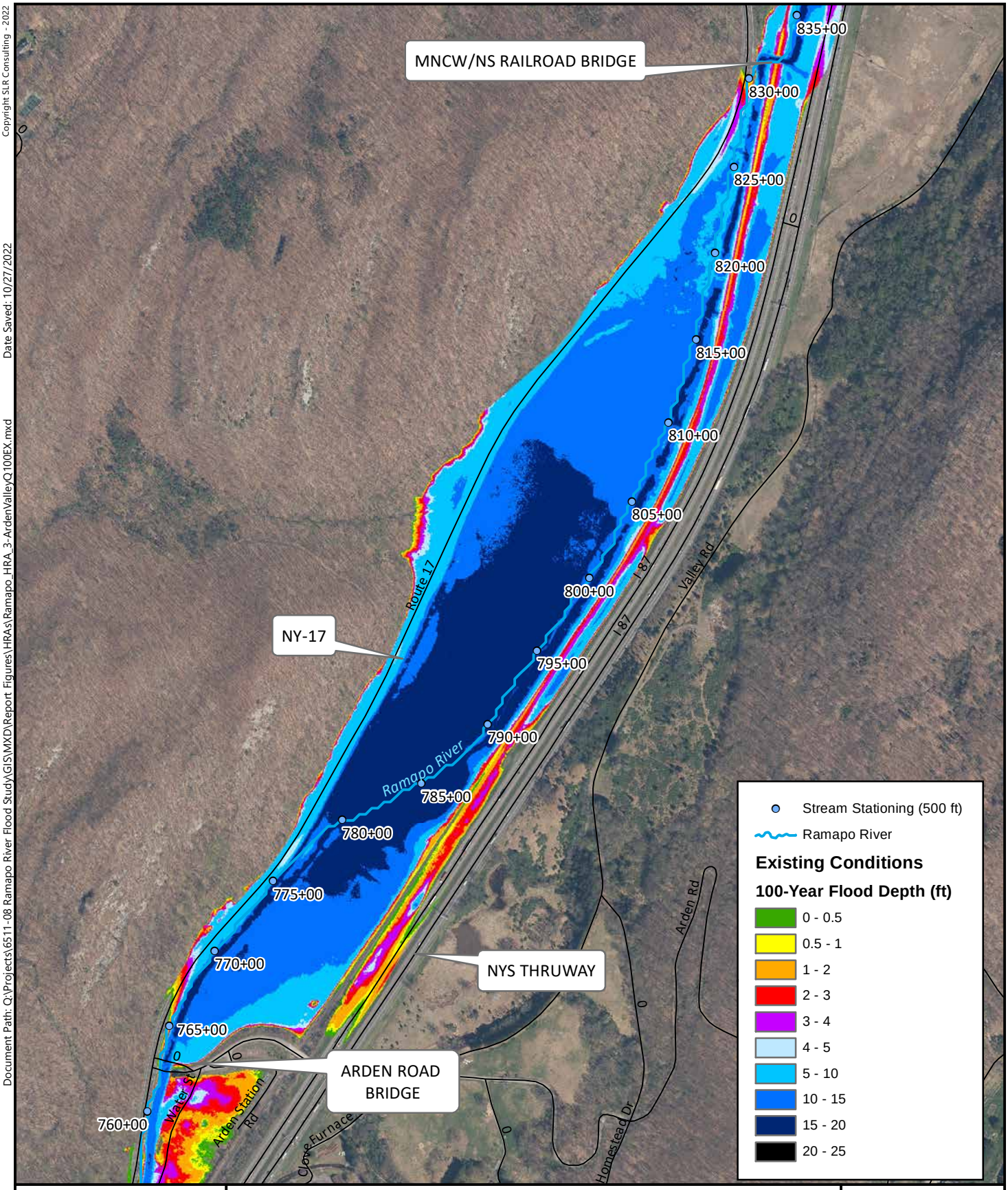
16511.00008 PROJ. NO.

FIG. 4-49



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HRA #3 - ARDEN ROAD BRIDGE - EXISTING CONDITIONS 100-YR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

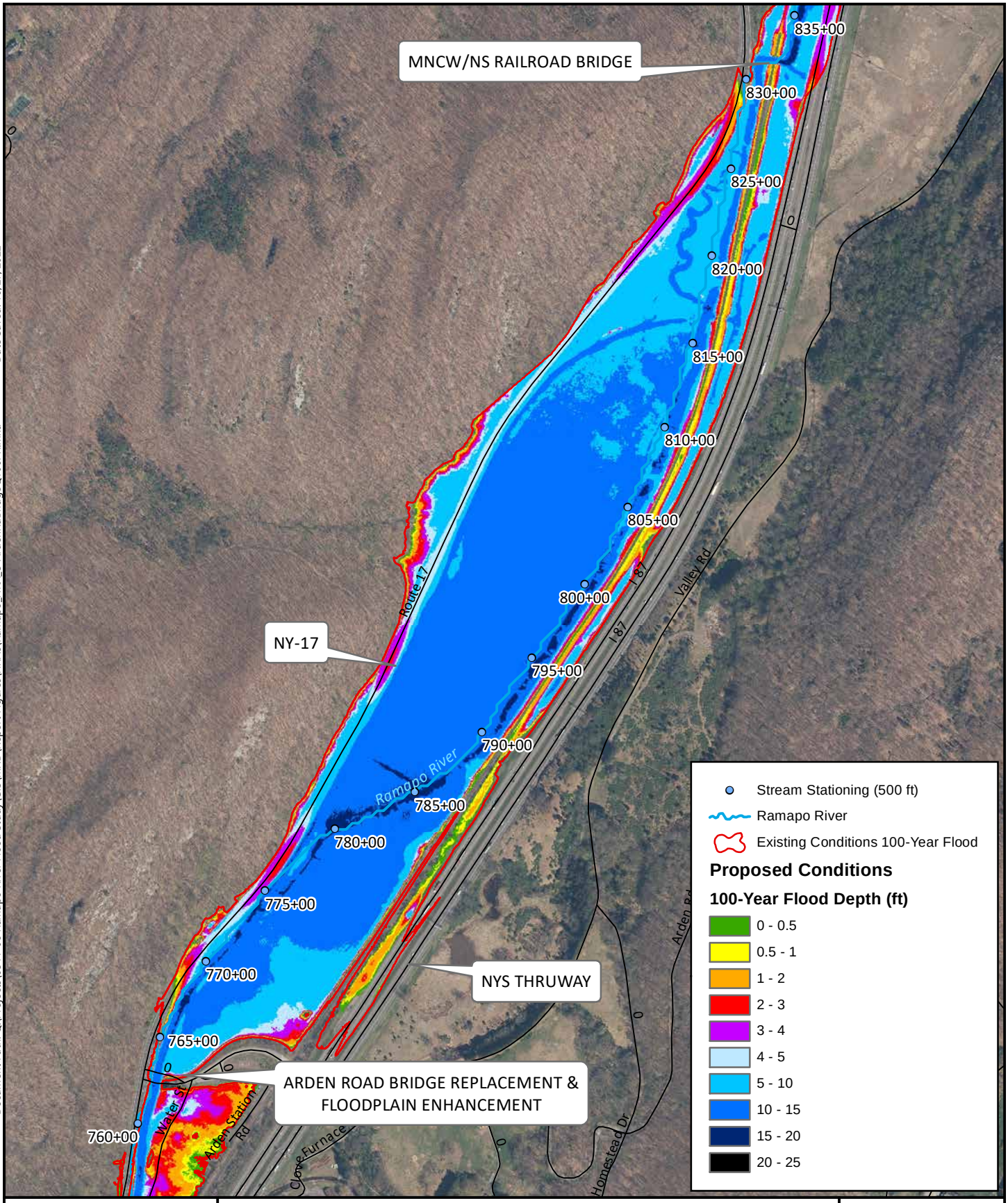
0 500
Feet

SCALE 1 " = 700 '
DATE 10/27/2022
16511.00008
PROJ. NO.

FIG. 4-50

Date Saved: 10/27/2022

Document Path: Q:\Projects\6511-08 Ramapo River Flood Study\GIS\MXD\Report Figures\HRAs\Ramapo_HRA_3-ArdenRdBridgeQ100PR.mxd



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HRA #3 - ARDEN RD BRIDGE - PROPOSED CONDITIONS 100-YR FLOOD

Ramapo River Flood Mitigation Study

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Rockland and Orange Counties, NY

N

0 500 Feet

SCALE 1 " = 700 '

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16511.00008 PROJ. NO.

FIG. 4-51

4.4 HIGH RISK AREA 4

HRA 4 is primarily located in the village of Harriman, beginning at the village limits at STA 815+00 and extending to the boundary with Monroe at STA 991+00. A portion of HRA 4 falls within a census block that has been designated as a Disadvantaged Community. Portions of HRA 4 have also been designated as Potential Environmental Justice Areas. HRA 4 is shown in Figure 4-52.

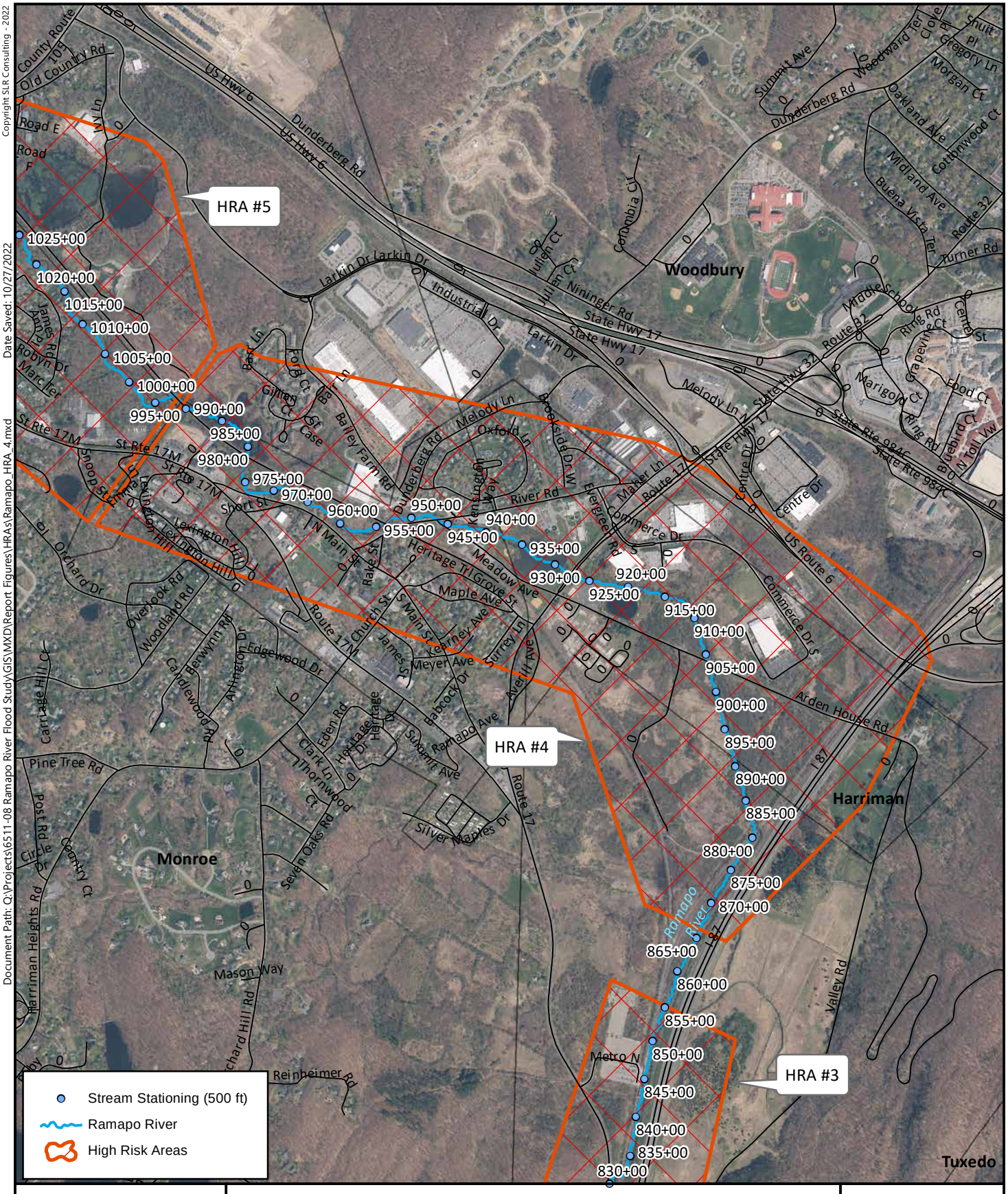
4.4.1 HRA 4 HARRIMAN DOWNSTREAM

The downstream portion of HRA 4 is depicted in Figure 4-53. Effective FEMA HEC-RAS modeling for the Ramapo River that was developed in 2007 terminates at a railroad bridge at STA 880+00, approximately 1,000 feet downstream of the Harriman village limits. The FEMA model was run with a normal depth downstream boundary condition, which does not account for the backwater influence of the structures downstream. To more accurately reflect flood conditions in the downstream portion of the village of Harriman, water surface elevations determined from modeling the downstream reach were used to replace the normal depth boundary condition for the respective floods. This increases existing conditions 100-year flood depths upstream by about 6 feet compared to the FEMA model. This additional depth is due to backwaters generated by downstream structures and downstream valley slope and confinement.

As much as 3 feet of backwaters from the Arden Road (STA 762+50) and railroad (STA 832+00) bridges in HRA 3 carry almost a mile upstream into HRA 4, reaching the NY-17 bridge at STA 927+50. Even without the tailwater control on the railroad bridge at STA 880+00 and the Arden House Road bridge at STA 904+00, these bridges are undersized. In the 100-year flood, Arden House Road is modeled as overtopping by up to 6 feet along over 1,500 feet as it traverses low across this broad section of floodplain. So much of the roadway overtops that while the bridge itself is a lateral constriction in the channel, the roadway embankment does not significantly obstruct longitudinal downstream floodplain flows, and crossing does not generate substantial backwaters compared to natural conditions in the 25-year and greater flood events. Several commercial facilities are located upstream of the Arden House Road bridge, some of which may be subjected to flooding beginning in the 25-year flood event. While the flooding in this area is exacerbated by the backwaters from the four undersized bridges downstream, much of the flood-prone area upstream of the Arden House Road bridge is within the river's natural floodplain along this low-gradient reach of the Ramapo River.

When the privately owned Arden House Road bridge is due for replacement, a minimum 65-foot span that meets NYSDEC Stream Crossing Guidelines is recommended; however, this will not provide significant flood mitigation benefits or alleviate overtopping of the low-lying roadway in severe flood events, even with the undersized bridges downstream replaced as well. Any elevation of the road embankment to prevent overtopping would necessitate a commensurate increase in bridge span to avoid increasing upstream flooding (i.e., the flood flows that currently would overtop the road would instead have to be accommodated by the replacement bridge), so the additional backwaters from the raised embankment do not exacerbate flooding at upstream properties.

Existing conditions flood mapping in the 50-year flood event is shown in Figure 4-54. Existing conditions flood mapping in the 100-year flood event is shown in Figure 4-55.



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RAMAPO RIVER - HIGH RISK AREA #4

Ramapo River Flood Mitigation Study
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Rockland and Orange Counties, NY

N
0 500 1,000
Feet

SCALE 1 " = 1,600 '
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FIG. 4-52

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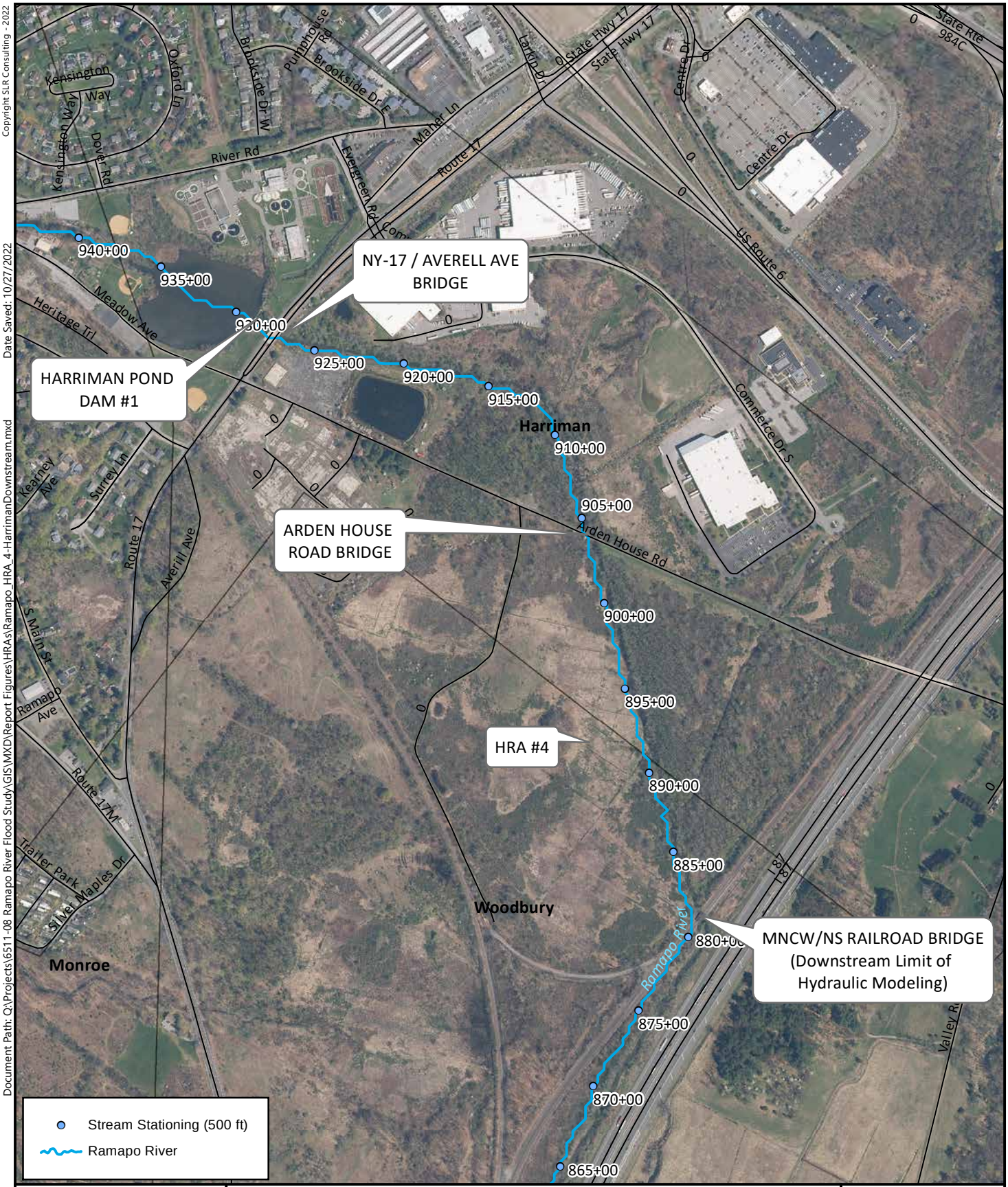

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HRA #4 - HARRIMAN DOWNSTREAM

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

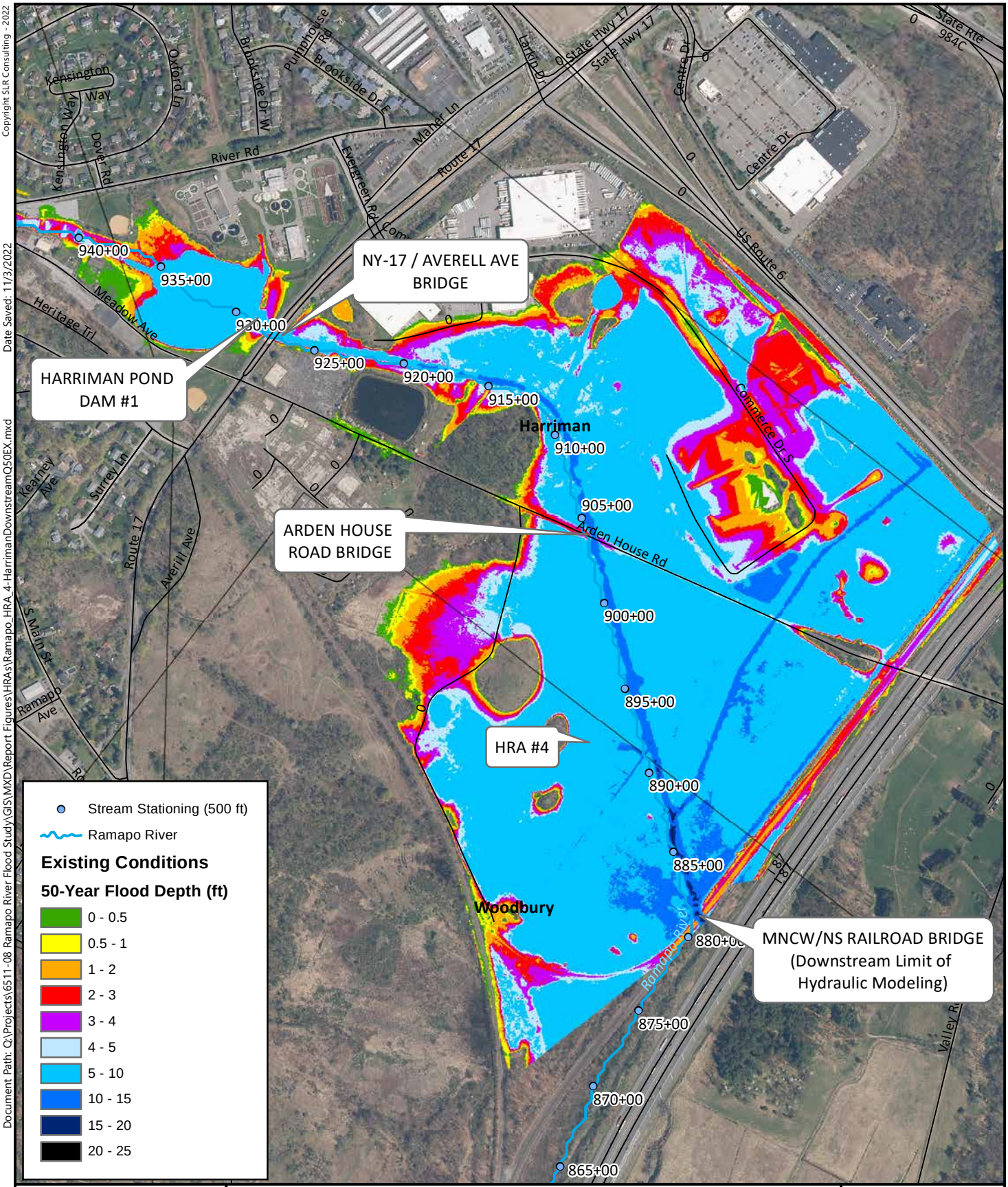
0 500
Feet

SCALE 1 " = 700 '

DATE 10/27/2022

16511.00008
PROJ. NO.

FIG. 4-53



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HRA #4 - HARRIMAN DOWNSTREAM - EXISTING CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study

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Rockland and Orange Counties, NY

N

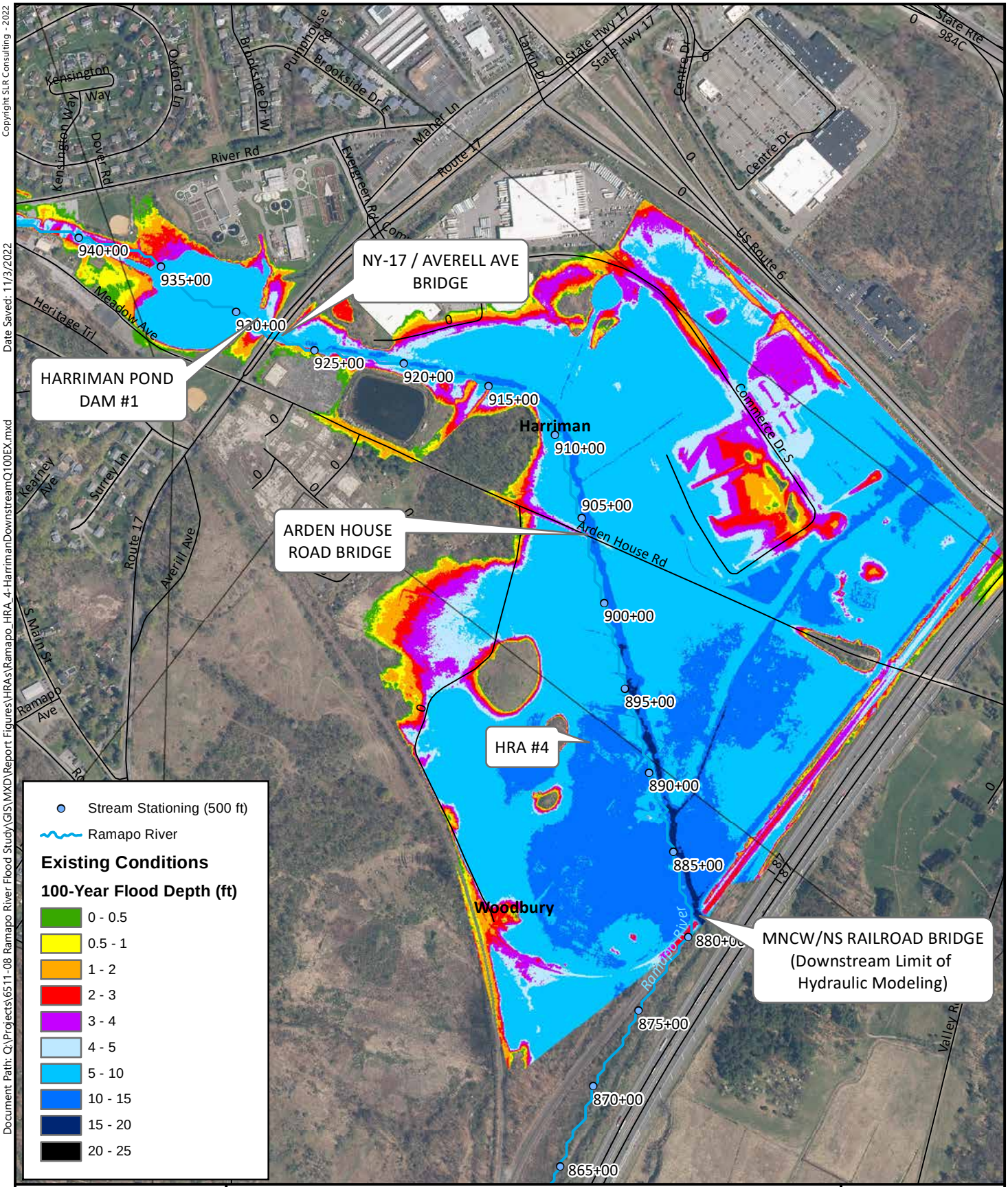
0 500 Feet

SCALE 1 " = 700 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-54



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HRA #4 - HARRIMAN DOWNSTREAM - EXISTING CONDITIONS 100-YR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

0 500 Feet

SCALE 1 " = 700 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-55

4.4.2 HRA 4 HARRIMAN UPSTREAM

The upstream portion of HRA 4 is shown in Figure 4-56. The existing NY-17 (Averell Avenue) bridge crossing at STA 928+00 is undersized and does not meet current NYSDOT freeboard requirements in the 50- and 100-year flood events. In the existing conditions 100-year flood event, the bridge generates about 1.3 feet of backwaters over approximately 100 feet upstream to the toe of Harriman Pond Dam #1 at STA 929+00. Modeling indicates that the bridge backwater reaches the dam beginning in the 50-year flood event and impacts the hydraulic performance of the dam's spillway beginning in the 100-year flood event. However, this bridge is itself impacted by the backwaters from several undersized bridges downstream in HRA 4 and in HRA 3. Without the existing tailwater control, the performance of the Averell Avenue bridge improves, upstream water surface elevations are reduced by approximately 1 foot in the 50- and 100-year floods, and the influence on spillway hydraulics at the Harriman Pond Dam #1 would be significantly reduced, although the bridge would still not meet NYSDOT freeboard requirements. A replacement 150-foot bridge was modeled as hydraulically adequate for the projected future 50- and 100-year floods, assuming that the downstream tailwater controls are removed. If existing conditions downstream are maintained, this proposed bridge replacement would not significantly improve upstream flooding. When it is due for replacement, the proposed approximately 150-foot span at the NY-17/Averell Avenue crossing is recommended in the ideal scenario wherein the undersized bridges downstream in HRA 4 and in the upper reaches of HRA 3 have been replaced or are scheduled for replacement as well. Because this may not be the case, hydraulic analyses associated with the bridge replacement should consider the influence of downstream crossings and the new bridge geometry adjusted as needed.

Harriman Pond Dam #1 (NYSDEC ID:195-0418; Federal ID: NY13191) is a municipally owned, Class A – low hazard, 10-foot-tall earth and concrete gravity dam used for recreation, built in 1913 and last inspected in 2008. The dam increases upstream 100-year flood depths by up to about 1.3 feet, which affects flooding at an adjacent park and an about 200-foot-long stretch of Meadow Avenue, which is modeled as flooding by up to about 0.4 feet under existing conditions. The wastewater treatment plant on the upstream left bank to the north is not modeled as being subject to 100-year flooding under current or projected future flood scenarios.

Harriman Pond Dam #2 (NYSDEC ID: 195-0419; Federal ID: NY13192) is located at STA 940+00. This Class A – low hazard concrete gravity dam was constructed in 1912, last inspected in 1973, and is privately owned. The structure generates up to about 1.6 feet of additional backwater flooding in the 100-year flood event. Modeling shows that this can contribute to flooding on property on the left bank upstream. This small 4-foot-high dam's listed purpose is recreation. It is recommended that the feasibility of dam removal or modification to reduce upstream flooding be explored.

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HRA #4 - HARRIMAN UPSTREAM

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 700 '

DATE 10/27/2022

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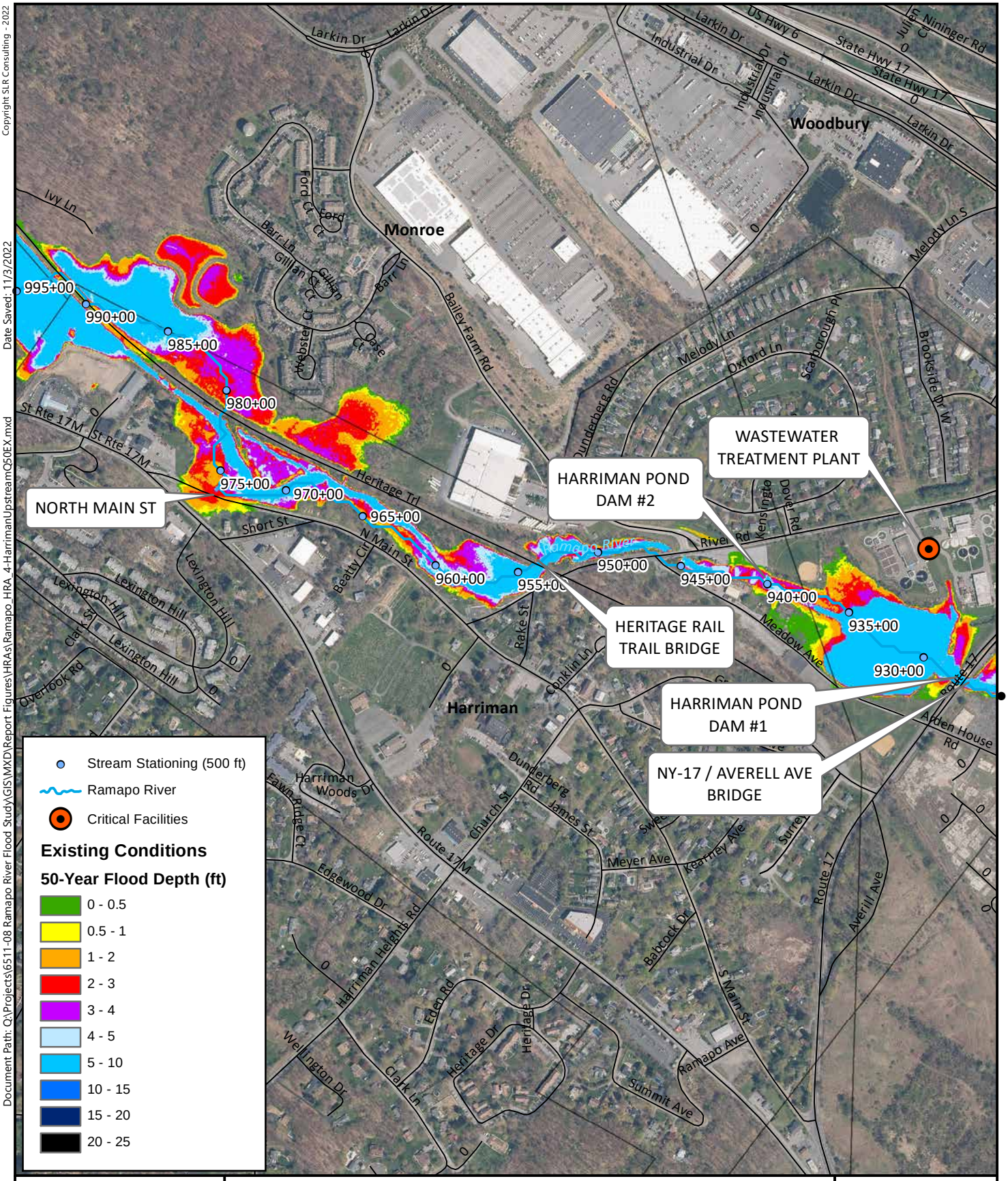
FIG. 4-56

Modeling indicates that the River Road bridge at STA 946+00 does generate some backwaters, although no upstream properties or infrastructure appears to be impacted. The bridge may be impacted by floodwaters beginning in the 50-year flood event. When it is due for replacement, an approximately 100-foot span is recommended along with a reduced skew angle, as practical, to increase the effective hydraulic opening of the bridge.

A dam at STA 952+00 appears to have been breached or removed between 2010 and 2013, which has lowered upstream 100-year water surface elevations by as much as 1.6 feet. The Heritage Rail Trail bridge just upstream at STA 953+50 is adequate for current flows, although under projected future flood conditions the bridge may be impacted by the 100-year flood event.

Near STA 975+00, two businesses and a section of North Main Street are prone to flooding beginning in the estimated 10-year flood event, shown in Figure 4-58A. This flooding occurs at a low point in the roadway just east of its intersection with NY-17M where for about 400 feet the grade drops down to the floodplain from a higher terrace as it follows the Ramapo River on its right (south) bank; the properties are located in a low-lying area on the south side of North Main Street. This area appears to be naturally flood prone, so relocation of the businesses is recommended. The affected section of North Main Street can be made redundant by Short Street, which is not flood prone and connects North Main Street to NY-17M just 500 feet away. The intermediate section of North Main Street could be removed and this section of floodplain reclaimed. Exploring the feasibility of relocating the flood-prone businesses and making any necessary improvements to Short Street to eliminate the flood-prone section of North Main Street is recommended.



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HRA #4 - HARRIMAN UPSTREAM - EXISTING CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

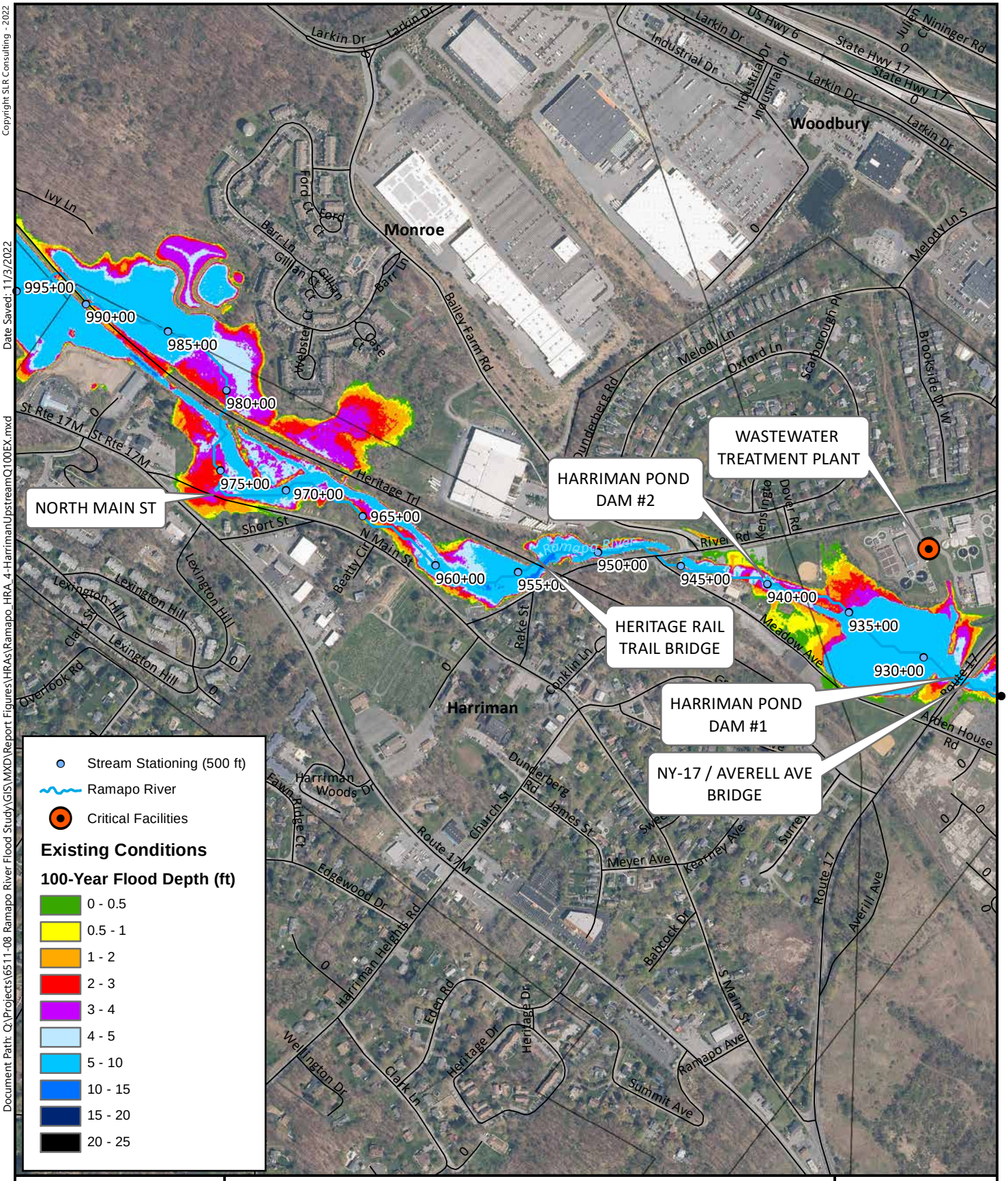
0 500 Feet

SCALE 1 " = 700 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-57



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HRA #4 - HARRIMAN UPSTREAM - EXISTING CONDITIONS 100-YR FLOOD

Ramapo River Flood Mitigation Study
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Rockland and Orange Counties, NY

N

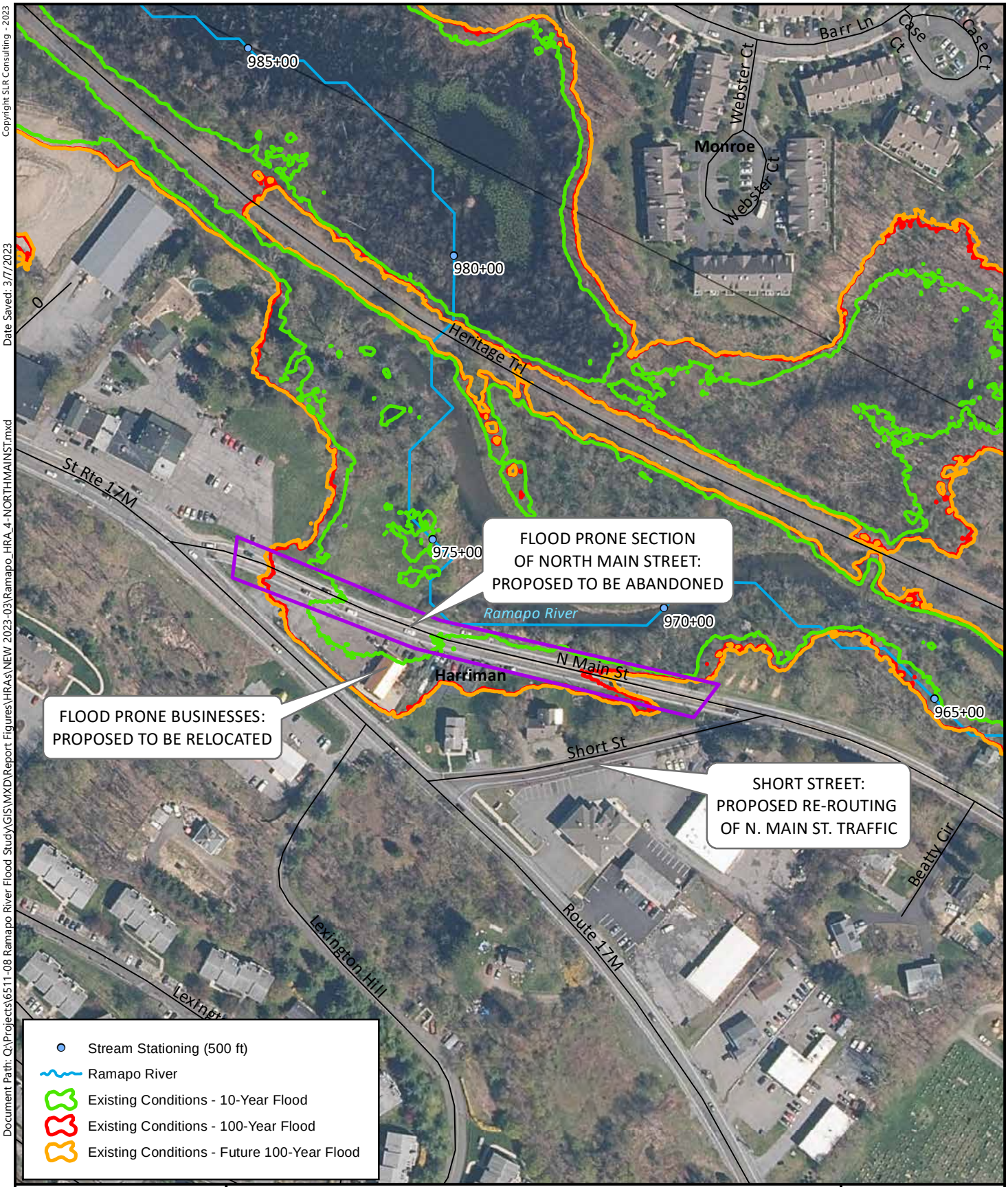
0 500
Feet

SCALE 1 " = 700 '

DATE 11/3/2022

16511.00008
PROJ. NO.

FIG. 4-58



Date Saved: 3/7/2023

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HRA #4 - PROPOSED NORTH MAIN ST RELOCATION

Ramapo River Flood Mitigation Study
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Rockland and Orange Counties, NY

N

0 210
Feet

SCALE 1 " = 200 '

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FIG. 4-58A

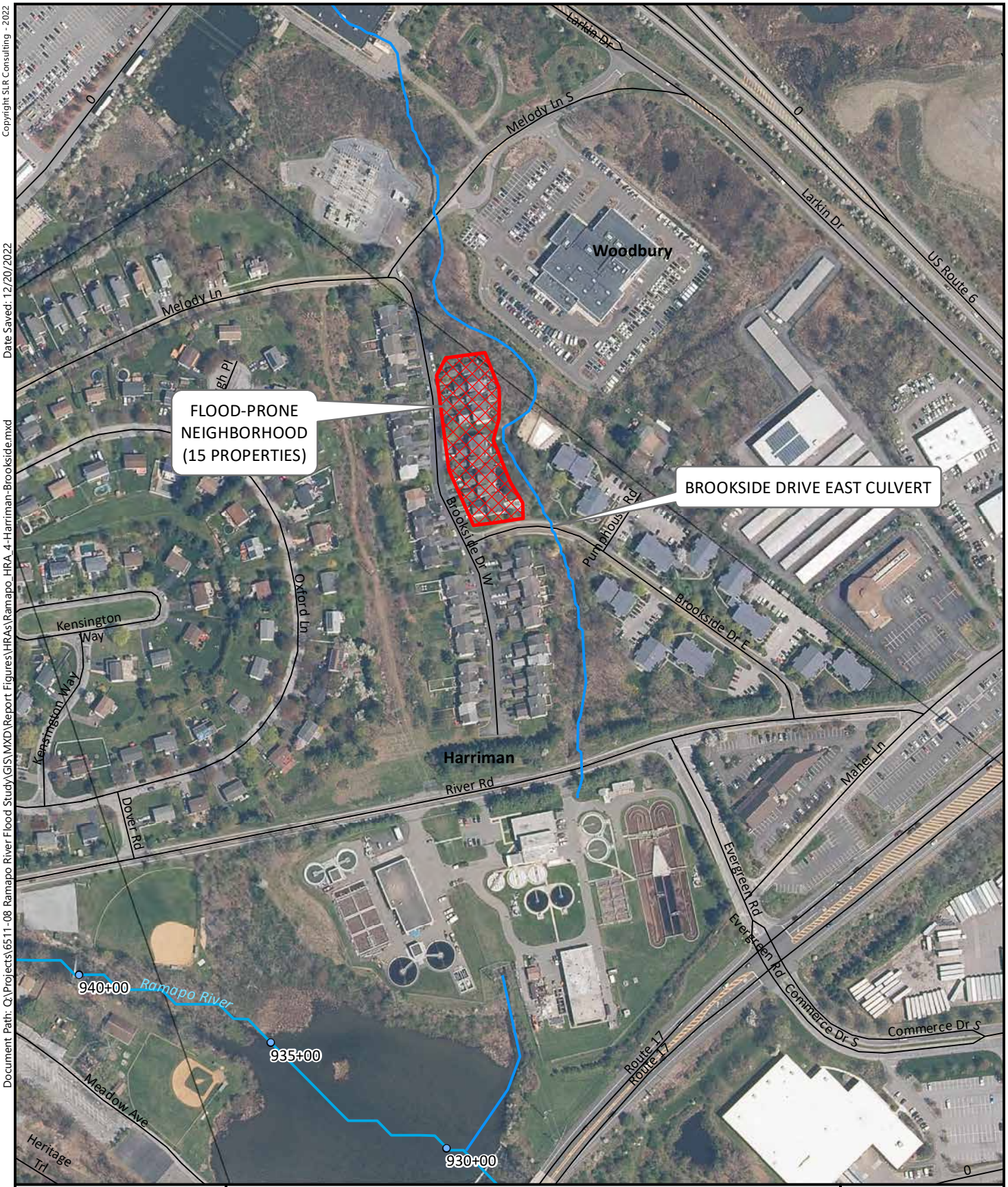
4.4.3 HRA 4 BROOKSIDE DRIVE

Flooding has been reported in the Brookside Drive neighborhood along a small tributary that joins the Ramapo River near STA 930+00 in the pond formed by Harriman Pond Dam #1. The area is mapped in Figure 4-59. Brookside Drive East is carried over this tributary by an approximately 6-foot-diameter, 130-foot-long CMP culvert (Figure 4-60). Flooding has been reported at 15 properties located upstream of this culvert, on the right (west) bank of this tributary, shown in Figure 4-61. Hydraulics of the culvert were assessed using the Federal Highway Administration's HY-8 computer software. Results indicate that the structure is undersized and contributes to increased upstream flood depths.

Under clear water conditions, assuming no obstruction of the existing culvert by wood or other debris, overtopping of the roadway is expected beginning in the estimated 50-year flood (300 cfs) while backwaters are sufficient to impact the affected properties upstream beginning in the estimated 25-year flood (240 cfs). Partial or complete occlusion of the culvert by debris can exacerbate upstream flood depths, causing more severe flooding or impact to properties in lesser-magnitude floods as well.

A proposed replacement 18-foot span, 8-foot rise (with 2 feet of embedment) concrete box culvert was modeled as reducing 100-year flood (370 cfs) depth upstream by nearly 5 feet, and this alternative is recommended. Under clear water conditions, modeling indicates that with this proposed replacement the culvert's backwater would no longer impact the adjacent flood-prone properties up to and including in the estimated 500-year flood (560 cfs). This significantly larger structure would also be far less prone to debris jamming than the existing undersized culvert.

Several other potentially inadequate culvert crossings are located along this tributary to the Ramapo River, which also appears to be routed underground beneath the Harriman Wastewater Treatment Plant downstream of River Road, although no reports of associated flooding were received other than upstream of the Brookside Drive East crossing.



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HRA #4 - HARRIMAN - BROOKSIDE DRIVE EAST CULVERT

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

0 300
Feet

SCALE 1 " = 300 '

DATE 12/20/2022

16511.00008
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FIG. 4-59

Figure 4-60: Downstream outlet of Brookside Drive East culvert crossing

Figure 4-61: Flood-prone properties upstream of the Brookside Drive East culvert crossing, view to the northwest

4.5 HIGH RISK AREA 5

HRA 5 begins at the Monroe/Harriman village limits at STA 991+00 and extends upstream through the village of Monroe to the boundary with the town of Monroe at STA 1225+00 near the headwaters of the Ramapo River. A portion of HRA 5 falls within a census block that has been designated as a Disadvantaged Community. Portions of HRA 5 have also been designated as Potential Environmental Justice Areas. A map of HRA 5 is shown in Figure 4-62.

Several areas within HRA 5 are residential neighborhoods that appear to be in areas that are naturally flood prone to some degree. The area near the intersection of Marc Terrace and James Road is at a relatively low elevation alongside a tributary that joins the Ramapo River at STA 1003+00, shown in Figure 4-65A. Three repetitive loss properties are reported in this residential neighborhood. Modeling indicates that 2 buildings are impacted by the 10-year flood event on Ramapo River, 6 homes in the 25-year flood, 12 buildings in the 50-year flood, which includes 2 businesses, and 17 and 22 structures in the current and projected future 100-year floods, respectively. Nearly 40 homes and businesses in this area are vulnerable to 500-year flooding. These counts only include where flood mapping from hydraulic modeling indicates flooding at primary buildings on a property (e.g., houses but not sheds); many more properties are modeled as affected in other ways (e.g., lawns, outbuildings, driveways, parking lots).

Flooding in the Marc Terrace/James Road neighborhood is primarily caused by backwaters from the downstream constriction between the Heritage Rail Trail embankment on the left/north bank and what is presumably floodplain fill associated with development between the river and NY-17M on the right/south bank. Removal of 2,100 linear feet of the 5- to 7-foot-high rail trail embankment near the Harriman/Monroe village limits between STA 967+00 and STA 992+00 to eliminate this constriction and restore floodplain connectivity through this reach was modeled as reducing both 50- and 100-year flood elevations at the Marc Terrace/James Road neighborhood by about 2.5 feet and removing several homes from the flood-prone area. Projected future 50- and 100-year flood elevations are both reduced by about 2.8 feet. 500-year flood depths are reduced by nearly 6 feet. While the rail trail embankment was modeled as being completely removed, similar hydraulic performance could be achieved by rerouting the trail along the northern floodplain fringe or by maintaining the existing alignment but reducing the embankment elevation by several feet such that it is readily overtopped in flood conditions. Exploring the feasibility of removal, realignment, or lowering the elevation of this section of the rail trail embankment to restore floodplain access is recommended. Modeled 50-year flood depths under existing and proposed conditions are shown in Figures 4-65B and 4-65C, respectively; existing and proposed 100-year flood depths are shown in Figures 4-65D and 4-65E. Some flooding of the Marc Terrace/James Road neighborhood appears to be naturally occurring and may also be affected by a small tributary that joins Ramapo River from the south, which was not modeled. Voluntary buyout or relocation of naturally flood-prone properties is recommended; properties nearest to the river are subjected to the most frequent flooding and should be prioritized for buyout or relocation.

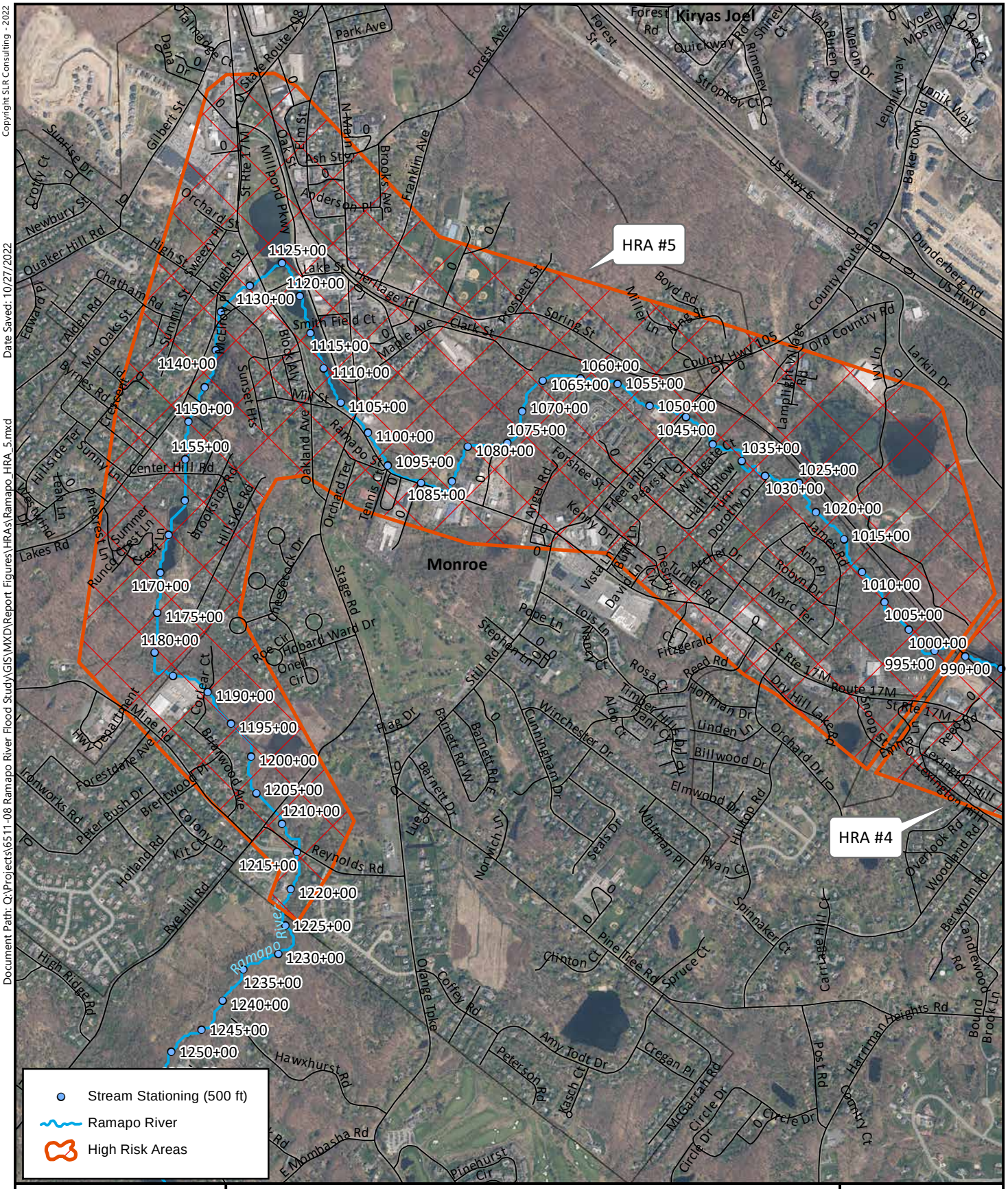
Dorothy Drive runs perpendicular to the Ramapo River, terminating at a cul-de-sac on the river's right bank at STA 1030+00. The Dorothy Drive neighborhood is in a low-lying area along a reach where the river is relatively confined between housing developments at higher elevations on the right bank and the

Heritage Rail Trail embankment running alongside the river on the left bank. There are 4 repetitive loss properties reported in this neighborhood, with 2 homes modeled as being impacted by 10-year flooding, 6 homes in the 25-year flood, 11 in the 50-year flood, 12 in the 100-year flood, and 15 homes impacted by the projected future 100-year flood. All 28 homes along Dorothy Drive are modeled as being flood prone in the 500-year flood.

At the Dorothy Drive neighborhood, a 400-foot-wide right bank floodplain enhancement was modeled, requiring six to eight property buyouts and up to about 3 feet of cut to match the assumed natural floodplain elevation. However, hydraulics here are generally controlled by both a terrain constriction about 1,100 feet downstream of Dorothy Drive near STA 1016+00 (between James Road and Ivy Lane) and the rail trail embankment between STA 967+00 and STA 992+00 that also exacerbates flooding at the Marc Terrace neighborhood, so this partial floodplain reclamation scenario would not provide flood reduction elsewhere along Dorothy Drive. Up to about 0.1 feet of flood reduction was modeled for a short distance upstream of Dorothy Drive, but this does not affect any developed areas. This alternative was not assessed further. The Heritage Rail Trail embankment, where it runs along the Ramapo River opposite Dorothy Drive, does not significantly increase flooding in this area because of the terrain constriction at STA 1016+00. However, the backwaters from the embankment farther downstream between STA 967+00 and STA 992+00 do extend upstream to Dorothy Drive and the embankment removal discussed above associated with flood mitigation at the Marc Terrace/James Road neighborhood is modeled as reducing 50- and 100-year flood depths by about 1.0 foot each at Dorothy Drive and both projected future 50- and 100-year flooding by about 1.1 feet. Although the severity of flooding is reduced, the 11 properties within about 400 feet of the river would remain flood prone in these events. Notably, 500-year flooding may be alleviated at about a dozen properties located farthest from the river. Voluntary buyout or relocation of flood-prone properties is recommended; properties nearest to the river are subjected to the most frequent flooding and should be prioritized for buyout or relocation.

Freeland Street crosses the Ramapo River at STA 1045+00 with a 24-foot-wide, 16-foot-tall concrete arch culvert that was built in 1940. The roadway embankment is raised about 25 feet above the floodplain elevation and also crosses above the former railroad (currently the Heritage rail trail) as it follows the Ramapo valley. The culvert is hydraulically adequate but does generate up to about 5 feet of additional backwater flooding in the 100-year flood event, which raises water surface elevations by about 2.5 feet at one property about 250 feet upstream of the culvert. The building appears to be elevated on a knoll above 100-year water surface elevations although other parts of the property are impacted. When the culvert is due for replacement, a 100-foot bridge is recommended, which reduces upstream flooding by allowing for floodplain connectivity through the crossing. Given the height of the existing approach embankment, a longer span may be necessary, depending on abutment configuration.

A close-up view of the flood-prone Dorothy Drive and Marc Terrace/James Road neighborhoods is shown in Figure 4-63. Figures 4-64 and 4-65 depict flooding depths in the modelled 50- and 100-year floods.



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RAMAPO RIVER - HIGH RISK AREA #5

Ramapo River Flood Mitigation Study
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Rockland and Orange Counties, NY

N

0 500 1,000
Feet

SCALE 1 " = 1,600 '

DATE 10/27/2022

16511.00008
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FIG. 4-62

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Date Saved: 10/27/2022

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HRA #5 - MONROE DOWNSTREAM

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

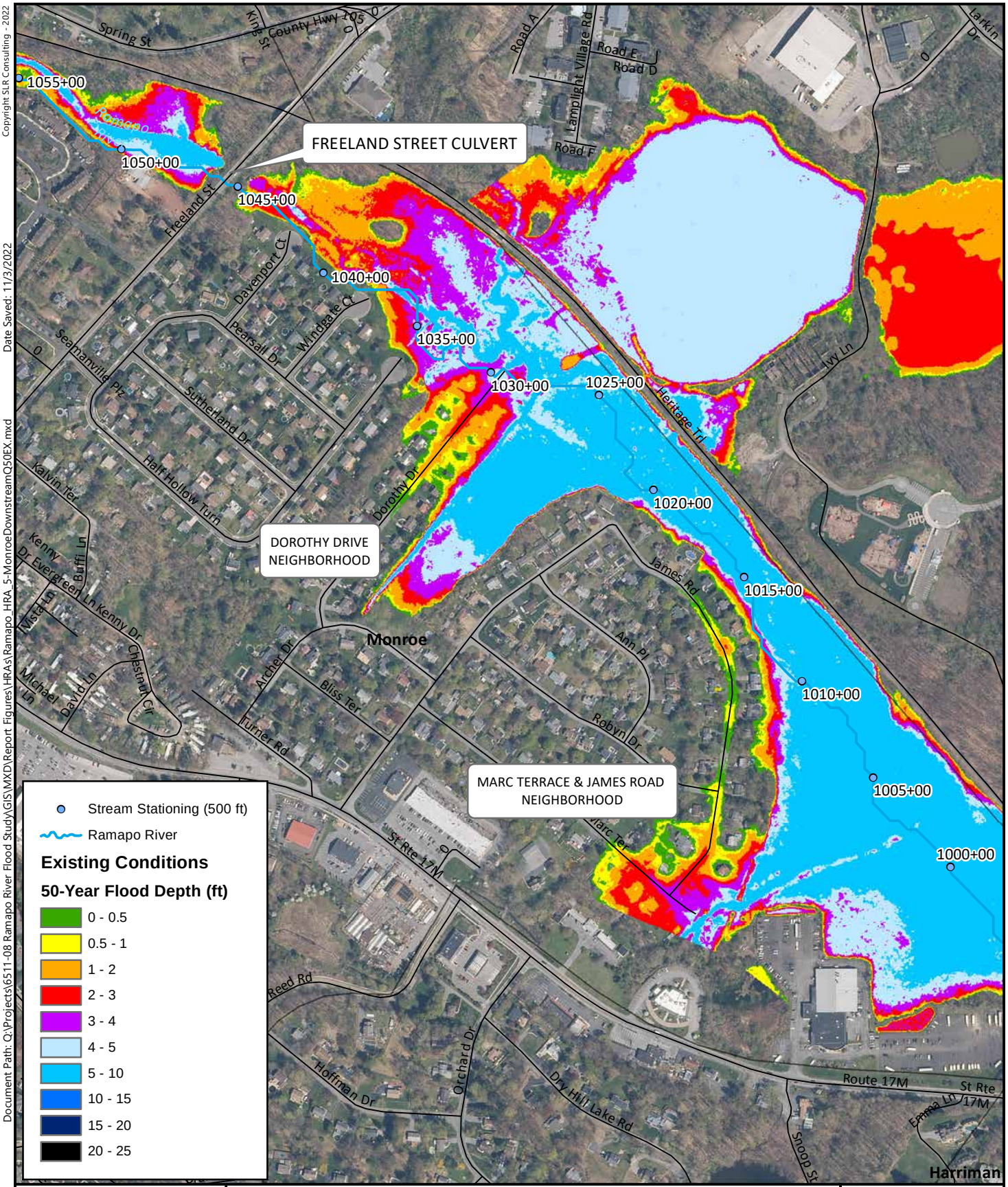
0 500
Feet

SCALE 1 " = 500 '

DATE 10/27/2022

16511.00008
PROJ. NO.

FIG. 4-63



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HRA #5 - MONROE DOWNSTREAM - EXISTING CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

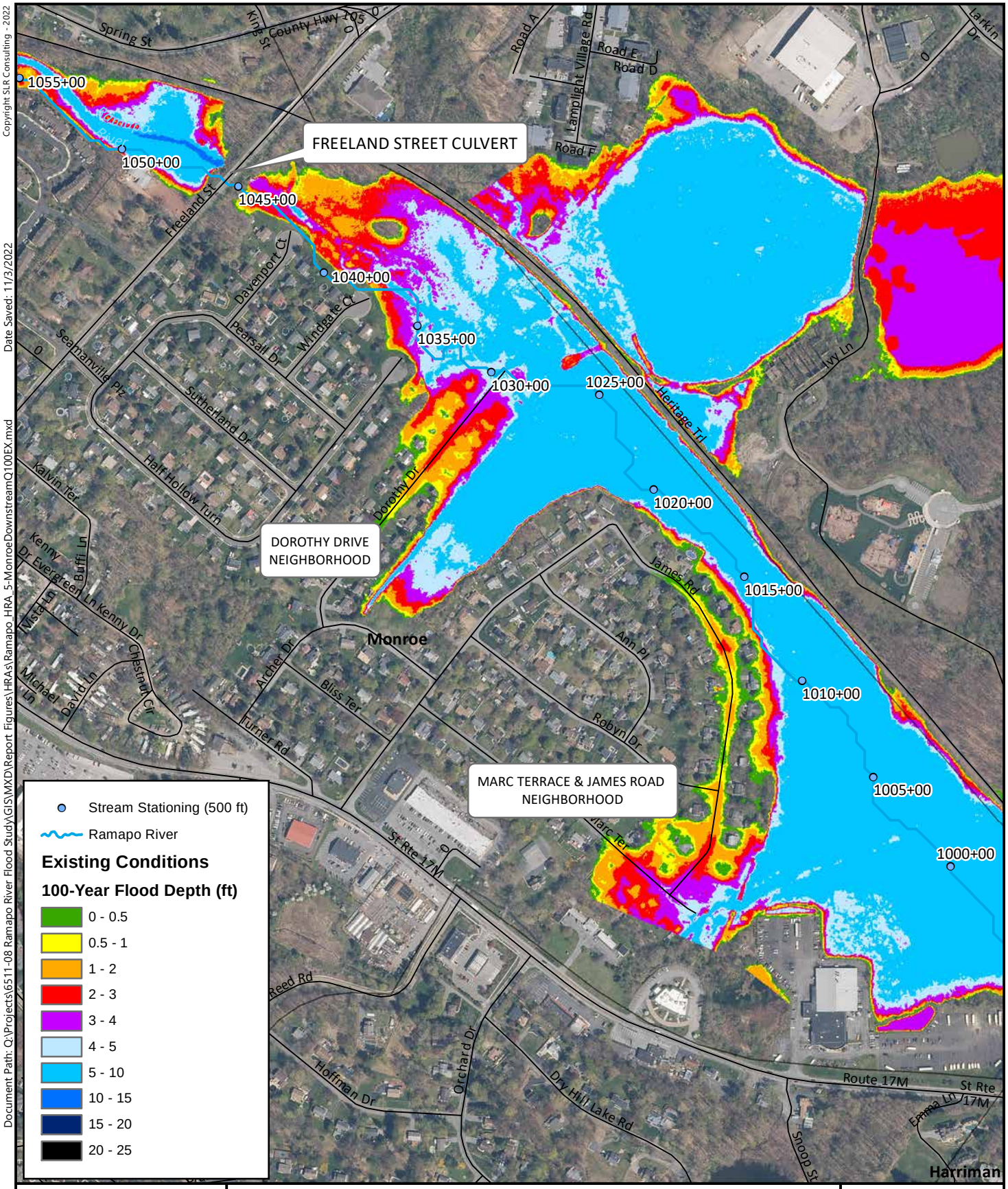
0 500
Feet

SCALE 1 " = 500 '

DATE 11/3/2022

16511.00008
PROJ. NO.

FIG. 4-64



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HRA #5 - MONROE DOWNSTREAM - EXISTING CONDITIONS 100-YR FLOOD

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Rockland and Orange Counties, NY

N

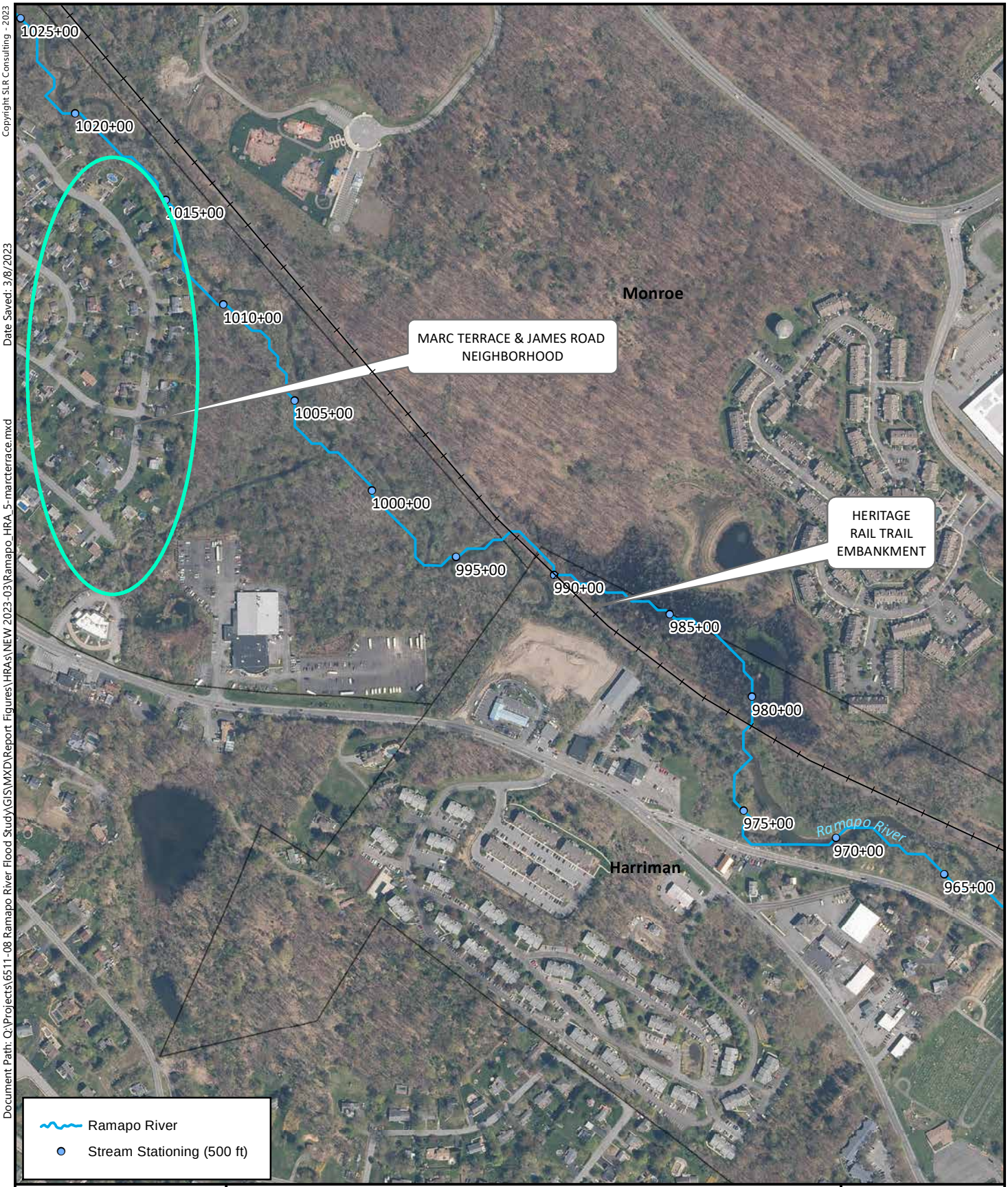
0 500 Feet

SCALE 1 " = 500 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-65



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HRA #5 - MARC TERRACE NEIGHBORHOOD

Ramapo River Flood Mitigation Study
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Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 500 '

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16511.00008
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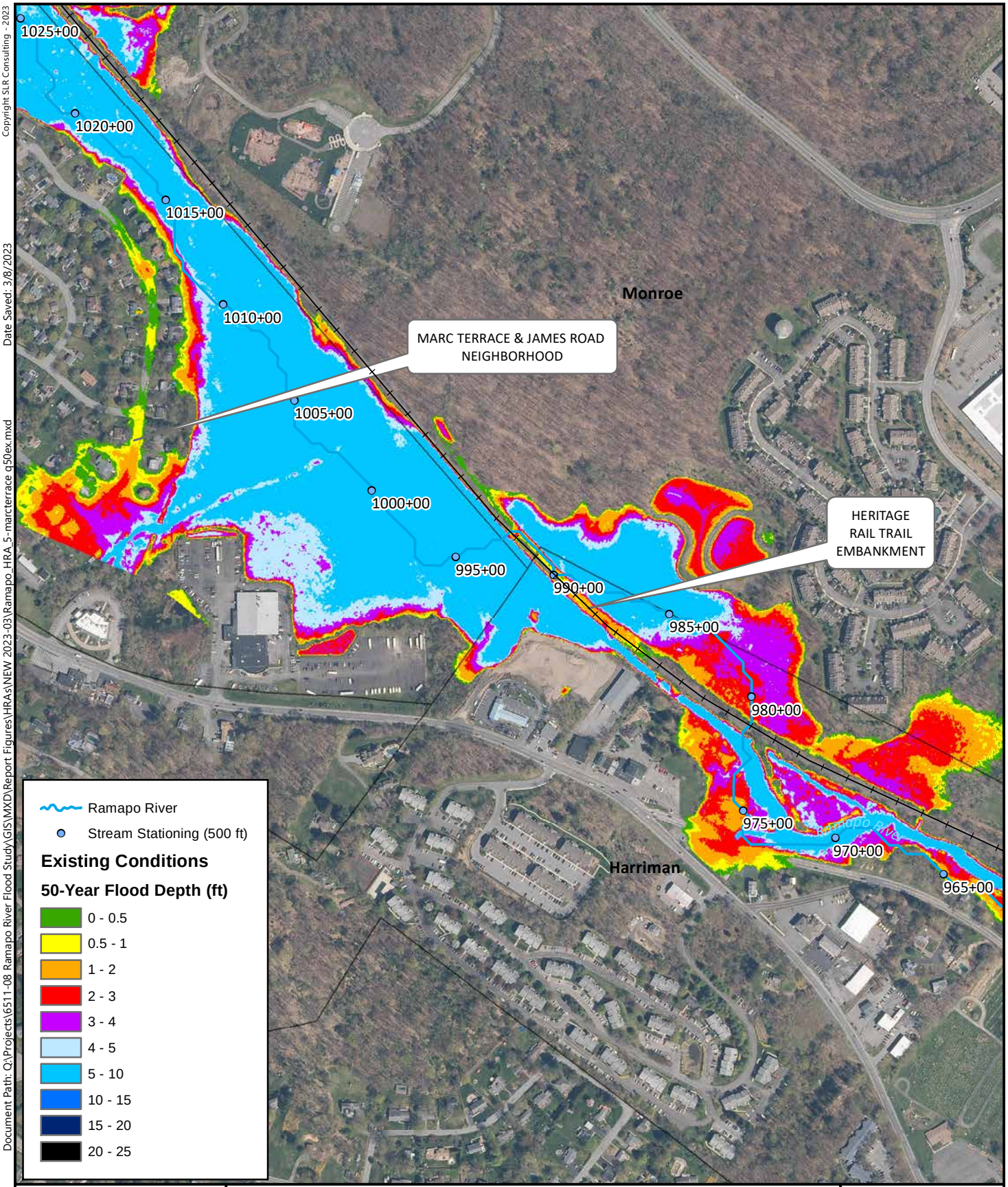
FIG. 4-65A



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HRA #5 - MARC TERRACE - EXISTING CONDITIONS 50-YEAR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

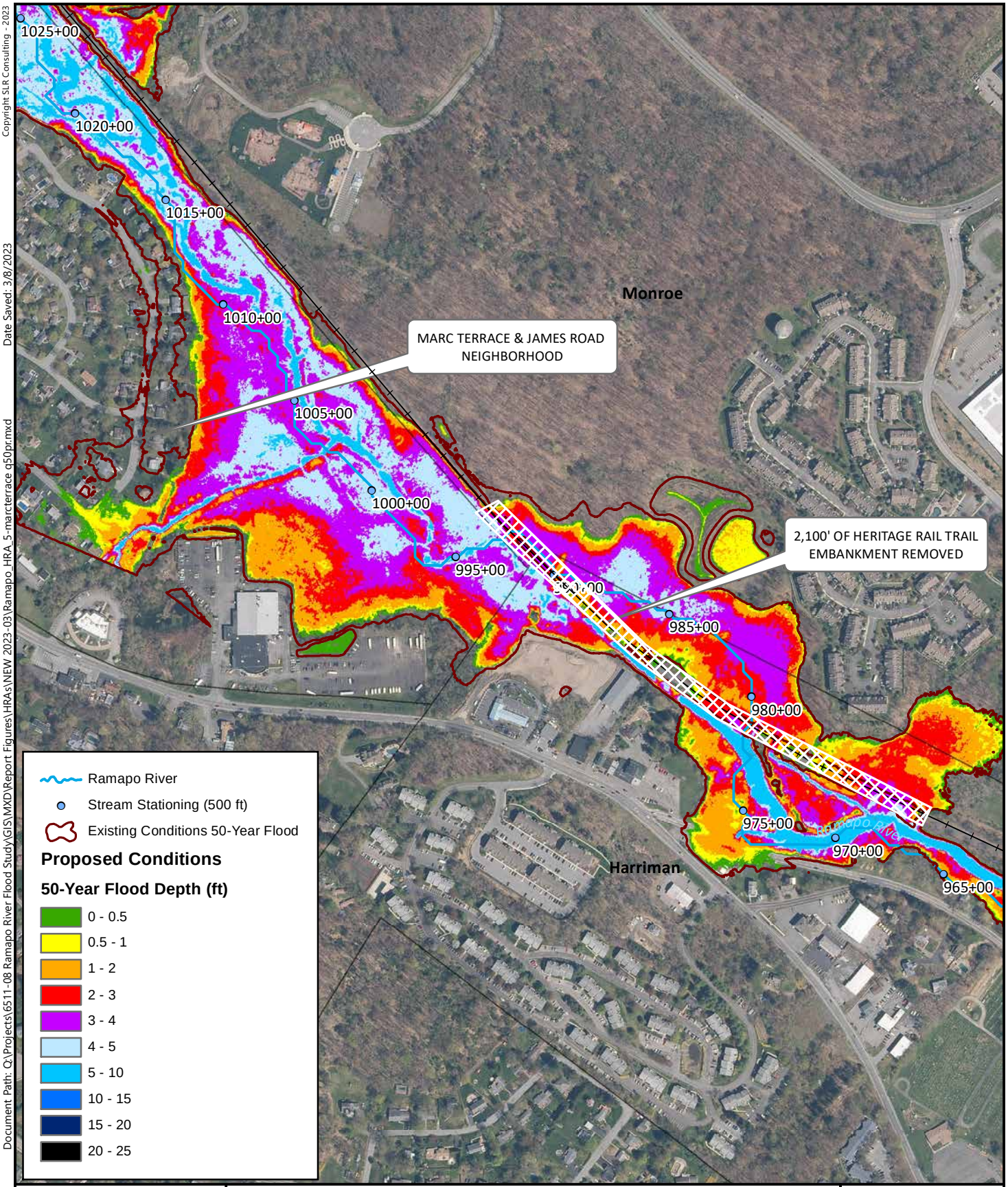
0 500 Feet

SCALE 1 " = 500 '

DATE 3/8/2023

16511.00008 PROJ. NO.

FIG. 4-65B



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HRA #5 - MARC TERRACE - PROPOSED CONDITIONS 50-YEAR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 500 '

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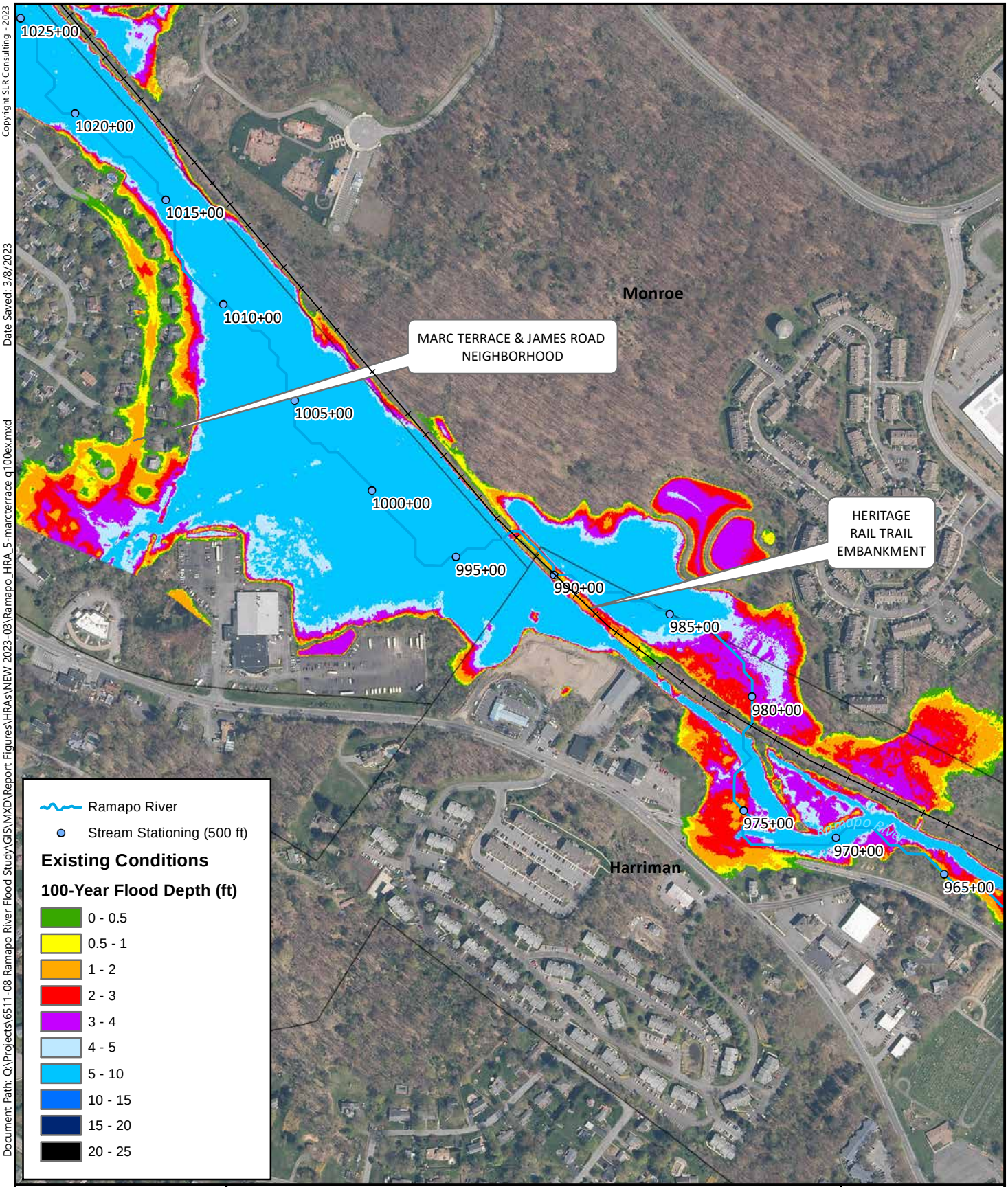
16511.00008
PROJ. NO.

FIG. 4-65C



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HRA #5 - MARC TERRACE - EXISTING CONDITIONS 100-YEAR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

0 500 Feet

SCALE 1 " = 500 '

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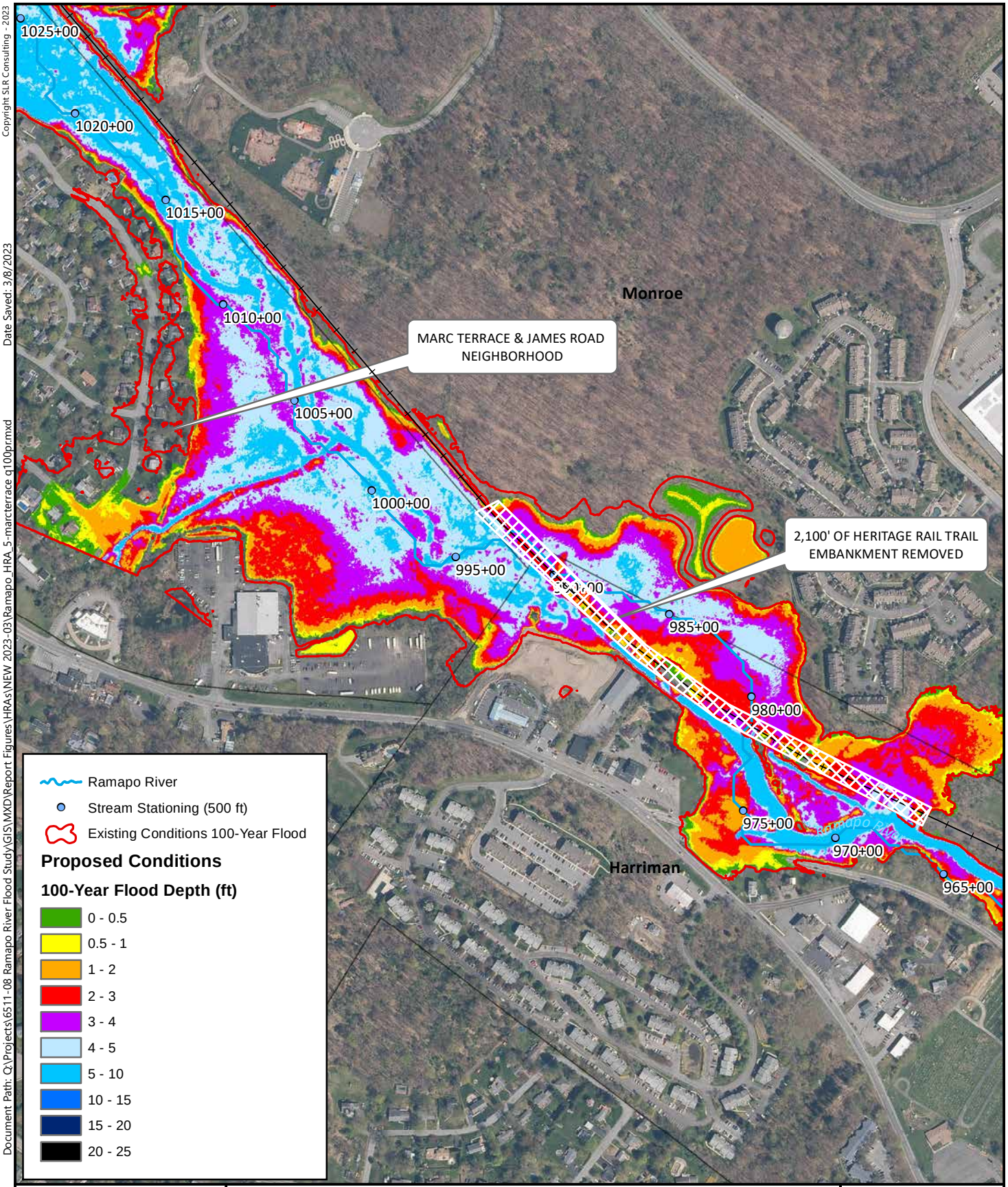
16511.00008 PROJ. NO.

FIG. 4-65D



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HRA #5 - MARC TERRACE - PROPOSED CONDITIONS 100-YEAR FLOOD

Ramapo River Flood Mitigation Study

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Rockland and Orange Counties, NY

N

0 500 Feet

SCALE 1 " = 500 '

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FIG. 4-65E

Clark Street is a dead-end road that leads to a small neighborhood on the Ramapo River's left bank at STA 1065+00. Nine out of the 12 homes in this neighborhood are modeled within the 100-year floodplain. An additional flood-prone building at the end of the road that had also been within the FEMA floodway appears to have been demolished recently. Flooding in parts of this neighborhood is modeled in the 10-year flood, with buildings impacted beginning in the 25-year flood. Removal of all homes on Clark Street and lowering the elevation of the area by about 3 feet to match the left floodplain grade upstream and downstream is modeled as reducing 100-year water surface elevations by less than 0.05 feet through this reach, with the best improvement in the 10-year flood of 0.12 feet. Therefore, no substantial flood mitigation at the properties farther from the river might be achieved by reclamation of properties closer to the stream for floodplain. This neighborhood is in a naturally flood-prone area along a shallow-sloping reach of the Ramapo River, just downstream of a broad swath of floodplain. Voluntary buyout or relocation of flood-prone properties is recommended.

Stage Road crosses the Ramapo River with a 20-foot-wide, 7-foot-tall arch culvert at STA 1102+50. The culvert is undersized for flood flows and is modeled as overtopping slightly in the current 100-year flood and by 1.6 feet in the projected future 100-year flood. When it is due for replacement, upgrading the Stage Road culvert to an 80-foot bridge is recommended. A shorter span may be necessary due to constraints of adjacent property and infrastructure.

The Monroe Ponds Dam (NYSDEC ID: 195-0430; Federal ID NY00036) at STA 1104+00 is a Class A – Low Hazard, 14-foot-high earth and stone dam, built in 1936, owned by the Village of Monroe, and last inspected in 2016. An Engineering Assessment and an Emergency Action Plan were completed in 2014 and 2015, respectively. Compared to natural conditions, the dam raises 100-year floodwater surface elevations upstream by about 4.4 feet. This causes flooding of significant sections of Lakes Road/Lake Street, NY-17M, and Millpond Parkway. The dam's backwater causes Lake Street and its crossing of the Ramapo River at the Monroe Ponds to overtop beginning in the modeled 25-year flood. The backwater also reaches the NY-17M culvert crossing of the Ramapo River as it enters the Monroe Ponds. It is recommended that the feasibility of lowering the spillway elevation of the Monroe Ponds Dam be explored, to reduce the flood hazard over a large area in the village; collapsible flashboards can be installed to maintain the pond elevation in normal conditions but are designed to break during flood conditions to increase spillway capacity.

A closeup view of the central portion of HRA 5 in Monroe is shown in Figure 4-66. Figure 4-67 depicts 50-year flood depths in this area, and Figure 4-68 shows the modeled 50-year flood with the crest elevation of the Monroe Ponds Dam lowered by 3 feet (i.e., this scenario assumes that flashboards are installed to maintain the existing pool elevation under normal flows, but these have collapsed as designed under flood conditions). Figure 4-69 depicts existing conditions 100-year flood depths, and Figure 4-70 depicts proposed conditions 100-year flooding.

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HRA #5 - MONROE CENTER

Ramapo River Flood Mitigation Study
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Rockland and Orange Counties, NY

N

0 500
Feet

SCALE 1 " = 600 '

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16511.00008
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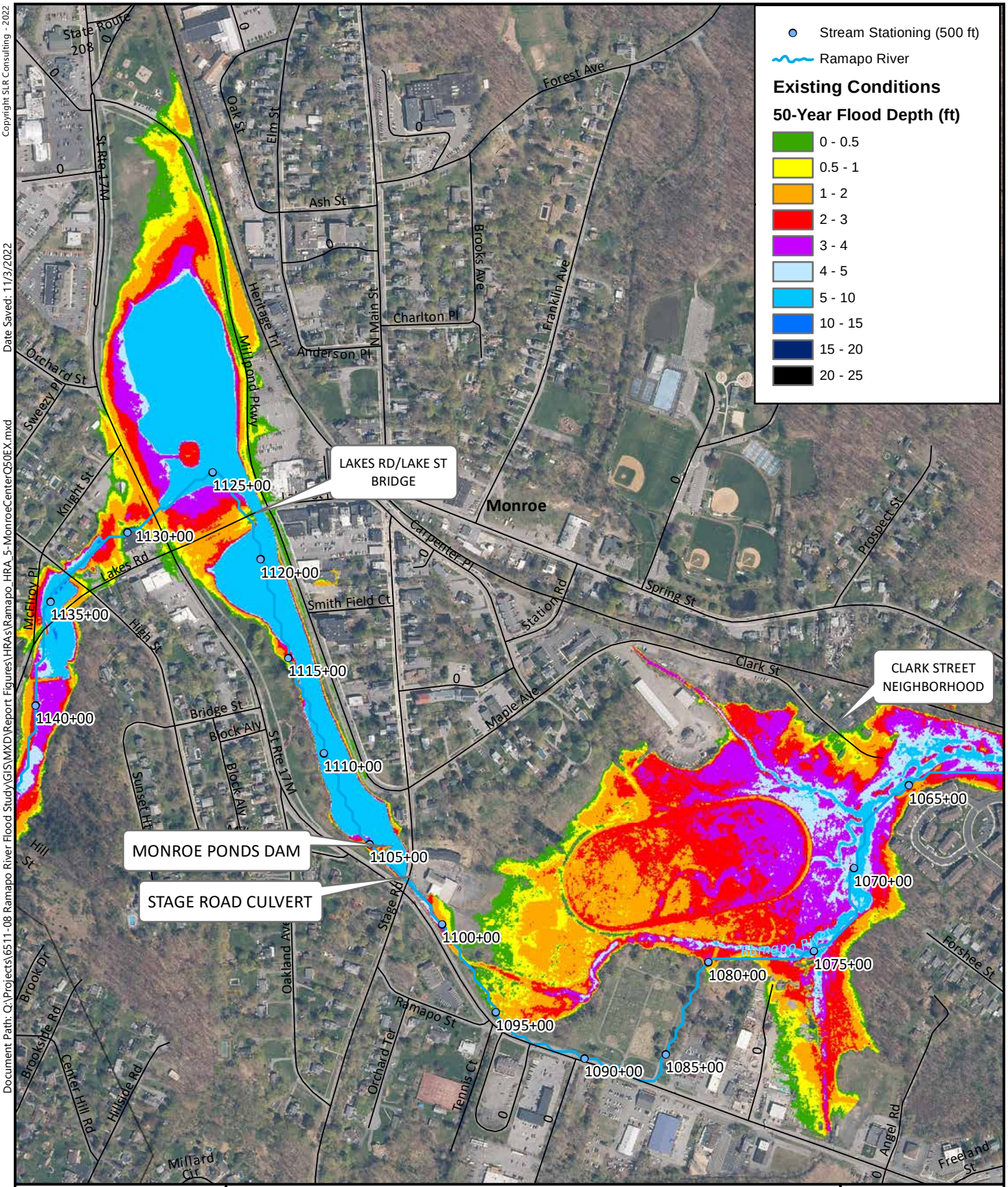
FIG. 4-66



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HRA #5 - MONROE CENTER - EXISTING CONDITIONS 50-YEAR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

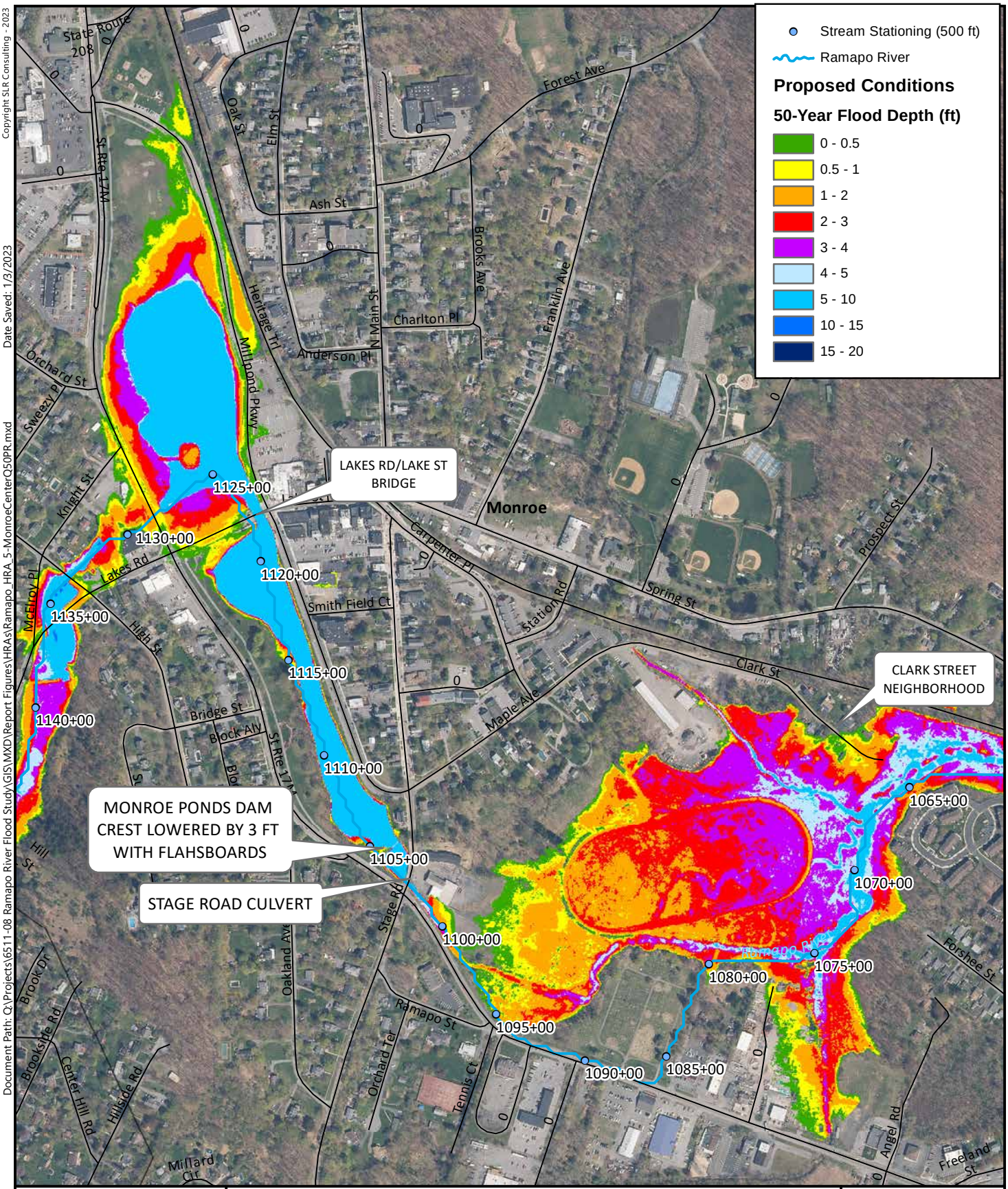
0 500 Feet

SCALE 1 " = 600 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-67



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HRA #5 - MONROE CENTER - PROPOSED CONDITIONS 50-YEAR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

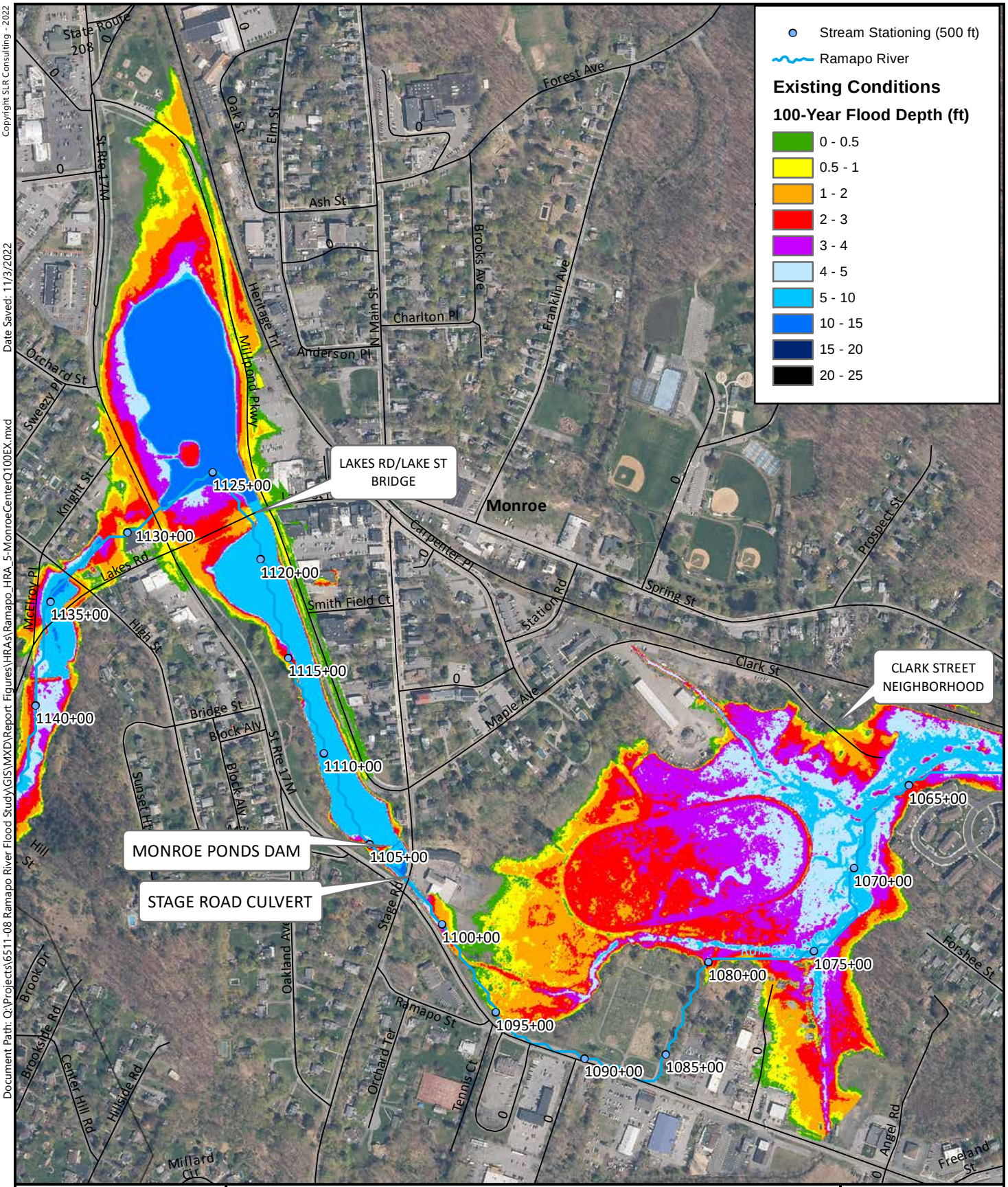
0 500 Feet

SCALE 1 " = 600 '

DATE 1/3/2023

16511.00008 PROJ. NO.

FIG. 4-68



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HRA #5 - MONROE CENTER - EXISTING CONDITIONS 100-YEAR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

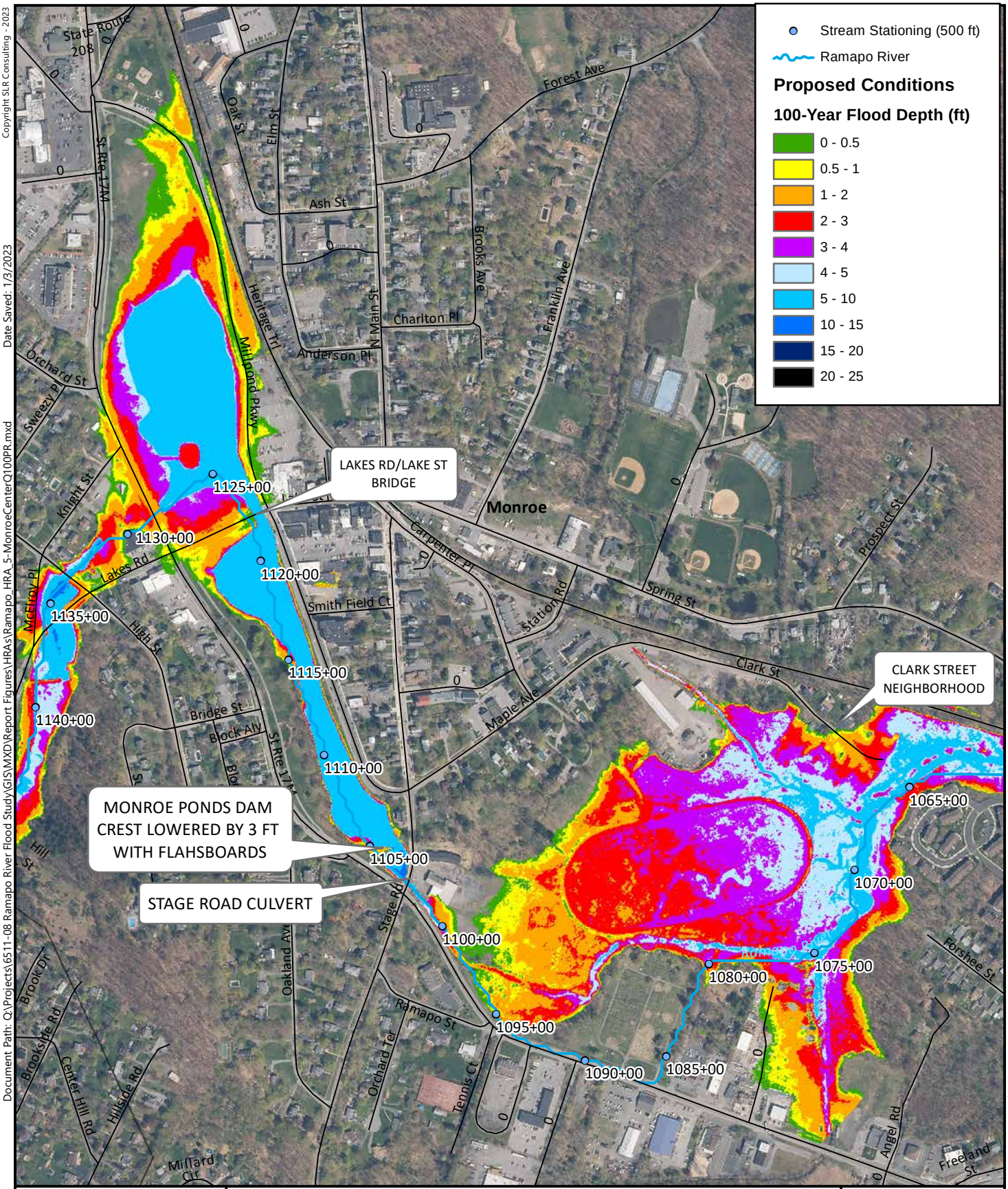
0 500 Feet

SCALE 1 " = 600 '

DATE 11/3/2022

16511.00008 PROJ. NO.

FIG. 4-69



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HRA #5 - MONROE CENTER - PROPOSED CONDITIONS 100-YEAR FLOOD

Ramapo River Flood Mitigation Study

SD113

Rockland and Orange Counties, NY

N

0 500 Feet

SCALE 1 " = 600 '

DATE 1/3/2023

16511.00008 PROJ. NO.

FIG. 4-70

The upstream reaches of the Ramapo River in HRA 5 are shown in Figure 4-71. Over most of the about 300 feet between STA 1128+00 and STA 1131+00, the Ramapo River flows through culverts: the river enters an approximately 210-foot-long, 8-foot-diameter CMP culvert that passes under a parking lot and alongside a building; it is daylighted for about 15 feet before entering an approximately 85-foot-long, 18-foot-span box culvert that passes beneath NY-17M and outlets into Monroe Ponds. The culverts, especially the longer upstream pipe section, are undersized and overtop in the 10-year and greater floods, causing or contributing to flooding at several properties. Daylighting the river over the ±200 feet upstream of the NY-17M crossing is recommended. When the NY-17M culvert is due for replacement, a 60-foot-span bridge is recommended.

The High Street and Lakes Road culvert crossings at STA 1133+50 and STA 1136+00, respectively, are modeled as undersized and overtop beginning in the 10-year flood. There is one repetitive loss property in this area. Replacement of both culverts with approximately 80-foot bridges is recommended when they are due for replacement or significant repair.

The Smith Pond Dam (NYSDEC ID: 195-0432; Federal ID NY13196) is located at STA 1139+00. It is 8 feet high, with an about 2-foot-high tailwater weir about 50 feet downstream. The Class A – Low Hazard dam was constructed of stone masonry in 1908 and is currently privately owned with a most recent inspection in 2012. The dam creates as much as about 2.5 feet of additional 100-year flood depths upstream, although this dissipates upstream to about 0.3 feet at the nearest affected building. If the dam is no longer necessary, the feasibility of removal should be considered when it is due for rehabilitation or significant repair.

The Hill Street bridge at STA 1147+00 was removed between 2013 and 2016. The abutments of the former approximately 20-foot span remain in place, and the approach embankments appear intact as well. Removal of the former bridge abutments and restoration of the adjacent stream banks is recommended along with removal of the approximately 120-foot-long, 5-foot-high embankment across the floodplain on the left bank. The Hill Street crossing had raised upstream 100-year floodwater surface elevations by over 2.5 feet, and while the bridge deck and superstructure are gone, much of the hydraulic constriction that causes excess upstream flooding remains.

The Center Hill Road culvert at STA 1157+00 is modeled as overtopping beginning in the 10-year flood and contributing to up to 3.5 feet of additional 100-year flood depths, affecting seven homes upstream. Replacement of the existing 8.75-foot wide, 6.25-foot-tall elliptical concrete culvert with a 55-foot-span bridge can reduce current and future 100-year flood depths by more than 3 feet upstream of the crossing.

The existing 3-foot-diameter culvert carrying Rye Hill Road over the Ramapo River at STA 1208+00 is undersized, and about 900 feet of the roadway is modeled as overtopping by up to 2 feet in the 100-year flood. About 400 feet of road is overtopped by more than half a foot in the 10-year flood. While the crossing generates about 0.5 feet of additional backwater depths in the 10-year flood, overtopping of Rye Hill Road is so substantial that in the 25-year and greater floods the crossing does not have a significant impact on upstream flooding. A short detour is available via Stage Road, Orange Turnpike, and Reynolds

Road. The feasibility of removing the crossing and dead-ending Rye Hill Road on either side of the floodplain should be explored, meanwhile road closure and detours during floods should be anticipated.

Figure 4-72 depicts modeled 50-year flood depths in the upstream reaches of HRA 5 under existing conditions. Figure 4-71 shows 50-year flood depths under proposed conditions, with replacement of the NY-17M, High Street, Lakes Road, and Center Hill Road culverts replaced as described above, the river daylighted over 200 feet near STA 1130+00, and the remnants of the Hill Street crossing removed. 100-year flood depths are shown in existing and proposed conditions in Figures 4-73 and 4-74, respectively.

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

HRA #5 - MONROE UPSTREAM

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

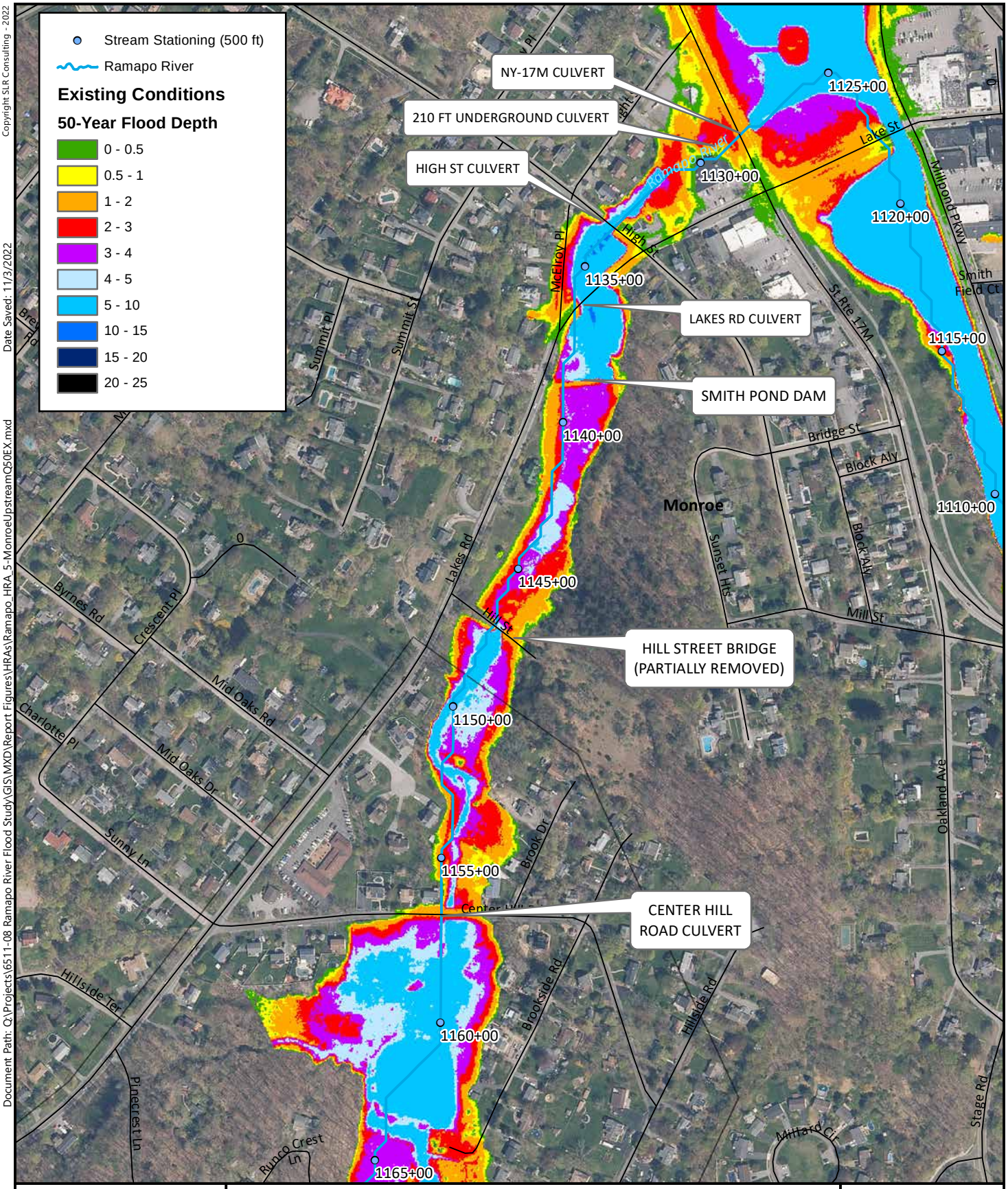
0 420
Feet

SCALE 1 " = 400 '

DATE 10/27/2022

16511.00008
PROJ. NO.

FIG. 4-71



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

HRA #5 - MONROE UPSTREAM - EXISTING CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

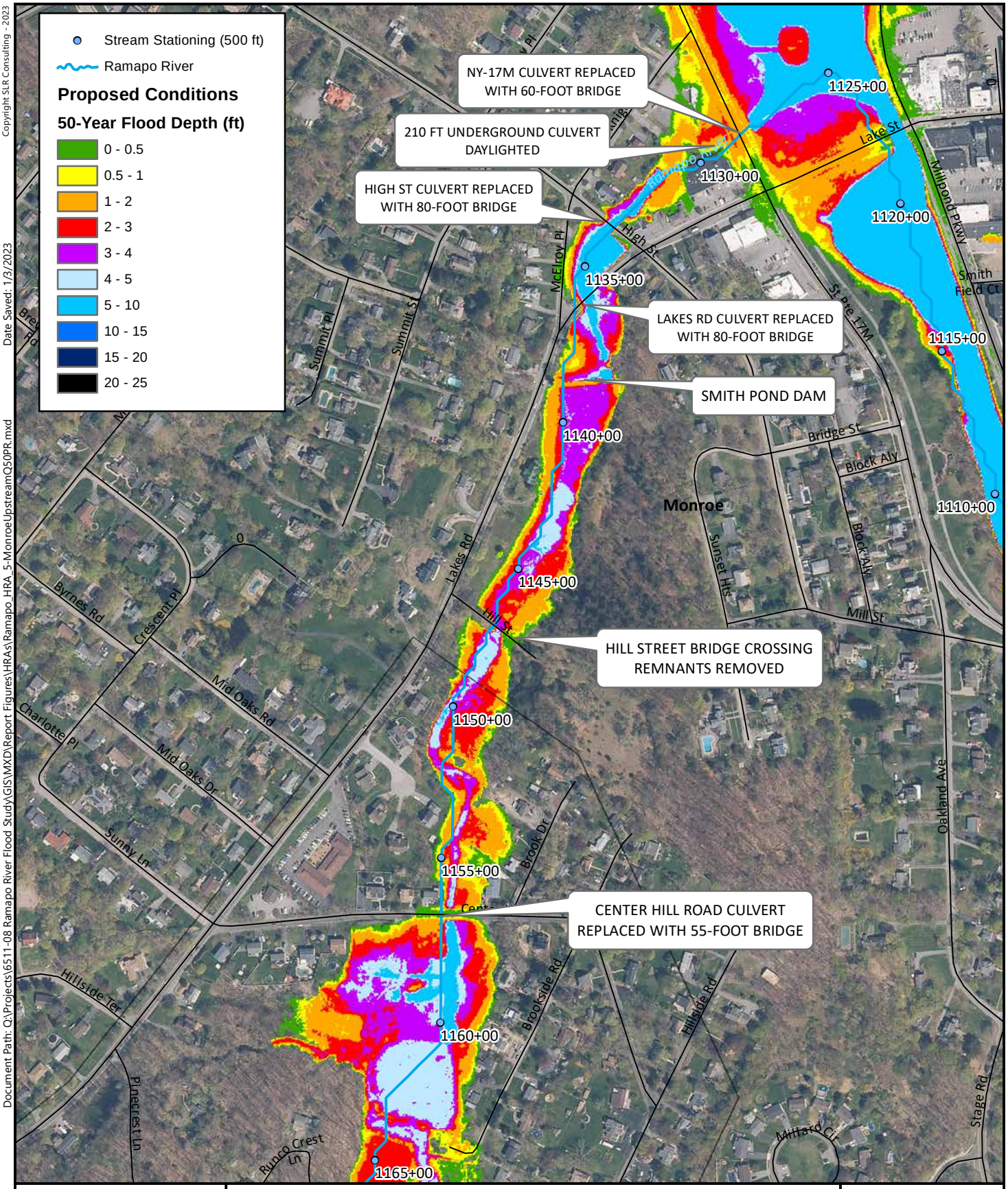
0 420
Feet

SCALE 1 " = 400 '

DATE 11/3/2022

16511.00008
PROJ. NO.

FIG. 4-72



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

HRA #5 - MONROE UPSTREAM - PROPOSED CONDITIONS 50-YR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

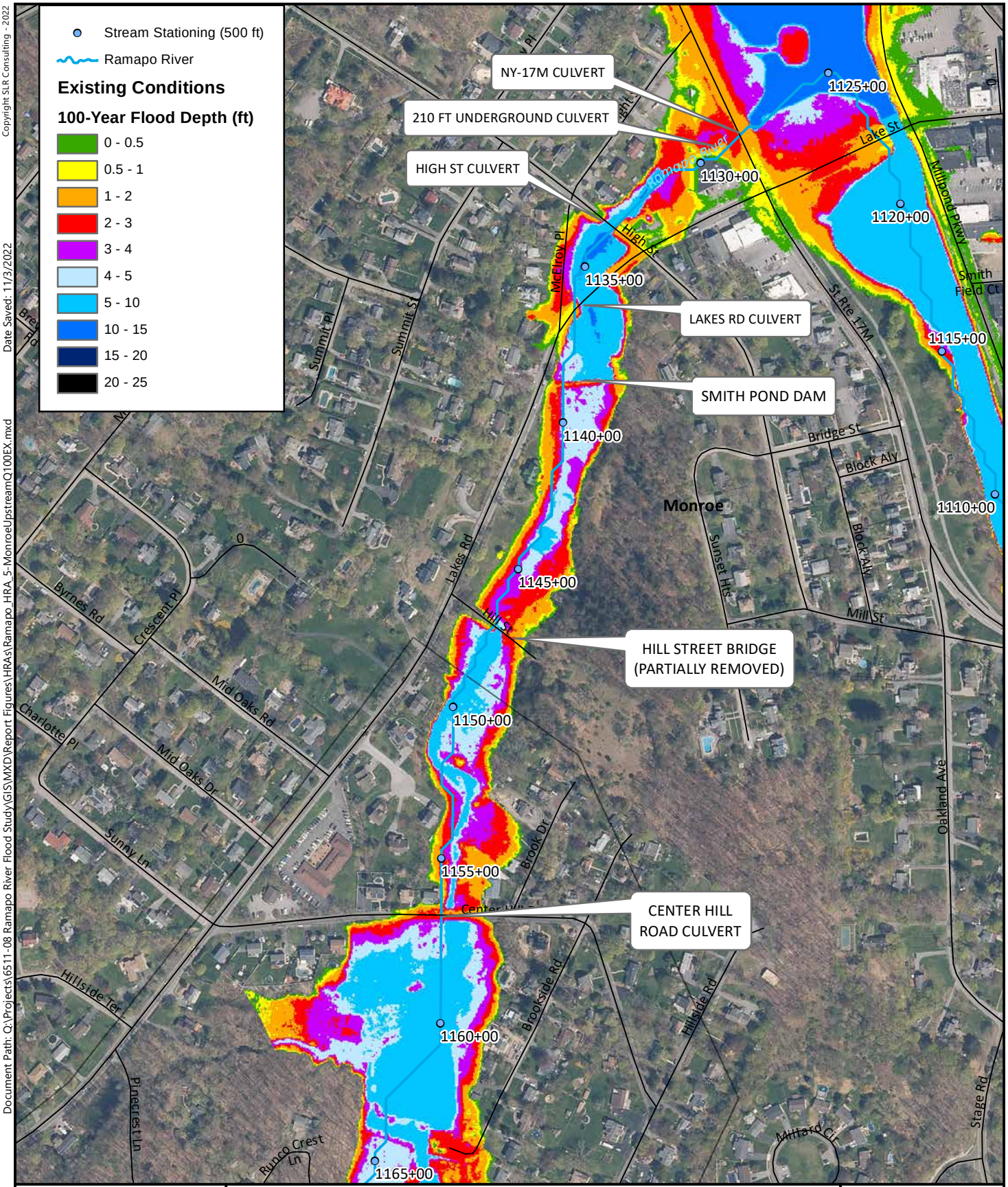
0 420
Feet

SCALE 1 " = 400 '

DATE 1/3/2023

16511.00008
PROJ. NO.

FIG. 4-73



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SLR

231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA #5 - MONROE UPSTREAM - EXISTING CONDITIONS 100-YR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

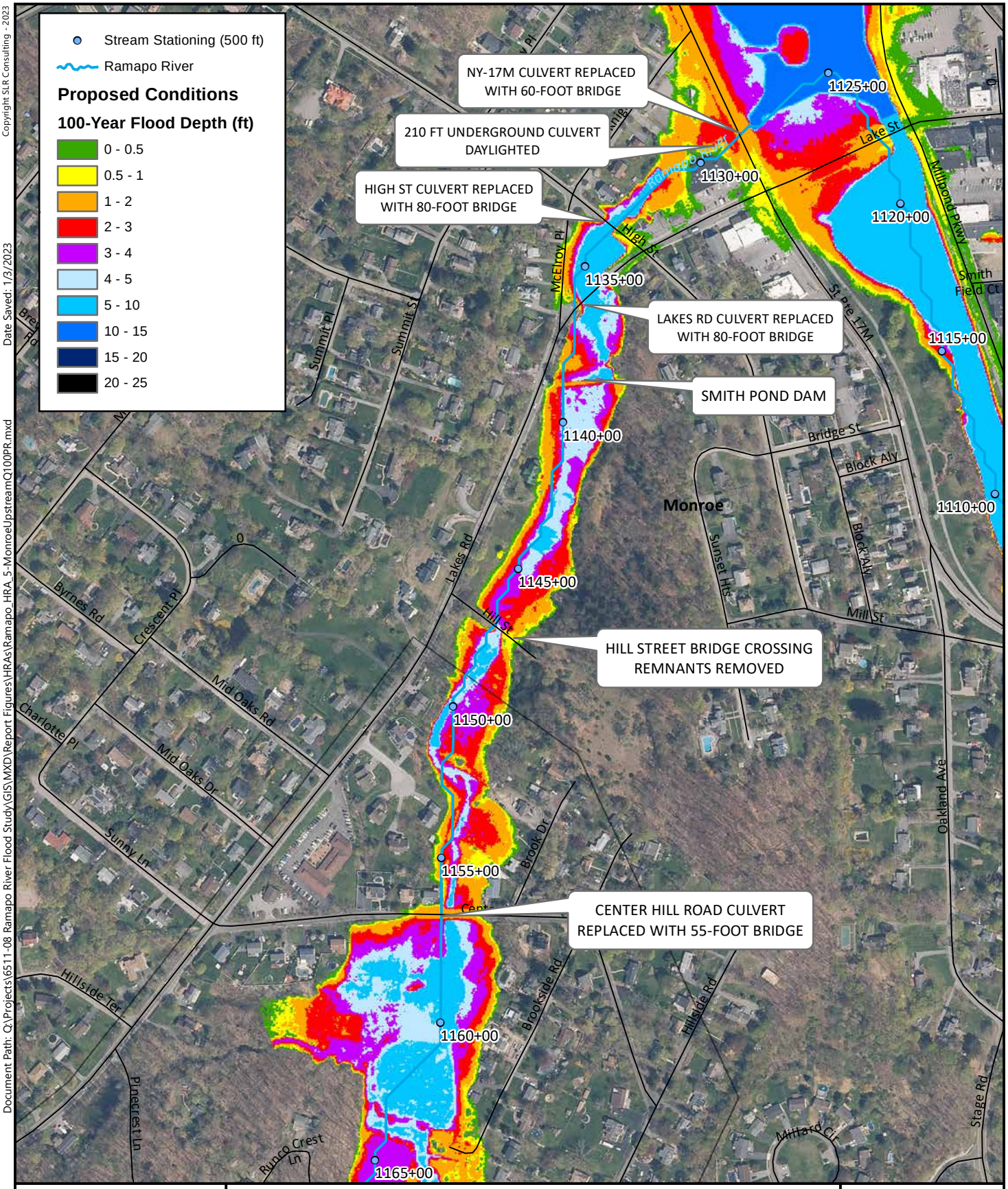
0 420
Feet

SCALE 1 " = 400 '

DATE 11/3/2022

16511.00008
PROJ. NO.

FIG. 4-74



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

HRA #5 - MONROE UPSTREAM - PROPOSED CONDITIONS 100-YR FLOOD

Ramapo River Flood Mitigation Study
SD113

Rockland and Orange Counties, NY

N

0 420
Feet

SCALE 1 " = 400 '

DATE 1/3/2023

16511.00008
PROJ. NO.

FIG. 4-75

5. RECOMMENDATIONS

In the following section, flood mitigation recommendations are provided either as HRA-specific recommendations or as overarching recommendations that apply to the entire watershed or stream corridor. Flood mitigation scenarios such as floodplain enhancement and channel restoration, road closures, dam removals, and replacement of undersized bridges and culverts, are recommended where appropriate.

5.1 HRA 1 RECOMMENDATIONS

The following recommendations are provided for HRA 1:

- Removal of abandoned railroad embankment and bridge crossing at STA 13+00.
- Removal of abandoned road bridge and embankment at STA -7+50 in Mahwah, New Jersey.
- Floodplain reclamation along approximately 4,000 feet of the Ramapo River's right bank in New Jersey between the state line and the NJ-17 bridge.
- Until the above-recommended improvements are undertaken, it is recommended that the WWTP facility and the municipal drinking water wells receive floodproofing to at least 3 feet above projected future 100-year flood elevations and above the 500-year flood elevation.
- A replacement bridge at the Fourth Street crossing of the Ramapo River at STA 60+00 along with detailed, up-to-date hydrologic and hydraulic assessments. Significant upstream flood reductions can be achieved by replacing the current bridge with a 160-foot span. However, a critical facility is located immediately upstream of the bridge, and modeling indicates that a 240-foot span and associated embankment removal and floodplain reclamation can alleviate the backwaters caused by the crossing.
- Studying the feasibility of modifications to or removal of the Hillburn Dam at STA 67+50 to reduce excess upstream flooding.
- When due for replacement, upgrading the Orange Turnpike bridge at STA 89+50 with an approximately 200-foot span.
- When due for replacement, upgrading the Metro-North/Norfolk Southern railroad bridge immediately upstream at STA 90+50 with an approximately 200-foot span.
- Studying the feasibility of removal of the out-of-service Bridge Street bridge at STA 138+00, maintenance of the bridge as a pedestrian crossing, or replacement with a more hydraulically adequate pedestrian bridge.
- Removal of the remnants of the Ramapo Foundry Dam at STA 150+00.

5.2 HRA 2 RECOMMENDATIONS

The following recommendations are provided for HRA 2:

- Replacement of the older, right (west) channel bridge of Seven Lakes Drive at STA 262+00 with a similar 100-foot-span bridge to the left (east) channel bridge.
- Removal of the 100-foot embankment on the center island and replacement of the entire Seven Lakes Drive crossing with a single approximately 300-foot bridge should be considered, although the left (east) channel bridge is relatively new (2011), so this may not be practical currently.
- Voluntary buyout or relocation of naturally flood-prone properties in the vicinity of the Seven Lakes Drive bridge and confluence of Stony Brook with the Ramapo River.
- Preparation of road closures and detours around Seven Lakes Drive in the event of flooding.

5.3 HRA 3 RECOMMENDATIONS

The following recommendations are provided for HRA 3:

- The East Village Road bridge at STA 402+50 was recently replaced (2019), although modeling indicates that several surrounding properties are in naturally flood-prone areas, and the new bridge will not entirely alleviate flooding at most affected properties. Voluntary buyout or relocation of flood-prone properties in the vicinity of the East Village Road crossing, including areas east of I-87 affected by backwater flooding through the overpass, is recommended.
- At the Kanawauke Road bridge at STA 544+00, removal of the approximately 350-foot-long, 6-foot-high berm on the upstream left bank and about 750 feet of 3-foot- to 4-foot-high berms on both downstream banks is recommended.
- Removal of the embankments/abutments of the archaic crossing about 150 feet downstream of the Kanawauke Road bridge at STA 542+50 is recommended as well.
- Removal of the approximately 550-foot-long, 20-foot-tall embankment traversing the right floodplain at STA 635+00.
- Replacement of the Metro-North/Norfolk Southern railroad bridge at STA 727+00 with an approximately 130-foot span along with an improved channel alignment.
- Replacing the Arden Road bridge at STA 762+50 with a 200-foot or greater span along with associated embankment removal to restore floodplain connectivity.
- Study the feasibility of raising or relocating NY-17 upstream of the Arden Road bridge.

- Replacement of the railroad bridge at STA 832+00 with a minimum 120-foot span. This bridge is impacted by the backwater from the existing Arden Road bridge, which should be considered in more detailed hydrologic and hydraulic analyses associated with replacement of both crossings.

5.4 HRA 4 RECOMMENDATIONS

The following recommendations are provided for HRA 4:

- Replacement of the railroad bridge at STA 880+00 with a minimum 120-foot span. This bridge is impacted by the backwater from the existing Arden Road (STA 762+50) and railroad (STA 832+00) bridges in HRA 3, which should be considered in more detailed hydrologic and hydraulic analyses associated with replacement of both crossings.

- Replacement of the privately owned Arden House Road bridge at STA 904+00 with a minimum 65-foot span to meet NYSDEC stream crossing guidelines when the structure is due for replacement or significant repair. Any elevation of the road embankment to prevent overtopping would necessitate a commensurate increase in bridge span to avoid increasing upstream flooding.

- Preparation for road closures and detours around Arden House Road in the event of flooding.

- Replacement of the NY-17/Averell Avenue bridge at STA 928+00 with an approximately 150-foot span, assuming that the undersized bridges downstream in HRA 4 and in the upper reaches of HRA 3 have been replaced or are scheduled for replacement as well. Hydraulic analyses associated with the bridge replacement should consider the influence of downstream crossings and the new bridge geometry adjusted as needed.

- Studying the feasibility of removing or modifying Harriman Pond Dam #2 to reduce upstream flooding.

- Replacement of the River Road bridge at STA 946+00 with an approximately 100-foot span along with a reduced skew angle, as practical, to increase the effective hydraulic opening of the bridge.

- Study the feasibility of removing the flood-prone section of North Main Street at STA 975+00 near the intersection with NY-17M, redirecting traffic to the current Short Street alignment, and relocating the adjacent flood-prone businesses.

- Replacement of the Brookside Drive East culvert crossing of an unnamed tributary to the Ramapo River with an approximately 18-foot-span, 8-foot-rise concrete box culvert, accompanied by thorough hydrologic and hydraulic analyses.

5.5 HRA 5 RECOMMENDATIONS

The following recommendations are provided for HRA 5:

- Voluntary buyout or relocation of flood-prone properties in the Marc Terrace and James Road neighborhood near STA 1003+00. Properties nearest to the Ramapo River and an unnamed southern tributary are subjected to the most frequent flooding and should be prioritized for buyout or relocation.

- Explore the feasibility of removing, relocating, or modifying the Heritage Rail Trail embankment to improve floodplain connectivity and reduce flooding at the Marc Terrace/James Road and Dorothy Drive neighborhoods.

- Voluntary buyout or relocation of flood-prone properties in the Dorothy Drive neighborhood near STA 1030+00. Properties nearest to the river are subjected to the most frequent flooding and should be prioritized for buyout or relocation.

- Replacement of the Freeland Street culvert at STA 1045+00 with a minimum 100-foot-span bridge.

- Voluntary buyout or relocation of flood-prone properties in the Clark Street neighborhood near STA 1065+00. Properties nearest to the river are subjected to the most frequent flooding and should be prioritized for buyout or relocation.

- Replacement of the Stage Road culvert at STA 1102+50 with an 80-foot-span bridge.

- Study the feasibility of making modifications to the Monroe Ponds Dam at STA 1104+00 to reduce upstream flooding.

- Daylighting the Ramapo River near STA 1130+00 where it runs through a 210-foot-long culvert upstream of Monroe Ponds and the NY-17M crossing.

- When the NY-17M culvert near STA 1130+00 is due for replacement, a 60-foot bridge is recommended.

- Replacement of the High Street and Lakes Road culvert crossings at STA 1133+50 and STA 1136+00, respectively, with approximately 80-foot bridges.

- Removal of the Smith Pond Dam at STA 1139+00 should be considered when it is due for rehabilitation or significant repair.

- Removal of the former Hill Street bridge abutments and approach embankments at STA 1147+00.

- Replacement of the Center Hill Road culvert at STA 1157+00 with a 55-foot bridge.

- Study the feasibility of removing the Rye Hill Road crossing at STA 1208+00. Prepare for road closures and detours around Rye Hill Road in the event of flooding.

5.6 REPLACEMENT OF UNDERSIZED STREAM CROSSINGS

Hydraulically undersized stream crossings contribute to flooding and washout of roadways. In addition to the recommendations for the replacement of stream crossings within the HRAs described above, it is recommended that undersized stream crossings elsewhere in the Ramapo River watershed be identified and prioritized for replacement. Guidance for this prioritization should be based on capacity modeling and on available information regarding the physical condition of the crossing and its impact to aquatic organism passage connectivity.

5.7 UPDATE FEMA HYDRAULIC MODELING AND MAPPING

FEMA hydraulic modeling for a significant portion of the Ramapo River in New York is based on an antiquated HEC-2 analysis dating from the 1980s. This includes the approximately 17 miles from the New Jersey state line upstream to the village of Harriman. It is recommended that new FEMA modeling be developed to reflect current hydraulic and hydrologic conditions. Updates to hydraulic modeling should then be reflected with updated FIRMs. The updated hydraulic modeling and mapping would reflect changes such as bridge replacements, flood mitigation projects, or updated flood hydrology.

As discussed in Section 2.4.1, existing FEMA modeling of the Harriman and Monroe reach appears to underestimate flooding along the approximately 4,500 feet of the Ramapo River downstream of the NY-17M bridge and should be corrected to account for the downstream hydraulic conditions that contribute to backwater flooding in this area.

5.8 DAM MODIFICATIONS

it is recommended that certain dams along the Ramapo River that have a compelling active use but also contribute to flooding of nearby property and infrastructure explore the feasibility of increasing spillway capacity to better accommodate flood flows or other modifications that may mitigate upstream flooding.

Archaic, unnecessary, breached, or abandoned dams should be considered for removal as a cost-effective and ecological long-term flood mitigation solution.

All dams should be regularly inspected and maintained in sound condition in accordance with 6 NYCRR Part 673 and Environmental Conservation Law (ECL) § 15-0507.

5.9 INDIVIDUAL PROPERTY FLOOD PROTECTION

A variety of measures is available to protect existing public and private properties from flood damage. While broader mitigation efforts are most desirable, they often take time and money to implement. On a case-by-case basis where structures are at risk, individual floodproofing should be explored. Property owners within FEMA-delineated floodplains should also be encouraged to purchase flood insurance under the NFIP and to make claims when damage occurs. Potential measures for property protection include the following:

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

Construction of property improvements such as barriers, floodwalls, and earthen berms – Such structural projects can be used to prevent shallow flooding. There may be properties within the basin where implementation of such measures will serve to protect structures.

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

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

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

- Relocate valuable belongings above the 100-year flood elevation to reduce the amount of damage caused during a flood event.
- Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the BFE (if the ceiling permits). A wooden platform of pressure-treated wood can serve as the base.
- Anchor the fuel tank to the wall or floor with noncorrosive metal strapping and lag bolts.
- Install a backflow valve to prevent sewer backup into the home.
- Install a floating floor drain plug at the lowest point of the lowest finished floor.
- Elevate the electrical box or relocate it to a higher floor and elevate electric outlets.

Encouraging property owners to purchase flood insurance under the NFIP and to make claims when damage occurs – While having flood insurance will not prevent flood damage, it will help a family or business put things back in order following a flood event. Property owners should be

encouraged to submit claims under the NFIP whenever flooding damage occurs in order to increase the eligibility of the property for projects under the various mitigation grant programs.

5.10 ROAD CLOSURES

Approximately 75 percent of all flood fatalities occur in vehicles. Shallow water flowing across a flooded roadway can be deceptively swift and wash a vehicle off the road. Water over a roadway can conceal a washed-out section of roadway or bridge. When a roadway is flooded, travelers should not take the chance of attempting to cross the flooded area. It is not possible to tell if a flooded road is safe to cross just by looking at it.

One way to reduce the risks associated with the flooding of roadways is their closure during flooding events, which requires effective signage, road closure barriers, and consideration of alternative routes.

According to FEMA modeling and anecdotal reporting, flood-prone roads exist within the Ramapo River watershed. In some cases, small, unnamed tributaries and even roadside drainage ditches can cause washouts or other significant damage to roadways, culverts, and bridges. Drainage issues and flooding of smaller tributary streams are generally not reflected in FEMA modeling, so local public works and highway departments are often the best resource for identifying priority areas and repetitively damaged infrastructure.

5.11 ROUGH ORDER OF MAGNITUDE COST RANGE OF KEY RECOMMENDATIONS

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

Table 5-1 Cost Range of Recommended Actions

Recommendation	< $100k	$100k - $500k	$500k - $1M	$1M - $5M	$5M - $10M
HRA 1					
Removal of abandoned railroad embankment and bridge crossing at STA 13+00			X		
Removal of abandoned road bridge and embankment at STA -7+50			X		
Floodplain reclamation along 4,000 feet of Ramapo River's right bank in New Jersey				X	
Replacement of bridge at Fourth Street crossing of Ramapo River at STA 60+00					X
Study feasibility of modifications to Hillburn Dam at STA 67+50 to reduce excess upstream flooding	X				
Replacement of Orange Turnpike bridge at STA 89+50					X
Replacement of Metro-North/Norfolk Southern railroad bridge at STA 90+50					X
Removal of remnants of Ramapo Foundry Dam at STA 150+00		X			
HRA 2					
Replacement of older, right (west) channel bridge of Seven Lakes Drive at STA 262+00				X	
HRA 3					
Removal of 350-foot-long, 6-foot-high berm on upstream left bank and 750 feet of 3-foot- to 4-foot-high berms on both downstream banks at Kanawauke Road bridge at STA 544+00			X		
Removal of embankments/abutments of archaic crossing about 150 feet downstream of Kanawauke Road bridge at STA 542+50		X			
Removal of 550-foot-long, 20-foot-tall embankment traversing right floodplain at STA 635+00			X		
Replacement of Metro-North/Norfolk Southern railroad bridge at STA 727+00 along with improved channel alignment					X
Replacement of Arden Road bridge at STA 762+50 along with associated floodplain improvements					X
Study feasibility of raising or relocating NY-17 upstream of Arden Road bridge		X			
Replacement of railroad bridge at STA 832+00					X
HRA 4					
Replacement of railroad bridge at STA 880+00					X

Recommendation	< $100k	$100k - $500k	$500k - $1M	$1M - $5M	$5M - $10M
Replacement of Arden House Road bridge at STA 904+00				X	
Replacement of NY-17/Averell Avenue bridge at STA 928+00				X	
Study feasibility of removing or modifying Harriman Pond Dam #2	X				
Replacement of River Road bridge at STA 946+00				X	
Study feasibility of removing flood-prone section of North Main Street at STA 975+00		X			
Replacement of Brookside Drive East culvert crossing of an unnamed tributary to Ramapo River			X		
HRA 5					
Replacement of Freeland Street culvert at STA 1045+00				X	
Replacement of Stage Road culvert at STA 1102+50				X	
Study feasibility of modifications to Monroe Ponds Dam at STA 1104+00	X				
Daylighting Ramapo River near STA 1130+00			X		
Replacement of NY-17M culvert at STA 1130+00				X	
Replacement of High Street and Lakes Road culvert crossings at STA 1133+50 and STA 1136+00					X
Removal of Smith Pond Dam at STA 1139+00			X		
Removal of former Hill Street bridge abutments and approach embankments at STA 1147+00			X		
Replacement of the Center Hill Road culvert at STA 1157+00				X	
Study feasibility of removing Rye Hill Road crossing at STA 1208+00	X				

5.12 FUNDING SOURCES

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

Emergency Watershed Protection Program (EWP)

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

FEMA Building Resilient Infrastructure and Communities (BRIC) Program

Building Resilient Infrastructure and Communities (BRIC) will support states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The BRIC program guiding principles are supporting communities through capability- and capacity-building, encouraging and enabling innovation, promoting partnerships, enabling large projects, maintaining flexibility, and providing consistency.
https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities.

FEMA Pre-Disaster Mitigation (PDM) Program

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

FEMA Hazard Mitigation Grant Program (HMGP)

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process following a disaster.

The HMGP is one of the FEMA programs with the greatest possible fit to potential projects recommended in this report. However, it is available only in the months subsequent to a federal disaster declaration in the State of New York. Because the state administers the HMGP directly, application cycles will need to be closely monitored after disasters are declared in New York.
https://www.fema.gov/hazard-mitigation-grant-program

FEMA Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) programs and made the following significant changes to the FMA program:

- The definitions of repetitive loss and SRL properties have been modified.
- Cost-share requirements have changed to allow more federal funds for properties with RFC and SRL properties.
- There is no longer a limit on in-kind contributions for the nonfederal cost share.

One limitation of the FMA program is that it is used to provide mitigation for *structures* that are insured or located in SFHAs. Therefore, the individual property mitigation options are best suited for FMA funds. Like PDM, FMA programs are subject to the availability of appropriation funding as well as any program-specific directive or restriction made with respect to such funds.
http://www.fema.gov/flood-mitigation-assistance-grant-program

NYS Department of State

The NYS Department of State (NYSDOS) may be able to fund some of the projects described in this report. In order to be eligible, a project should link water quality improvement to economic benefits.

NYS Department of Environmental Conservation – Municipal Waste Reduction and Recycling (MWRR) Program

The NYSDEC administers MWRR funding to local government entities for waste reduction and recycling projects. The overall goal of this funding program is to assist municipalities in expanding or improving local waste reduction and recycling programs and to increase participation in those programs.

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

- Capital Investment in Facilities and Equipment

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

U.S. Army Corps of Engineers (USACE)

The USACE provides 100 percent funding for floodplain management planning and technical assistance to states and local governments under several flood control acts and the Floodplain Management Services (FPMS) Program. Specific programs used by the USACE for mitigation are listed below.

- Section 205 – Small Flood Damage Reduction Projects: This section of the 1948 Flood Control Act authorizes the USACE to study, design, and construct small flood control projects in partnership with nonfederal government agencies. Feasibility studies are 100 percent federally funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65 percent with a 35 percent nonfederal match. In certain cases, the nonfederal share for construction could be as high as 50 percent. The maximum federal expenditure for any project is $7 million.

- Section 14 – Emergency Stream Bank and Shoreline Protection: This section of the 1946 Flood Control Act authorizes the USACE to construct emergency shoreline and stream bank protection works to protect public facilities such as bridges, roads, public buildings, sewage treatment plants, water wells, and nonprofit public facilities such as churches, hospitals, and schools. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $1.5 million.

- Section 208 – Clearing and Snagging Projects: This section of the 1954 Flood Control Act authorizes the USACE to perform channel clearing and excavation with limited embankment construction to reduce nuisance flood damages caused by debris and minor

shoaling of rivers. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $500,000.

- Section 206 – Floodplain Management Services: This section of the 1960 Flood Control Act, as amended, authorizes the USACE to provide a full range of technical services and planning guidance necessary to support effective floodplain management. General technical assistance efforts include determining the following: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages, or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Types of studies conducted under FPMS include floodplain delineation, dam failure, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, floodproofing, and inventories of flood-prone structures. When funding is available, this work is 100 percent federally funded.

In addition, the USACE provides emergency flood assistance (under Public Law 84-99) after local and state funding has been used. This assistance can be used for both flood response and postflood response. USACE assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the USACE can loan or issue supplies and equipment once local sources are exhausted during emergencies.

New York State Grants

As part of New York's efforts to improve the business climate and expand economic growth, the NYS Consolidated Funding Application (CFA) was created. The CFA allows applicants to access multiple state funding sources through one application, making the process quicker, easier, and more productive.
https://apps.cio.ny.gov/apps/cfa/

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

Climate Smart Communities (CSC)

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

Environmental Facilities Corporation

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

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

Bridge NY Program

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

Private Foundations

Private entities such as foundations are potential funding sources in many communities. Communities will need to identify the foundations that are potentially appropriate for some of the actions proposed in this report.

In addition to the funding sources listed above, other resources are available for technical assistance, planning, and information. While the following sources do not provide direct funding, they offer other services that may be useful for proposed flood mitigation projects.

Land Trust and Conservation Groups

These groups play an important role in the protection of watersheds, including forests, open space, aquatic ecosystems, and water resources.

Communities will need to work closely with potential funders to ensure that the best combinations of funds are secured for the proposed alternatives and for the property-specific mitigation such as floodproofing, elevations, and relocations. It will be advantageous for the communities to identify combinations of funding sources in order to reduce their own requirement to provide matching funds.

6. LAND USE ANALYSIS

6.1 LAND USE AND ZONING REVIEW AND ANALYSIS

Potential changes to land use, particularly development proposals in close proximity to a water body or within a riparian buffer, can bring about issues and consequences both for the impact on those developments should a flood occur but also as a contributor to the flooding problem itself. In New York State, land use is controlled at the municipal level through zoning, subdivision, and other related regulations, including wetlands and floodplain ordinances.

In Rockland County, there has been a significant amount of work conducted by the state, county, and local municipalities, typically following a flood event such as Superstorm Sandy, which creates an immediate need to respond to the disaster as well as an understanding that situations surrounding such disasters need to be assessed and plans developed to mitigate likely future repeat events.

This analysis reviewed publicly available project-relevant documents found online to identify recommendations and opportunities identified for communities to address issues related to flooding through land use and zoning. This analysis also provides "best practice" recommendations that communities in Rockland and Orange Counties (within the Ramapo watershed) can review and discuss implementing, if not already in the municipal code. A significant and positive finding from the literature review effort undertaken is that Ramapo watershed communities in both Rockland and Orange Counties have adopted a Flood Damage Prevention Ordinance. These ordinances, generally adopted in 2013 and 2014, go a long way toward addressing potential issues and concerns related to flooding and land use planning.

Our review of the following documents did not find any municipal-specific land use or zoning recommendations to carry forward for this project. We have summarized any potential recommendations related specifically to flooding that may be useful to consider when assessing potential changes to existing zoning, subdivision, and other regulations that could impact flood-related conditions:

- *Hudson River Estuary Habitat Restoration Plan – NYSDEC* (2013)
    - This Plan identifies priority habitats vital to the health and resiliency of the estuary and actions for restoring them. The plan states that it is "…the basis for coordinating funding, planning, research and implementation of resources toward a single, focused goal: The enduring health and wellbeing of the Hudson River estuary, its inhabitants and the people of the Hudson River Valley and New York State." It states that despite improvements in the Hudson River, there "…remains a profound need for habitat restoration." There was nothing specific communities identified in this plan. That said, riparian buffer protections and related protections of vital habitats by municipalities will generally assist with the implementation and protection efforts identified and desired by this plan. Additionally, while the watershed is not located

within the estuary boundaries, it is within the Estuary Grant Program boundaries and, as such, could potentially utilize this program for efforts within the watershed.

- All Rockland County and Orange County communities within the Ramapo watershed have a flood damage prevention ordinance or standards to address flood damage prevention. The standards adopted can vary from community to community, but they all provide construction standards for actions within flood hazard areas.

- All Rockland County communities are under the "umbrella" of the 2011 Rockland County Comprehensive Plan *Rockland Tomorrow: County Comprehensive Plan.* There are only a few specific mentions or recommendations related to flooding and flood prevention for individual municipalities, but where such a mention is made, it is included under that community below. All communities fall within the following recommendations from the Plan:
    - Land Use and Zoning Chapter
        - No Key issues identified.
    - Natural Resources Chapter – Encourage the municipalities to establish buffers along streams as appropriate, with the specific distance dictated by conditions on the ground and scientific study.
    - Infrastructure Chapter – Use planning techniques for green infrastructure and stormwater management as provided by the NYSDEC.

- All Orange County communities are under the "umbrella" of the 2018 Orange County Comprehensive Plan Update and the five supplemental chapters. There are only a few specific mentions or recommendations related to flooding and flood prevention for individual municipalities. All communities fall within the following recommendations from the plan:
    - The 2010 Water Master Plan supplemental chapter mentions implementing a strategically designed stream flow monitoring network as an element of a watershed management program. The plan states that such a network would allow the county to utilize the NWS Advanced Hydrological Prediction System (AHPS) to assist in emergency management during extreme hydrological events such as floods. The plan suggested enhancing the existing USGS stream gauge network that was within the county.
    - The 2004 Open Space supplemental chapter discussed protecting and enhancing priority aquatic systems as the highest priority/highest cost. This included a recommendation to encourage municipalities to put conservation easements along river corridors and tributaries to prevent development on or disturbance of the riverbank and floodplain.
    - The 2019 Transportation supplemental chapter notes that Orange County's geography makes heavy downpours from extreme storm events and the associated riverine flooding of particular concern for transportation infrastructure. The plan further notes that almost every municipality in the county is susceptible to flooded roads. There is a mention of flooding potentially impacting rail stations. The Tuxedo, Sloatsburg, and Suffern stations are all in close proximity to the Ramapo River.

- *Cleaner, Greener Communities Mid-Hudson Regional Sustainability Plan (Mid-Hudson Planning Consortium)* 2013
    - This plan was developed to "…set realistic yet ambitious objectives for the long-term sustainable development of the Region, each of which is supported by initiatives and projects that can be implemented in the short-, medium-, and long-term." The plan lists 218 project ideas, some of which are directed toward Rockland County specifically, but none of those projects are flood or land use/zoning focused. That said, there are Mid-Hudson-wide recommended projects related to flooding that are relevant, including the following:
        - Project 63 – Install porous pavement in municipalities.
        - Project 188 – Increases in the extent of riparian buffers.
        - Project 203 – Watershed remediation. This project will help identify and target funds to specific vulnerable locations to protect roads and other facilities from flooding.
        - Project 212 – Get municipalities involved in green infrastructure. Enable more green infrastructure projects by removing cost and knowledge barriers.

Rockland County and Orange County Hazard Mitigation Plans

- The Rockland County Plan "…demonstrates county and community commitment to reducing risks from all hazards and serves as a guide for decision makers as they commit resources to minimize the effects of hazards. The HMP is the blueprint for reducing the county's vulnerability to disasters and hazards. The HMP is intended to integrate with county and municipal planning mechanisms already in place, such as building and zoning regulations, environmental planning, and long-range planning mechanisms."
    - Communities within the Ramapo watershed had Jurisdictional Annexes developed detailing information about their community as well as recommendations for projects to be undertaken to mitigate different types of hazards, including flooding.

- The purpose of the Orange County Plan "…is to effectively reduce future disaster damages, public expenditure, private losses, and community hazard vulnerability. This plan update provides an opportunity for Orange County and its municipalities to develop a comprehensive risk assessment and to outline proposed mitigation actions to minimize the costs and impacts of future disaster events."
    - All Orange County communities within the Ramapo watershed, except Kiryas Joel, had a Jurisdictional Annex developed detailing information about their community as well as recommendations for projects to be undertaken to address hazards.

6.2 MUNICIPAL ASSESSMENTS

The following section details individual recommendations for each community being assessed within the Ramapo watershed. Following these write-ups are "best practices" that each community can review to assess whether or not they are already in their municipal code or are an opportunity to enhance the code

to further protect municipal resources, residents, businesses, and the natural environment from unplanned and unwanted impacts from flooding.

6.2.1 TOWN OF HAVERSTRAW

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/11795031

The town has a Flood Damage Prevention code (Chapter 87). This code has standards related to elevation and flood-resistant construction.

The town also has a Subdivision of Land code (Chapter 87), Freshwater Wetlands code (Chapter 90), Stormwater Management code (Part 3), and a Special Permit Uses code (Article 5). Within Article 5, Section 167-36 – multifamily housing in the Water Replenishment District (WRD), there are provisions to exclude water bodies from the buildable lot area. Additionally, the first floor elevation for all buildings and parking areas shall be above the limits of the floodplain (adjusted for wave action – no less than 2 feet above the 100-year floodplain). Regarding minimum lot area, no more than 50 percent of any lot may include lands under water or within the 100-year floodplain.

Other Land Use documents reviewed:

- *Rockland Tomorrow: County Comprehensive Plan* 2011
  Specific elements detailed in the plan specific to the Town of Haverstraw include the following:
  - Land Use and Zoning Chapter
    - Key issues identified: The riverfront presents significant opportunities for Haverstraw's revitalization, especially with the existence of the Haverstraw-Ossining ferry service. Constraining issues in the town include the ongoing presence of waterfront industry, which, while important to the town's economic development strategy, can affect future redevelopment of the waterfront and impede public access to the Hudson River – and the challenge of providing ways to safely connect isolated commercial and multifamily housing uses.
  - Floodplains – High flood risk – large flood zones along Hudson River.

6.2.2 VILLAGE OF POMONA

Zoning & Other Code(s) Analysis

https://ecode360.com/12718574

The village has a Flood Damage Prevention code (Chapter 79) adopted in 2014. This code has standards related to elevation and flood-resistant construction.

The village also has a Subdivision of Land code (Chapter 79), Wetlands code (Chapter 126), and a Stormwater Management code (Chapter 114). Additionally, Section 130-10, Special Permit uses, has a minimum net lot area calculation and states that no portion of any land under water counts towards the net lot area and no more than ¼ of the lot that is a wetland or within the 100-year floodplain can be counted towards the net lot area. The tree permit removal process requires a plan showing wetland and floodplain areas (Section 121-5). Finally, Chapter 119, Site Development Plan Review, requires that "…the proposed activity and the manner in which it is to be accomplished will not adversely affect the preservation and protection of existing wetlands, water bodies, watercourses and floodplains."

Stormwater Management

Other Land Use documents reviewed:

- The village is located partly in the town of Haverstraw and partly in the town of Ramapo. The village did not have any publicly available municipal planning documents for review, but documents for each of the towns were reviewed under the associated sections herein.

6.2.3 VILLAGE OF WESLEY HILLS

Zoning & Other Code(s) Analysis

https://ecode360.com/27842469

The village has a Flood Damage Prevention code (Chapter 119). This code has standards related to elevation and flood-resistant construction. There are requirements in the special permit uses for schools that limit wetlands and the 100-year floodplain to no more than one-quarter of the minimum lot area (Section 230-26).

The village also has a Subdivision of Land code (Chapter 193), a Wetlands code (Chapter 221), and a Stormwater Management code (Chapter 181). Additionally, the Table of Dimensional Requirements states that not more than 25 percent of any land under water, within a 100-year frequency floodplain, within utility easements or other easements or rights-of-way, or with unexcavated slopes over 25 percent shall be counted toward the minimum lot area. Chapter 221 defines wetlands as all lands and waters designated on the State Wetlands Map, which have a contiguous area of at least 1/10 of an acre and which contain other elements such as submerged lands, wetland vegetation, etc.

Other Land Use documents reviewed:

The Village of Wesley Hills did not have any publicly available municipal planning documents for review.

6.2.4 VILLAGE OF NEW HEMPSTEAD

Zoning & Other Code(s) Analysis

https://ecode360.com/30180572

The village has a Flood Damage Prevention code (Chapter 154). This code has standards related to elevation and flood-resistant construction.

The village also has Subdivision of Land code (Chapter 255), Freshwater Wetlands code (Chapter 159), and a Stormwater Management Code (Chapter 245). Additionally, no part of any land within an access easement or right-of-way shall be counted toward the minimum lot area. Only 25 percent of any land under water or within land defined as a wetland by Chapter 159 or within a 100-year-frequency floodplain or within a drainage easement containing open drainage channels or facilities or within a utility easement containing overhead lines or equipment or with unexcavated slopes over 25 percent shall be counted toward the minimum lot area. Only 75 percent of any land within a conservation easement or within a drainage easement containing only piped drainage facilities or within a sewer easement or utility easement containing only underground facilities shall be counted toward the minimum lot area. The rules set forth herein shall apply with equal effect to preexisting and proposed easements and rights-of-way.

Other Land Use documents reviewed:

- *Village of New Hempstead Comprehensive Plan – 2020*
  - The Village Comprehensive Plan is a policy document focused on nine basic land use planning-focused principles. None of the principals specifically list flooding.
  - There are four areas with 100-year floodplain and one location with a 500-year floodplain. The plan recommended that the village "promote" setbacks from a stream and elevation above the BFE for new development and additions.
  - The Plan notes that the village is working with others to form a Stormwater Consortium that could, among other objectives, "…attenuate flood risk." *The status of this consortium should be confirmed as this is a positive step toward coordinated efforts that cross municipal boundaries.*
  - Quality Neighborhoods Goal #9 is to "Promote stormwater quality and ensure there is not increased potential flooding from land use layouts which enable rapid flows off-site…"

6.2.5 TOWN OF RAMAPO

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/11858832

The town has a Flood Damage Prevention code (Chapter 149). This code has standards related to elevation and flood-resistant construction.

The town also has a Streams and Watercourses section (Chapter 240), a Special Bulk Requirements section (Section 376-42), cluster regulations (Section 376-42), and a Stormwater Management and Sediment and Erosion Control Section (Chapter 237). Section 376-42 of the Zoning Ordinance requires that not more than 50 percent of a lot be land under water or land in the 100-year floodplain. Finally, buffers are a defined term in the code, but there do not appear to be requirements for vegetated buffer zones along watercourses.

Other Land Use documents reviewed:

- *Town of Ramapo Comprehensive Plan 2004*
  - Assess whether or not to enact a wetlands law to provide an additional level of protection for wetlands. *Wetlands are a defined term in the Stormwater Control regulations, but there do not appear to be stand-alone wetlands regulations.*
  - Assess whether or not to require vegetation buffer zones along watercourses.
  - Consider reducing the permitted development intensity by:
    - Requiring that the area of the lot without the specified impediments be a contiguous area and in a location on the lot that makes development on it feasible in light of other considerations.
    - Increase the percentage of the lot that must be free of the specified impediments from 50 percent to a higher percentage (e.g., 75 percent).
    - Require that wetland areas be dedicated from minimum lot area requirements.
    - Consider decreasing the percentage of such areas that may be counted towards meeting the lot area requirement from 50 percent to a lower percentage (e.g., 25 percent).
    - Apply these provisions to lots intended for nonresidential use – the first sentence of Section 376-42.A states that these provisions apply only to a minimum lot area requirement for residential uses.

  Some code changes that relate to these topics have been implemented since the 2004 Comprehensive Plan.
  - For Subdivision regulations, consider the following revisions:
    - Identify any standards that are inconsistent with the objective of minimizing overall land disturbance during subdivision development. Examples include reducing roadway widths, required cul-de-sac dimensions, etc. to reduce the amount of land disturbance and impervious surface.
  - The Town of Ramapo should protect rivers and streams, including their riparian buffers, banks, and floodplains. Preference should be given to:
    - Properties within the 100-year floodplain of rivers and streams
    - Properties adjacent to the water bodies identified as stressed, threatened, impaired, or precluded on the New York State Department of Environmental conservation Priority Water Body List.

- Properties adjacent to Class A (a water body classified by the NYSDEC as suitable for swimming) rivers or streams, or rivers and streams that support fish.
- Riparian buffers (an area of trees, shrubs, and herbaceous vegetation located adjacent to and upslope from a lake, stream, or other body of water that maintains stream system integrity, protects water quality, and improves the habitat of plants and animals on land and in the water) along stream or river corridors.
- Properties that surround or adjoin springs or intermittent streams.

Some code changes that relate to these topics have been implemented since the 2004 Comprehensive Plan.

- The town should protect its watershed. Preference should be given to:
  - …Wetlands, floodplains, and riparian buffers.
- For Housing…
  - Properties to be considered for multifamily rezoning should be unencumbered by environmental resources such as steep slopes, wetlands, streams, floodplains, and other factors that would suggest that the property is not suitable for the intensity of development proposed.

A Northeast Ramapo Strategic Plan is/was under development. The Generic Environmental Impact Statement/State Environmental Quality Review Act (GEIS/SEQRA) forms are online, but the Plan was not.

6.2.6 VILLAGE OF MONTEBELLO

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/8769742

The village has a Flood Damage Prevention Ordinance code (Chapter 92). This code has standards related to elevation and flood-resistant construction.

The village also has a Wetland and Stream Protection Ordinance (Chapter 191) that was amended in its entirety in 2018, Subdivision of Land code (Chapter 163), and Stormwater Management code (Chapter 158).

Other Land Use documents reviewed:

- 2017 Comprehensive Plan (Link: Comprehensive Plan | Village of Montebello, NY)
  - Develop a Village Greenprint Environmental Protection Overlay District (EPOD). This recommendation is to encourage clustering within environmentally sensitive areas to limit large lot development without increasing average density. Remaining environmentally sensitive areas should be preserved within contiguous open

space systems that are protected through easement or dedication to the village and should not be "chopped" up among individual properties wherever possible. It should be clarified that variances are not permitted to be sought in order to increase the density of the standard layout prior to application of average density. *Floodplain, wetland, and steep slopes Environmental Protection Overlay Districts were adopted into the code in 2019.*

- Revise zoning to limit development within environmentally sensitive areas. The village's current zoning law requires larger minimum lot sizes for properties constrained by certain features, e.g., floodplains, wetlands, water bodies, and steep slopes, in order to protect these sensitive environmental features. The Zoning Code limits but does not prohibit development within these sensitive areas. The plan recommends that the Zoning Code be revised to further limit potential disturbance to the environmentally sensitive features and to provide no credit for sensitive environmental features when determining size. The village could consider increased buffers (up to 300-foot buffers) for certain wetlands and waterways that are in areas specifically prone to flooding, similar to recent New Jersey state regulations. These revisions may be potentially done through the EPOD legislation. *The bulk requirements table has been updated several times since 2017, although these standards apply to all development within the 29 use types, not just those with sensitive environmental areas. The Table of General Use Requirements does not appear to include limitations on development within environmentally sensitive areas by district.*

6.2.7 VILLAGE OF SUFFERN

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/13756491

The Village of Suffern has a Flood Damage Prevention Ordinance code (Chapter 141). This code has standards related to elevation and flood-resistant construction.

The village also has a Critical Environmental Area Overlay District (Section 266.18), a Subdivision of Land code (which is under development at the time of drafting this write-up), and a Floodplain District (Chapter 266). Section 266-17 restricts the construction or placement of structures that will "…adversely affect the efficiency or the capacity of the floodway or increase flood heights, cause increased velocities or obstruct or otherwise catch or collect debris which will obstruct flow under flood conditions."

Other Land Use documents reviewed:

- Village Comprehensive Plan – An update to the Comprehensive Plan for the village was out to bid at the time of this document being drafted. The RFP states that there are no known copies of the existing plan.

6.2.8 VILLAGE OF HILLBURN

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/15367578

The village has a Flood Damage Prevention code (Chapter 130). This code has standards related to elevation and flood-resistant construction.

The village also has Subdivision of Land code (Chapter 210), Critical Areas of Environmental Concern regulations (Section 105), and Stormwater Management code (Chapter 198). The village has the ability to designate critical areas of environmental concern by resolution (Section 105). There are Stormwater Management regulations (Chapter 198) and regulations in the Subdivision regulations that pertain to the use of land in a floodplain (Chapter 210).

Other Land Use documents reviewed:

- The Village of Hillburn did not have any publicly available municipal planning documents for review.

6.2.9 VILLAGE OF SLOATSBURG

Zoning & Other Code(s) Analysis Highlights

https://static1.squarespace.com/static/5ffb0bf6fe0aa250928500e6/t/600dd3f8c42d5b31a3c6a8ac/1611518974683/CompZoningRevZ1.6.pdf

The village does not have a Flood Damage Prevention code. The Zoning Code has a short section discussing the importance of flood prevention in Section 54-49 titled *Federal Flood Hazard Regulations*.

This section lists three specific purposes: to restrict or prohibit uses that are dangerous to health, safety, or property in times of flood or that cause increased flood heights or velocities; to require uses vulnerable to floods to be provided with flood protection at the time of initial construction; and to protect individuals from buying lands that are unsuited for intended purposes because of flood hazards. Per a conversation with the village building inspector, the village passed *Flood Hazard Regulations of the Village of Sloatsburg,* which resulted in the village utilizing NYSDEC and Rockland County Drainage Agency (RCDA) guidance when reviewing projects within a floodplain. The flood boundary maps dated January 6, 1982, as amended, are used to identify flood hazard areas.

The village also has Stormwater Management regulations (Chapter 54).

Other Land Use documents reviewed:

- Rockland County Hazard Mitigation Plan (HMP) – Village of Sloatsburg Annex – The Annex document included several ongoing projects and two new projects. The new mitigation initiatives included a project to notify facility managers/operators of potential mitigation measures to consider for the Pine Grove Pond water tower, NYS Thruway, and Sloatsburg/Ramapo Service Area. The second mitigation initiative was to raise the Sloatsburg Wastewater Treatment Plant utilities and other mechanical devices above the BFE.

- Village of Sloatsburg 2007 Comprehensive Plan – The plan noted that there is an extensive floodplain system associated with the Ramapo River, and as a result, the village is subject to flooding on both sides of the river, primarily within the Ramapo River valley floor. Streams associated with the Ramapo River, Stony Brook, and Nakoma Brook also have floodplains and are subject to flooding. Portions of the village's early development, including the Central Business District and the "Flats," are located within the 100-year floodplain. The Land Use Plan evolved from consideration of a number of factors, including the natural environment and its sensitivities, including constraints to development created by the presence of floodplains, among other elements. The Plan identified the former Oakbrook Shopping Center 11.4-acre parcel as a large vacant property in the downtown district that is located within the 100-year floodplain. It also recommended that the village consider designating the Ramapo River as a Critical Environmental Area (CEA) based on the numerous environmental sensitivities, including the floodplain (it has since been classified as a CEA).

- Village of Sloatsburg 2006 Comprehensive Plan, Central Business District, and Zoning Draft Generic Environmental Impact Statement (DGEIS) – The DGEIS noted that any future development of the former Oakbrook Shopping Center will depend on the extent to which any uses can be safeguarded from flooding and stormwater management can be addressed. It further stated that any project proposal would have to specifically document how it can be designed to conform to applicable local and federal flood regulations. It also notes that most of the county-owned parkland is located within the Ramapo River floodplain and that lands along the Ramapo River should be acquired by the village, county, or state to protect the river from development runoff and to maintain flood levels downstream.

6.2.10 TOWN OF WARWICK

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/11766563

The town has a Flood Damage Prevention code (Chapter 89). This code has standards related to elevation and flood-resistant construction.

The town also has a Subdivision of Land code (Chapter 137), Cluster Development Regulations (Section 164-41.1), and Stormwater Management Regulations (Section 164.47.10).

Other Land Use documents reviewed:

- Orange County HMP – Town of Warwick Annex - The Annex document included several ongoing projects and two new projects. The new mitigation initiatives involved floodproofing existing facilities, only one of which is within the jurisdiction of the village. The project is to protect the Fourth Street pump station by installing appropriate physical protective measures to mitigate future flood losses. This project was classified as a medium priority.

- Town Comprehensive Plan – The 2016 Update added a chapter on Sustainability. This chapter included a section on protecting habitats and water quality, including a recommendation to amend the town's regulations to recognize the need for upland buffers to be established to smaller wetlands. The update also suggests identifying critical watersheds, adopting local preservation practices, and coordinating with other jurisdictions within a shared watershed. The 2008 Comprehensive Plan included several discussions related to flooding, including a reference to the fact that the Subdivision Regulations require that the Planning Board "encourage" the preservation of floodplains, among other things.

- Community Preservation Project – A key element of the Town of Warwick Community Preservation Fund was the creation of the Community Preservation Project Plan, which was considering additional regulatory techniques and subdivision, zoning, and wetland protection laws as well as consideration of other conservation strategies. The town also has a Community Preservation Fund to fund projects identified in the Community Preservation Plan, and Flood Damage Prevention is an alternative to protect community character.

6.2.11 VILLAGE OF TUXEDO PARK

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/11136428

The village has a Flood Damage Prevention code (Chapter 55). This code has standards related to elevation and flood-resistant construction.
The village also has a Subdivision code (Chapter 85) and Stormwater Management regulations (Section 85-25). Neither set of regulations specifically discuss regulations pertaining to flooding, although in many cases it is embedded within the general requirements (mostly covered by Chapter 55).

Other Land Use documents reviewed:

The Village of Tuxedo Park did not have any publicly available municipal planning documents for review.

6.2.12 TOWN OF TUXEDO

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/12917388

The town has a Flood Damage Prevention code (Chapter 53). This code has standards related to elevation and flood-resistant construction.

The village also has a Subdivision code (Chapter 85). The code restricts land that floods from being platted for residential use and requires engineering analysis of impacts from proposed development on potential flooding and stream capacity.

The town zoning code was undergoing a revision in 2021 while this document was being drafted. One of the purposes stated in the draft document was "To protect the Town's sensitive environmental features, including but not limited to…wetlands, streams, ponds, lakes and other surface water features, and the 100-year floodplain from disturbances which would have a significant negative impact on the Town's population and environs." The proposed document includes a section titled Federal Flood Hazard Areas and has specific regulations and standards related to the 100-year floodplain. The existing adopted code found online (in the fall of 2021) did not appear to include the proposed 2021 revisions.

Other Land Use documents reviewed:

- The town's Comprehensive Plan was updated in 2018. The plan notes that the Ramapo River aquifer basin is a federally designated sole-source aquifer located within EPA Region 2 established under the Safe Drinking Water Act (SDWA). The plan states that a major source of recharge for the valley-fill aquifer is naturally occurring seepage from the Ramapo River during flood stages. The plan references a study published in 1974 that documented the existence of a hydraulic connection between the Ramapo River and the valley-fill aquifer. Additionally, the plan update states that it supports recommendations from the Watershed Management Plan, including, specifically, supporting a review of the 1985 Flood Mitigation Study performed by the USACE NY District for current support and applicability. An implementation action item on a long-term time horizon (10+ years) is to dredge locations in the Ramapo River to improve water quality; flood control in coordination with NYSDEC, USACE, and the town board.

- Although not a planning document, the Tuxedo Farms project, located on approximately 2,300 acres of land generally parallel to the Ramapo River (but on the west side of Route 17 – not immediately adjacent to the river), is a large approved project currently being discussed for potential amendments to the site plan. While the developer has an approved plan for 1,200 units, they are looking to amend the plan to provide approximately 2,000 residential units (3,460 bedrooms – up from 2,860, not including active adult bedrooms). While this project does not border the Ramapo River, there are at least two streams from within the

proposed development area that run into the Ramapo River. The northern stream enters the Ramapo River near Schoolhouse Road while the southern stream enters near Park Avenue.

6.2.13 VILLAGE OF HARRIMAN

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/12443678

The village has a Flood Damage Prevention code (Chapter 82). This code has standards related to elevation and flood-resistant construction.

The village also has a Subdivision of Land code (Chapter A146) and Stormwater Control code (Article XIII). The Subdivision of Land code states that land subject to periodic or occasional flooding shall not be platted for residential occupancy, nor for any other use that may endanger life or property.

Other Land Use documents reviewed:

- The Village of Harriman did not have any publicly available municipal planning documents for review.

6.2.14 VILLAGE AND TOWN OF WOODBURY

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/13241574

The village and town boundaries are the same except for a portion of the town in the village of Harriman. All planning and zoning for both the town and village (outside the village of Harriman) has been administered by the village since 2007.

The village (and town) have a Flood Damage Prevention code (Chapter 82). This code has standards related to elevation and flood-resistant construction.

The village also has a Subdivision of Land code (Chapter 272), Cluster Development section (Section 310.31), Flood Hazard Areas code (Chapter 161), and Stormwater Management and Erosion and Sediment Control code (Chapter 267). The Flood Hazard Areas section (Chapter 161) states that the Village of Woodbury assures the Federal Insurance Administration that it will enact and maintain in force as necessary land use and control measures consistent with the criteria in Section 1910 of the NFIP regulations. This section vests responsibilities, authority, and means to the Code Enforcement Officer and Village Engineer per this section and details building permit application processes for building permits, subdivision proposals, and water supply and sewage systems. The village Subdivision of Land code states that land shall not be platted for residential or any other subdivision use if it cannot safely be used for

such purposes without danger to health or peril from fire, flood or other menace. Finally, the Cluster Development section (Section 310.31) authorizes cluster development on a case-by-case basis in all residential zoning districts.

Other Land Use documents reviewed:

- Village of Woodbury Comprehensive Plan (2008 – Updated 2018) – Section 7 (Natural Resources) includes a goal to protect Woodbury's important natural resources and includes floodplains, wetland systems, and unique ecosystems.
    - It also includes a recommendation regarding development proposals and stormwater management/water quality/water quantity that includes, among other recommendations, that regulations not allow development to create downstream flooding or offsite erosion. Regarding wetlands, the plan notes that the preservation of wetlands is important because, among other things, it reduces flood damage.
    - There is a floodplains section that discusses how floodplains serve as a temporary natural water storage area and reduce peak flows during flooding, thereby limiting downstream bank erosion.
    - A 2008 Village Open Space and Natural Resource Protection Plan was included as an addendum to the Comprehensive Plan. A high-priority recommended next step was for the village to undertake development of a stream corridor management plan.

6.2.15 VILLAGE OF KIYAS JOEL

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/11011273

The village has a Flood Damage Prevention code (Chapter 77). This code has standards related to elevation and flood-resistant construction.

The village also has a Subdivision of Land section (Section 155-14), Stormwater Management code (Chapter 125), and Stormwater Management code (Chapter 125). The Stormwater Management code focuses on regulating actions to prevent stormwater pollution and requires assessment of stormwater runoff and hydrologic and hydraulic analysis (for structures), identification of receiving waters for runoff, and water quantity and quality controls for land development activities.

Other Land Use documents reviewed:

- The Village of Kiryas Joel did not have any publicly available municipal planning documents for review.

6.2.16 TOWN OF BLOOMING GROVE

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/6947045

The town has a Flood Damage Prevention code (Chapter 132). This code has standards related to elevation and flood-resistant construction.

The town also has a Subdivision of Land code (Chapter 210) and Stormwater code (Chapter 201). The Subdivision Code Design Standards require that a tract be adequately drained, that land in wetlands and floodplains shall be preserved as undeveloped open space, and that a subdivision be designed to prevent flooding.

Other Land Use documents reviewed:

- Comprehensive Plan – The town's Comprehensive Plan was drafted in 2005 and subsequently updated in 2017. While the 2017 update's only reference to flooding pertains to Camp Laguardia, a former institutional facility not located within the Ramapo watershed, the 2005 plan did include significant references and details related to flooding and land use.
    - The Natural Resources Inventory Chapter Wetlands section notes that floodplains, which often coincide with wetlands, must be protected. This section, however, does not mention the Ramapo watershed as a major floodplain issue likely because only a small portion of the watershed lies within the town, and it is the northwesternmost portion of the watershed that is in effect the beginning of the watershed area and nowhere near the Ramapo River itself.
    - The Natural Resources Goals and Objectives state that all new development should be sensitive to the existing natural resources. No new development should be located in, on, or harm environmentally sensitive areas, including, among others, floodplains, streams, rivers, creeks, lakes, ponds, and reservoirs.
    - The Natural Resources: Surface Water chapter recommended that the town protect the water quality of surface water bodies by establishing a surface water buffer area that regulates certain activities and improvements within 100' of any water body (including wetlands) in coordination with the existing Flood Damage Protection standards. Such regulations should include reduced residential densities and safeguards for wastewater treatment.

- Open Space Inventory – Created in 2019, the Open Space Inventory Map identified Open Space Area Priorities. Based upon a comparison of two existing PDF maps, within the Ramapo watershed area in the town, only the West Slope of Schunnemunk Mountain in South Blooming Grove may be within the Ramapo watershed. It is possible only Gonzaga Park is within the watershed and not the West Slope area.

- Natural Resource Inventory – This inventory was created in 2020. The Water Resources section discusses how poorly planned housing and business development in a watershed can dramatically increase the amount of stormwater runoff leading to several issues, including increased flooding risk. The focus of flooding in this Inventory is on the Moodna Creek watershed, not the Ramapo watershed; however, several elements of the plan speak generally to floodplains, which are relevant to any watershed.
    - The Flood Zones and Flooded Roads section discusses how local governments can play an important role in reducing the negative impacts of floods and that floodplains reduce downstream flood damage and serve as a safety zone between human settlement and the damaging impacts of floods and provide many other benefits as well as concerns.
    - The inventory includes a chapter on climate conditions and projections, including a discussion about precipitation patterns changing to bring about more rain (a 71 percent increase in the Northeast) and less snow, resulting in less aquifer recharge. The document recommends that Blooming Grove become climate resilient through several efforts, including the following:
        - Conduct a resiliency assessment of municipal and county documents.
        - Develop or update a vulnerability assessment.
        - Engage in a public information and outreach effort on the effects of historic storms and the benefits of floodplains.
        - Reference plans that address hazard exposure reduction and reduction in property loss.
        - Encourage building and permitting officials to complete training on retrofitting flood-prone residential buildings.

6.2.17 VILLAGE OF SOUTH BLOOMING GROVE

Zoning & Other Code(s) Analysis Highlights

https://www.villageofsouthbloominggrove.com/village-codes/

The village has a Flood Damage Prevention code (Chapter 232). This code has standards related to elevation and flood-resistant construction.
The village also has a Subdivision of Land code (Chapter 163) and Stormwater Management code (Chapter 158). The Subdivision code requires that low-lying lands along watercourses subject to flooding or overflowing during storm periods be preserved and retained in their natural state as drainage ways. While the village has its own Zoning Ordinance, Planning Board, and Zoning Board of Appeals, the Building Department elements are managed by the Town of Blooming Grove.

Other Land Use documents reviewed:

- The Village of South Blooming Grove did not have any publicly available municipal planning documents for review. Based upon review of a Village Board Resolution dated September

2021, it appears that the village, at the time of writing this document, is beginning the development of a Comprehensive Plan for the village.

6.2.18 VILLAGE OF MONROE

Zoning & Other Code(s) Analysis Highlights

https://ecode360.com/MO0222?#MO0222

The village has a Flood Damage Prevention code (Chapter 107). This code has standards related to elevation and flood-resistant construction.

The village also has a Subdivision of Land code (Chapter 175) and Stormwater Management code (Chapter 168). The Subdivision code states that for lots to be considered buildable, they must have no foreseeable difficulties for reasons of topography or other natural conditions. A lot proposed for single-family use must be at least 5,000 square feet with minimum dimensions of 25' meeting all zoning district requirements relative to setbacks, slopes, and other criteria.

Other Land Use documents reviewed:

- There are several reports and presentation found on the village's website. The only document that discussed flooding directly is the Village Comprehensive drafted in 2013.
    - The plan discusses the two overlay districts in the village. One of the overlays is the Environmentally Sensitive Overlay, which limits use of land by right to only parks and agriculture and requires a conditional use permit for any other use. The aim of the district is to require more significant Planning Board review for those applications, which include wetlands, water bodies, flood zones, or other sensitive environmental features.
    - The plan recommends that higher-density residential through multifamily/ townhouse overlay zones be permitted along the Route 17M corridor between Stage Road and Still Road. It notes, however, that some of the land has limited development potential due to flooding concerns but that with good design and compensating flood storage, structure parking can be provided within flood zone areas, allowing better use of the land.

6.3 BEST PRACTICES RECOMMENDATIONS

The following details best practices concepts and implementation options identified in several documents, including documents assessed from within Rockland and Orange Counties, the American Planning Association PAS Report 6 of 2018 and PAS Report 3 of 2016, which summarized flood mitigation actions from across the country, the NYSDOS Model Local Laws Increase Resilience webpage, and New York City Zoning for Flood Resiliency website.

The following divides the best practice recommendations into two categories – zoning and subdivision. As noted in the PAS Reports, the "…zoning code can be used to enable local elevation and mitigate its impacts through design standards and bulk regulations. Design standards can help to encourage a continuity of local character and give developers and homeowners a menu of potential options that can mitigate increased height, exposed piers and piles, and open spaces beneath the structure. The zoning and building code can be used to add additional freeboard above the FEMA BFE to account for sea-level rise and to retain and expand existing architectural design elements for raised structures."

These reports note that overlays can be used to protect areas without needing to adjust the underlying zoning. In effect, the Flood Damage Prevention Ordinances already in place essentially act as an overlay mapped through alternative map resources (FIRM mapping), which provides a specific geographic area within which such regulations apply.

Communities within the Ramapo watershed have in many cases undertaken the implementation of many positive regulatory actions to help mitigate the impacts of flooding within their communities. Land use planning is an action that is always searching for answers to existing problems and concerns as well as those that are anticipated in the future. Consideration of additional potential best practices to enhance the protection of property, riparian buffers, the Hudson River, tributaries, and other water bodies is essential to continuing the work already undertaken and maximize its impact now and into the future.

The following zoning regulatory actions should be reviewed and assessed for potential incorporation into local laws where applicable and feasible.

Resources utilized to develop the best practices audit matrix above included the following:

- https://dos.ny.gov/model-local-laws-increase-resilience
- https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/flood-resiliency-update/zoning-for-flood-resiliency.pdf
- https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Zoning-Practice-2018-06.pdf
- https://planning-org-uploaded-media.s3.amazonaws.com/document/Zoning-Practice-2016-03.pdf

As a component of this flood analysis, a Flood Resiliency Best Practices Audit was conducted for each watershed community. A map with the boundaries of the Ramapo River watershed and the towns and villages that fall within it is depicted in Figure 6-1. Results of the audit are presented in the following tables:

Rockland County:
Table 6-1: Town of Haverstraw
Table 6-2: Village of Pomona
Table 6-3: Village of Wesley Hills
Table 6-4: Village of New Hempstead
Table 6-5: Town of Ramapo

Table 6-1: Flood Resiliency Best Practices Code Audit Checklist

Town of Haverstraw, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☑	☐	☐	All multifamily housing developments in the WRD must provide permanent public access to the Hudson Riverfront.
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. Multi-family housing in the WRD district has a 2' above floodplain limitation adjusted for wave action. For non-residential structures, the lowest floor should be elevated 2' above BFE if no FIRM number is specified. Structures are to be floodproofed so that the structure is watertight below two feet above the base flood elevation, including utilities and sanitary facilities. Within the A, when no base flood data are available, the lowest floor (including basement) shall be elevated at least 3' above the highest adjacent grade.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	

Table 6-1: Flood Resiliency Best Practices Code Audit Checklist

Town of Haverstraw, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is conducted and the Village applies to FEMA for conditional Firm and floodway revision and approval is received.
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property. Waterbodies are excluded are excluded from buildable lot area calculations.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☑	☐	☐	The code states that the Planning Board can modify provisions to enable and encourage flexibility of design nd development of land in such a manner as to promote the most appropriate use of land.
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. There are code requirements that only a percentage of land underwater count toward minimum lot area. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development shall in certain circumstances provide the data for projects greater than 2 acres or 5 lots.

Table 6-1: Flood Resiliency Best Practices Code Audit Checklist

Town of Haverstraw, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 87

Subdivision of Land - Chapter A176

Stormwater Management - Part 3

Freshwater Wetlands - Chapter 90

Special Permit Uses (Multifamily in WRD) - Article 5

Table 6-2: Flood Resiliency Best Practices Code Audit Checklist

Village of Pomona, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE if no FIRM number is specified. Structures are to be floodproofed so that the structure is watertight below two feet above the base flood elevation, including utilities and sanitary facilities. Within the A, when no base flood data are available, the lowest floor (including basement) shall be elevated at least 3' above the highest adjacent grade.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas,

Table 6-2: Flood Resiliency Best Practices Code Audit Checklist

Village of Pomona, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. Furthermore, whenever any portion of a floodplain is authorized for development, the volume of space occupied by the authorized fill or structure below the base flood elevation shall be compensated for and balanced by a hydraulically equivalent volume of excavation taken from below the base flood elevation at or adjacent to the development site. All such excavations shall be constructed to drain freely to the watercourse. No area below the waterline of a pond or other body of water can be credited as a compensating excavation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	

Table 6-2: Flood Resiliency Best Practices Code Audit Checklist

Village of Pomona, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. There are code requirements that a lot not contain more than certain percentage of floodplain. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development shall in certain circumstances provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 79

Subdivision of Land - Chapter 118

Stormwater Management - Chapter 114

Table 6-3: Flood Resiliency Best Practices Code Audit Checklist

Village of Wesley Hills Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3' of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18" of freeboard in the "shaded X" area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24". This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE if no FIRM number is specified. Structures are to be floodproofed so that the structure is watertight below two feet above the base flood elevation, including utilities and sanitary facilities. Within the A, when no base flood data are available, the lowest floor (including basement) shall be elevated at least 3' above the highest adjacent grade.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas,

Table 6-3: Flood Resiliency Best Practices Code Audit Checklist

Village of Wesley Hills Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. There are code requirements that only a percentage of land underwater count toward minimum lot area. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development shall in certain circumstances provide the data for projects greater than 5 acres or 50 lots.

Table 6-3: Flood Resiliency Best Practices Code Audit Checklist

Village of Wesley Hills Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 119

Subdivision of Land - Chapter 193

Stormwater Management - Chapter 181

Wetlands - Chapter 221

Table 6-4: Flood Resiliency Best Practices Code Audit Checklist

Village of New Hempstead Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3' of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18" of freeboard in the "shaded X" area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24". This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE if no FIRM number is specified. Structures are to be floodproofed including utilities and sanitary facilities. Within the A, when no base flood data are available, the lowest floor (including basement) shall be elevated at least 3' above the highest adjacent grade.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	

Table 6-4: Flood Resiliency Best Practices Code Audit Checklist

Village of New Hempstead Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☐	☐	☐	forward.
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. There are code requirements that only a percentage of land underwater count toward minimum lot area. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development shall in certain circumstances provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	

Table 6-4: Flood Resiliency Best Practices Code Audit Checklist

Village of New Hempstead Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☑	☐	☐	The Sketch Plat requirements don't specifically state that floodplain areas need to be shown but it appears to be implied and consistent with the requirements of the code and flooding is noted as an element of the character of a parcel that is of importance to the Village.
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 154

Subdivision of Land - Chapter 255

Stormwater Management and Erosion and Sediment Control - Chapter 245

Freshwater Wetlands - Chapter 159

Table 6-5: Flood Resiliency Best Practices Code Audit Checklist

Town of Ramapo Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE if no FIRM number is specified. Structures are to be floodproofed so that the structure is watertight below two feet above the base flood elevation, including utilities and sanitary facilities. Within the A, when no base flood data are available, the lowest floor (including basement) shall be elevated at least 3' above the highest adjacent grade.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-5: Flood Resiliency Best Practices Code Audit Checklist

Town of Ramapo Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Regulations are subject to specific FIRM maps detailed in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	There is a cluster provision in the code.
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. There are code requirements that only a percentage of land underwater count toward minimum lot area. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development shall in cetain circumstances provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	

Table 6-5: Flood Resiliency Best Practices Code Audit Checklist

Town of Ramapo Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☑	☐	☐	The code includes a Streams and Watercourses section prohibiting certain actions along these features.
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 149

Stormwater Management and Sediment and Erosion Control - Chapter 237

Special Bulk Requirements - §376-42

Clustering - §376-43

Streams and Watercourses - Chapter 240

Table 6-6: Flood Resiliency Best Practices Code Audit Checklist

Village of Montebello Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE if no FIRM number is specified. Structures are to be floodproofed including utilities and sanitary facilities. Within the A, when no base flood data are available, the lowest floor (including basement) shall be elevated at least 3' above the highest adjacent grade.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-6: Flood Resiliency Best Practices Code Audit Checklist

Village of Montebello Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. Construction, alteration or enlargement of any habitable building in a 100-year flood area requires Planning Board site development plan review in addition to a floodplain permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	The Flood Damage Prevention Ordinance requires subdivisions to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	The code prohibits construction, alteration or enlargement of any habitable building in a 100-year flood area without a floodplain permit and Planning Board site plan approval.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	

Table 6-7: Flood Resiliency Best Practices Code Audit Checklist

Village of Suffern, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE, including utilities and sanitary facilities, with walls substantially impermeable to the passage of water. Within the AO, non-residential must be completely floodproofed to 2' above BFE. When no base flood data are available, the lowest floor (including basement) shall be elevated at least 3' above the highest adjacent grade. The Floodplain District has specific standards and notes that a Special Use Permit is required for uses in the Floodplain District.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-7: Flood Resiliency Best Practices Code Audit Checklist

Village of Suffern, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☑	☐	☐	Cluster development must be considered for projects in the Critical Environmental Area Overlay District and Board of Trustees approval for such development must be given.
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development shall in certain circumstances provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	

Table 6-7: Flood Resiliency Best Practices Code Audit Checklist

Village of Suffern, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 141

Floodplain District - §266.17

Critical Environmental Area Overlay District - § 266.18

Subdivision of Land - Chapter 239. *Note: This code section included a note stating that the regulations are under review and will be included in the code when the process is complete. As such, there were no standards to review for this assessment*

Table 6-8: Flood Resiliency Best Practices Code Audit Checklist

Village of Hillburn, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE, including utilities and sanitary facilities, with walls substantially impermeable to the passage of water. Within the AO, non-residential shall have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as 2' above the depth number specified in feet on the community's FIRM or along with utilities and sanitary facilities, be completely floodproofed to that level to meet floodproofing standards. The Floodplain District has specific standards for uses in the Floodplain District.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	

Table 6-8: Flood Resiliency Best Practices Code Audit Checklist

Village of Hillburn, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Other Code Revisions				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at least 2' above BFE or be designed to prevent water from entering and accumulating within the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization, via a permit, is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.

Table 6-8: Flood Resiliency Best Practices Code Audit Checklist

Village of Hillburn, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 130

Stormwater Management - Chapter 198

Critical Areas of Environmental Concern - Section 105

Subdivision of Land - Chapter 210

Table 6-9: Flood Resiliency Best Practices Code Audit Checklist

Village of Sloatsburg, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☐	☐	☐	
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3' of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18" of freeboard in the "shaded X" area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24". This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☐	☐	☐	
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☐	☐	☐	
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☐	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☐	☐	☐	

Table 6-9: Flood Resiliency Best Practices Code Audit Checklist

Village of Sloatsburg, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☐	☐	☐	
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☐	☑	☐	Though the Village does not have a Flood Damage Prevention Code section, it does have a Federal Flood Hazard Regulations section which lists three specific purposes of said section: to restrict or prohibit used that are dangerous to health, safety or property in times of flood or that cause increased flood heights or velocities; to require uses vulnerable to floods to be provided with flood protection at the time of initial construction, and to protect individuals from buying lands that are unsuited for intended purposes because of flood hazards.
Prohibit new development unless effect on flooding is minimal or zero.	☐	☐	☐	
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☑	☐	☐	Cluster development is authorized for potential use in any subdivision or site plan application in any residence or mixed use district.
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Wetland and Watercourses section of the code requires assessment to ensure that watercourses conform to several items including that such activities not threaten public safety, the natural environment or cause nuisances. Criteria include, but are not limited to impeding flood flows, reducing flood storage areas or destroying storm barriers thereby resulting in increased flood heights, frequencies or velocities on other lands.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	A biodiversity study is required, except for development of a one-family dwelling, for all other permits involving more than 10 acres of land.
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	

Table 6-9: Flood Resiliency Best Practices Code Audit Checklist

Village of Sloatsburg, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☑	☐	☐	The Ramapo River is classified as a sole source aquifer Critical Environmental Area. The potential impact of any Type 1 or Unlisted Action in SEQRA on environmental characteristics of the CEA is "a relevant area of concern and must be evaluated in the determination of significance." The River is also a NYSDEC designated WIld, Scenic and Recreational RIver and as such all building permits shall be reviewed by the building inspector to determine if the proposed action is on a property located within the River Corridor. NYSDEC approval is required prior to the issuance of an Village approvals for projects within the Corridor.The Code also prohibits approval on any project located along stream channel lines shown on the official map of Rockland County "...to assist in the alleviation of recurring flood damage to public and private property..." until the requirements of the County have been met and the building inspector can not issue a building permit for any structure, improvement or building until such requirements have been met.
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements for certain project types.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Stormwater Management - Chapter 54, Section 58

Federal Flood Hazard Area Regulations - Section 54-49

Table 6-10: Flood Resiliency Best Practices Code Audit Checklist

Town of Warwick, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within the AO, non-residential must be 2' above the depth number specified in feet on the Town's FIRM .Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-10: Flood Resiliency Best Practices Code Audit Checklist

Town of Warwick, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Town agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property. The subdivision code states that land to be subdivided shall be of such character that it can be used safely for building purposes without danger to health or peril from fire, flood or other menace. lots to be buildable shall have a rating of the site with respect to flood hazard (stream overflow) and ponding of "slight." Land subject to periodic or occasional flooding or land deemed by the Planning Board to be uninhabitable shall not be platted for residential occupancy nor for such other uses as may increase danger to health, life or property or aggravate the flood hazard, but such land within the plat shall be set aside for park purposes in addition to that area which is required for subdivision.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☑	☐	☐	Cluster subdivisions are permitted subject to Planning Board approval and any modification of applicable bulk or use modifications.

Table 6-10: Flood Resiliency Best Practices Code Audit Checklist

Town of Warwick, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 89

Cluster Development - 164-41.1

Subdivision of Land - Chapter 137

Stormwater Management - 164-47.10

Table 6-11: Flood Resiliency Best Practices Code Audit Checklist

Village of Tuxedo Park, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE, with all structural components below the base flood level being capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy. Within the AO, non-residential shall have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as 2' above the depth number specified in feet on the community's FIRM or along with utilities and sanitary facilities, be completely floodproofed to that level to meet floodproofing standards. The Floodplain District has specific standards for uses in the Floodplain District.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-11: Flood Resiliency Best Practices Code Audit Checklist

Village of Tuxedo Park, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. On streams with a regulatory floodway, no new construction, substantial improvements or other development in the floodway is permitted uness a technical evaluation shows that an encroachment will not increase flood levels during a base flood or the Village agrees to apply to FEMA for a conditional FIRM and floodway revision. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☐	☐	☐	
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering and accumulating within the components. Water supply systems must minimize or eliminate infiltration of floodwaters. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters. Sanitary sewer and storm drainage systems for buildigns that have openings below the base flood elevation shall be provided with automatic backflow valves or other automatic backflow devicces that are installed in each discharge line passing through a buildings exterior wall. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization, via a permit, is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				

Table 6-11: Flood Resiliency Best Practices Code Audit Checklist

Village of Tuxedo Park, NY Preliminary Audit	In Existing Code	Consider for Implementation	N/A	Notes
Zoning Code Ordinance Best Practices				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100′ to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☐	☐	☐	
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 55

Subdivision of Land - Chapter 85

Stormwater Management - Section 85-25

Table 6-12: Flood Resiliency Best Practices Code Audit Checklist

Town of Tuxedo, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE, with all structural components below the base flood level being capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy. Within the AO, non-residential shall have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as 2' above the depth number specified in feet on the community's FIRM or along with utilities and sanitary facilities, be completely floodproofed to that level to meet floodproofing standards. The Floodplain District has specific standards for uses in the Floodplain District.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-12: Flood Resiliency Best Practices Code Audit Checklist

Town of Tuxedo, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. On streams with a regulatory floodway, no new construction, substantial improvements or other development in the floodway is permitted uness a technical evaluation shows that an encroachment will not increase flood levels during a base floor or the Village agrees to apply to FEMA for a conditional FIRM and floodway revision. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	✓ ☐	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☐	☐	☐	
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that are resistant to flood damage and that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering and accumulating within the components. Water supply systems must minimize or eliminate infiltration of floodwaters. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters. Sanitary sewer and storm drainage systems for buildings that have openings below the base flood elevation shall be provided with automatic backflow valves or other automatic backflow devices that are installed in each discharge line passing through a buildings exterior wall. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization, via a permit, is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	

Table 6-12: Flood Resiliency Best Practices Code Audit Checklist

Town of Tuxedo, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☐ ✓	☐	☐	The Subdivision code restricts land that floods from being platted for residential use. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☐	☐	☐	
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 53

Subdivision of Land - Chapter 85

Table 6-13: Flood Resiliency Best Practices Code Audit Checklist

Town of Monroe, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within the AO, non-residential must be 2' above the depth number specified in feet on the Town's FIRM .Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-13: Flood Resiliency Best Practices Code Audit Checklist

Town of Monroe, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Town agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property. The subdivision code states that land subject to periodic or occassional flooding shall not be platted for residential occupancy nor for any other use which may endanger life or property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☑	☐	☐	Cluster development for proposed developments is authorized in all zoning districts, subject to Planning Board approval and meeting the cluster regulation standards.

Table 6-13: Flood Resiliency Best Practices Code Audit Checklist

Town of Monroe, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 27.B

Cluster Development - §57-21.7

Subdivision of Land - Article VII

Stormwater, Soil Erosion and Sediment Control - Chapter 46

Table 6-14: Flood Resiliency Best Practices Code Audit Checklist

Village of Harriman, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within the AO, non-residential must be 2' above the depth number specified in feet on teh Town's FIRM .Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-14: Flood Resiliency Best Practices Code Audit Checklist

Village of Harriman, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Town agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property. The subdivision code states that land subject to periodic or occassional flooding shall not be platted for residential occupancy nor for any other use which may endanger life or property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				

Table 6-14: Flood Resiliency Best Practices Code Audit Checklist

Village of Harriman, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 82

Subdivision of Land - Chapter A146

Stormwater Control - Article XIII

Table 6-15: Flood Resiliency Best Practices Code Audit Checklist

Town & Village of Woodbury, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within the AO, non-residential must be 2' above the depth number specified in feet on the Village's FIRM .Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-15: Flood Resiliency Best Practices Code Audit Checklist

Town & Village of Woodbury, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Town agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward. Additionally, the Village has Land use and control measures which "assures the Federal Insurance Administration that it will enact as necessary and maintain in force for those areas having flood or mudslide hazards adequate land use and control measures..."
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property. The subdivision code states that land shall not be platted for residential or any other subdivision use if it cannot safely be used for such purposes without danger to health or peril from fire, flood or other menace.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☑	☐	☐	Cluster development is authorized on a case-by-case basis in all residential districts.
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.

Table 6-15: Flood Resiliency Best Practices Code Audit Checklist

Town & Village of Woodbury, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 159

Cluster Development - §310.31

Subdivision of Land - Chapter 272

Stormwater Management and Erosion and Sediment Control - Chapter 267

Flood Hazard Areas - Chapter 161

Note: The Village and Town boundaries are the same except for a small portion of the Town in the Village of Harriman. All planning and zoning has been administered by the Village since 2007.

Table 6-16: Flood Resiliency Best Practices Code Audit Checklist

Village of Kiryas Joel, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within Zone AO, non-residential must be 2' above the depth number specified in feet on teh Town's FIRM .Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements. In Zone A, the lowest floor shall be elevated at least 3' above the highest adjacent grade.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-16: Flood Resiliency Best Practices Code Audit Checklist

Village of Kiryas Joel, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or development are prohibited without a valid floodplain development permit. For encroachments, evaluation is required (see code note about base flood increase of >1 foot below) and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property. The zoning code states that no portion of the minimum area requirement of a lot may be achieved by including land under water, land with an elevation below mean high water or land subject to periodic flooding. Additionally, the zoning code states that all minimum yard requirements [setbacks] must be satisfied by measurement on dry land.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	

Table 6-16: Flood Resiliency Best Practices Code Audit Checklist

Village of Kiryas Joel, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development proposals to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots (see minimum area requirements note above).
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 77

Subdivision of Land - §155-14

Stormwater Pollution Prevention Plan (SWPPP) - §125-7

Table 6-17: Flood Resiliency Best Practices Code Audit Checklist

Town of Blooming Grove, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within the AO, non-residential must be 2' above the depth number specified in feet on the Town's FIRM.Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-17: Flood Resiliency Best Practices Code Audit Checklist

Town of Blooming Grove, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas no structure shall be constructed, located, extended, converted or altered and no land excavated or filled without full compliance with the terms of the code. For encroachments, assessments and/or a technical evaluation is required and when the Town agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots. The Subdivision Code Design Standards require that a tract be adequately drained, that land in wetlands and floodplains shall be preserved as undeveloped open space and that a subdivision be designed to prevent flooding.

Table 6-17: Flood Resiliency Best Practices Code Audit Checklist

Town of Blooming Grove, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 132

Subdivision of Land - Chapter 210

Stormwater - Chapter 201

Table 6-18: Flood Resiliency Best Practices Code Audit Checklist

Village of South Blooming Grove, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within the AO, non-residential must be 2' above the depth number specified in feet on the Town's FIRM. Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-18: Flood Resiliency Best Practices Code Audit Checklist

Village of South Blooming Grove, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas no structure shall be constructed, located, extended, converted or altered and no land excavated or filled without a floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	☑	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☑	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	
Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots. The Subdivision Code requires that low-lying lands along watercourses subject to flooding or overflowing during storm periods be preserved and retained in their natural state as drainage ways.

Table 6-18: Flood Resiliency Best Practices Code Audit Checklist

Village of South Blooming Grove, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 232

Subdivision of Land - Chapter 163

Stormwater Management - Chapter 158

Note: The Village has it's own zoning ordinance, Planning Board and Zoning Board of Appeals, however the building department elements are managed by the Town of Blooming Grove.

Table 6-19: Flood Resiliency Best Practices Code Audit Checklist

Village of Monroe, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Elevation Design & Screening				
Require design interventions to screen and mitigate elevation impacts on the streetscape for elevated buildings.	☐	☐	☐	
Use hedges and fencing to separate private and public realms. Screen on-site parking located beneath a structure with foundation plantings and vegetative screening. Screen piers and columns that have been used to raise structures.	☐	☐	☐	
Building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.	☐	☐	☐	
Building fronts, entry porches and similar features must use materials, colors and proportions appropriate for the local architectural context. Large and multi-family building should use treatments similar to ensure local architectural consistency.	☐	☐	☐	
Guidelines for specific design elements such as canopies, galleries, and local significant materials, colors and design strategies to mitigate height and size perceptions are encouraged.	☐	☐	☐	
Bulk & Area Requirements				
Ensure that uses below the building Base Flood Elevation are restricted to access, parking and storage.	☑	☐	☐	The code restricts the areas below the lowest floor in certain zones to parking, access or storage and to automatically equalize hydrostatic flood forces.
Permit relief from height limits where possible for developers and property owners who wish to go above the Design Flood Elevation.	☐	☐	☐	
Enact new height limits where possible that are based on the new local design flood elevation (one to two feet over the BFE) where side and rear yard relief is possible.	☐	☐	☐	
Given the increased height of buildings due to elevation, turrets, towers and cupolas, ensure total building height does not exceed maximum height(s) desired, but also ensure that maximum building height requirements allow for building elevations without the need for a variance.	☐	☐	☐	
Require an additional 3’ of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area and 18” of freeboard in the “shaded X” area, which includes buildings between the 100-year and 500-year floodplains. All new single family detached dwellings outside of defined flood hazard areas need to be elevated 16-24”. This approach acknowledges the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area (based on historic flooding and not sea-level rise).	☑	☐	☐	Standards are included that require between 2' and 3' above BFE in certain zones as well as requirements for drainage paths in other zones for residential structures. For non-residential structures, the lowest floor in certain zones should be elevated 2' above BFE or be floodproofed so the structure is watertight below two feet above the BFE with walls substantially impermeable to the passage of water. Within the AO, non-residential must be 2' above the depth number specified in feet on the Town's FIRM .Together with utility and sanitary facilities, be completely floodproofed to that level to meet floodproofing requirements.
Permit reduced side or rear yards relative to overall height to allow squatter and more proportional buildings.	☐	☐	☐	
Require riparian and/or floodplain buffers - See also Subdivision Regulations.	☐	☐	☐	
Utilize net density calculations that exclude wetland and floodplain areas in a developable area.	☐	☐	☐	
Establish a maximum percentage of impermeable surface coverage on a lot which limits the density of development and addressing stormwater runoff.	☐	☐	☐	
Other Code Revisions				

Table 6-19: Flood Resiliency Best Practices Code Audit Checklist

Village of Monroe, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
Zoning Code Ordinance Best Practices				
Coastal Resilience Overlays could be applied to areas with the highest flood risk. These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.	☑	☐	☐	This exists in a way in the code. Within special flood hazard areas, construction or improvements are prohibited without a valid floodplain development permit. For encroachments, assessments and/or a technical evaluation is required and when the Village agrees to apply to FEMA for conditional Firm and floodway revision and approval is received, only then can construction or substantial improvements move forward.
Upland Resilience Overlays could be applied to lower-risk areas capable of accommodating growth. New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.	☑	☐	☐	
Neighborhood Resilience Overlays could be applied to lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context.	☑	☐	☐	
Permit property owners to reallocate lost floor area from the ground floor and sub-grade spaces to elsewhere in the structure.	☐	☐	☐	
Ensure that well heads are above the BFE.	☑	☐	☐	The Code requires water supply systems to minimize or eliminate infiltration of floodwaters into the system.
Add flood resistant construction (flood-proofing) standards such as ensuring buildings are watertight, utilities and sanitary facilities are above the BFE, enclosed within the building's watertight walls, or made watertight and resistance. Standards should also ensure that the building's structural components are also flood resistant.	☑	☐	☐	The Code requires anchoring of new structures and substantial improvements as well as the use of materials, utility equipment, and methods and practices that minimize flood damage. Utilities must be at or above the BFE or be designed to prevent water from entering or accumulating with the components. Water supply systems must minimize or eliminate infiltration of floodwaters. On-site waste disposal systems must be located to avoid impairment to them, or contamination from them, during flood events. New and replacement sanitary sewage systems must be designed to minimize or eliminate infiltration of floodwaters.
Prohibit new development unless effect on flooding is minimal or zero.	✓ ☐ ✓	☐	☐	Code prohibits development encroachment if it increases base flood by >1 foot (see encroachment note above). The code requires a details of any watercourse alteration or relocation. There are detailed permit application requirements including a technical analysis to determine whether or not proposed development will result in physical damage to any other property. The subdivision code states that for lots to be considered buildable, they must have no foreseeable difficulties for reasons of topography or other natural conditions. A lot proposed for single-family use must be at least 5,000 s.f. with minimum dimensions of 25' meeting all zoning district requirements relative to setbacks, slopes and other criteria.
Prohibit substantial improvements to nonconforming uses or structures in flood prone areas.	☐	☐	☐	Authorization is required for work in flood prone areas.
Consider acquisition of flood-prone lands, particularly where they include vital riparian areas and/or could provide a public benefit such as a park or passive open space.	☐	☐	☐	
Subdivision Ordinance Best Practices				
Subdivision Ordinance				
Conservation subdivision (cluster development) to encourage development be built in suitable areas of development that protects important natural features.	☐	☐	☐	

Table 6-19: Flood Resiliency Best Practices Code Audit Checklist

Village of Monroe, NY Preliminary Audit	*In Existing Code*	*Consider for Implementation*	*N/A*	*Notes*
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Prohibit subdivisions in floodprone areas.	☑	☐	☐	The Flood Damage Prevention Ordinance requires development to be consistent with the need to minimize flood damage, utilities and facilities must be located and constructed to minimize flood damage, and adequate drainage needs to be provided to reduce exposure to flood damage. When no base flood elevation data are available from other sources, the permit applicant for a subdivision or other development in certain circumstances shall provide the data for projects greater than 5 acres or 50 lots.
Require and maximize the width of riparian buffers. Provide riparian buffer requirements for the following:	☐	☐	☐	
Stream stabilization - A few dozen feet to a few hundred feet.	☐	☐	☐	
Water quality protection – A few dozen to a few hundred feet (a longer distance if sediment removal is desired)	☐	☐	☐	
Flood attenuation – A few dozen to several hundred feet	☐	☐	☐	
Riparian & wildlife habitat – A few dozen feet up to a mile, though the average minimum is approximately 100' to several hundred or a few thousand feet.	☐	☐	☐	
Protection of cold water fisheries – A few dozen feet to a few hundred feet	☐	☐	☐	
Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies.	☐	☐	☐	
Inventory riparian areas as part of the subdivision process and preserve unimpaired riparian areas in natural conditions.	☐	☐	☐	
Require restoration of impaired riparian zones as a condition of subdivision approval.	☐	☐	☐	
Restrict potentially problematic uses (Hazardous materials uses, for example)	☐	☐	☐	
Dedicate land for public facilities and services.	☐	☐	☐	
Require adequate access where evacuation may be necessary or where emergency vehicle access may be required.	☐	☐	☐	
Ensure utilities such as electric, natural gas, water and wastewater are hardened. Require electrical components to be mounted above flood levels. Major utility equipment should be considered a critical facility and be required to be located outside of the 500 year floodplain.	☐	☐	☐	
Consider the long-term needs of the community when discussing the potential for a homeowner's association to operate and/or maintain an area prone to flooding.	☐	☐	☐	
Require flood hazard information to be provided on a subdivision plat. Require the 100-year floodplain elevation to be shown on all subdivision plats. Information such as finished building pad elevation or proposed lowest finished floor elevation can also be detailed.	☐	☐	☐	
Any property with a floodplain should be required to show such information on the plan.	☐	☐	☐	
Require conservation easements around flood-prone areas or floodplains.	☐	☐	☐	
Require green infrastructure or low-impact development techniques, where feasible	☑	☐	☐	The code includes Stormwater Pollution Prevention Plan (SWPPP) requirements.
Each proposed lot must have a designated buildable site above the special flood hazard area (SFHA) as shown on the most current Flood Insurance Rate Map.	☐	☐	☐	

See Chapter __ for source information.

Code Sections Reviewed:

Flood Damage Prevention - Chapter 107

Subdivision of Land - Chapter 175

Stormwater Management - Chapter 168

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