N

0 250
Feet

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

HRA #1 - CONCEPT MAP

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

SCALE 1 " = 250 '
DATE 1/4/2022
PROJ. NO. 16511.00010

FIG. 4-13

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4.2 HIGH RISK AREA #2 – HAMLET OF SPARKILL

HRA 2 is located in the hamlet of Sparkill and extends from STA 75+00 to STA 110+00. Crossings include William Street and Valentine Avenue, near the Sparkill Palisades Fire Department, in the hamlet of Sparkill (Figure 4-14). The watershed of the creek at this location is 10.8 square miles. Data collected by FEMA indicates that, as of 2019, four properties in the hamlet of Sparkill were identified as repetitive loss or severe repetitive loss, all located along Route 340.

A sanitary pump station is located in Sparkill and is reportedly prone to flooding, resulting in loss of power and pump inoperability. A Rockland County-owned bridge with a span of 29.5 feet crosses the creek at William Street (Figure 4-15); its NAACC crossing code is *xy4102879173926036*, and it received an aquatic passability score of 0.91 out of 1.0: an *insignificant barrier*. There has been reported flooding at the adjacent Sparkill Palisades Fire Department, including during Tropical Storm Irene when flooding depths of 2 to 3 feet were reported at the firehouse, extensively flooding the first floor (Figure 4-16). Flooding also occurred along Route 340 near the intersection with Van Terrace (Figure 4-17). About 175 feet downstream from Willian Street, at Valentine Avenue, an NYSDOT-owned bridge with a span of 27.5 feet crosses the creek. The NAACC crossing code is xy4102912473925550 with an aquatic passability score of 0.89 out of 1.0, an *insignificant barrier.*

Hydraulic modeling was used to evaluate the William Street and Valentine Avenue crossings separately to identify the effect each structure has on flooding. The William Street bridge is hydraulically undersized and contributes to the flooding described above, including at the Sparkill Palisades Fire Department, a critical facility. If the William Street bridge were to be replaced with a new structure with a span of approximately 60 feet, a lateral reduction in flood extent of almost 70 feet would result during the 50-year flood. This reduction would pull the fire department out of the projected flood extents, as seen in the flood depth images in Figure 4-18 (50-year flood event under existing conditions) and Figure 4-19 (50-year flood event with a larger bridge). Vertical reductions range from 0.4 feet to 1.2 feet under current and future 10-year and 100-year flood events, respectively. These modeled reductions reach over 4,000 linear feet upstream (to approximately STA 130+00) and extend through the Palisades Interstate Parkway culvert, reducing water surface elevations by as much as 0.5 feet during the 100-year storm event and pulling homes along Route 340, across from Van Terrace, out of the 100-year floodplain (Figures 4-20 and 4-21). Although this improvement at William Street would have moderate reductions on water surface elevations at the Palisades Interstate Parkway (PIP) culvert, it does not resolve the hydraulic constriction produced by the existing PIP culvert itself.

> The William Street bridge is hydraulically undersized and contributes to flooding upstream of the bridge, including at the Sparkill Palisades Fire Department, a critical facility.

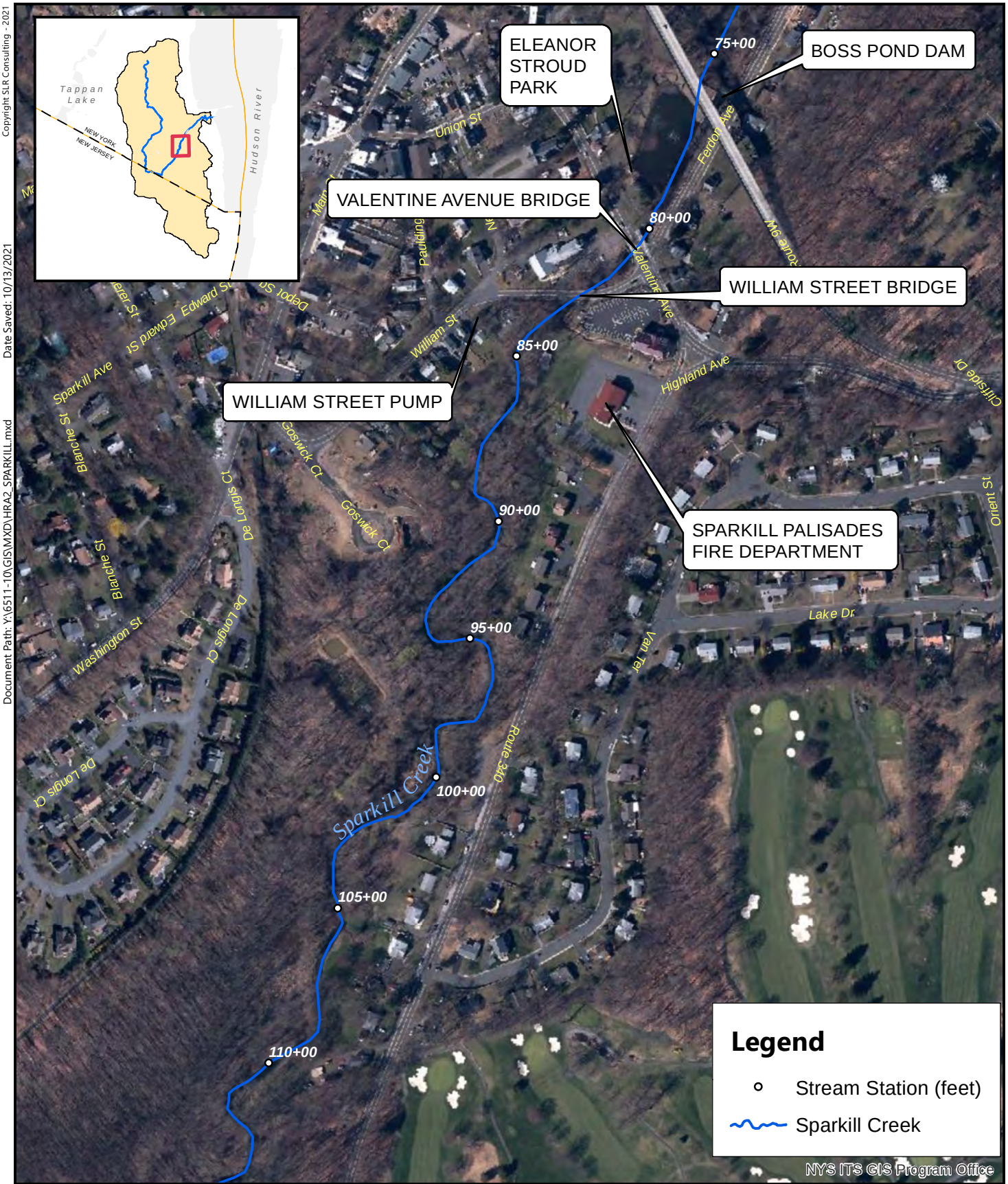
Hydraulic modeling indicates that under existing conditions the sanitary pump station experiences minor flooding during the 10-year flood event. Flooding is more severe during the 50-year and 100-year flood events with flooding depths of 0.5 feet and 2.0 feet, respectively. Under future flow scenarios, the pump station would experience 1.0 and 3.2 feet of flooding during the 50-year and 100-year flood events, respectively. Replacing the William Street bridge with an adequately sized structure would eliminate flooding of the pump station during the 10-year and 50-year flood events. During the 100-year flood event, flooding of the pump station would be reduced by over a foot, to a depth of 0.8 feet. The pump

station would begin to see minor flooding in the future 50-year flood event. Flood depths would be just over 0.8 feet during the future 100-year flood event.

Based on hydraulic analysis, the crossing under Valentine Avenue is adequately sized and capable of conveying the existing and future 100-year storms with about 1.3 feet of freeboard. There is no indication that the Valentine Avenue bridge is obstructing flood flows or limiting the hydraulic capacity of the bridge under William Street, which is situated 175 feet upstream.

The replacement of the William Street bridge is recommended.

Consideration should be given to the undersized crossing at William Street and the potential to combine the benefits from its replacement with future replacement of the structure under the PIP. The hydraulic performance of the PIP structure is discussed in more detail in Section 4.3 of this report.



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231 MAIN STREET
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HIGH RISK AREA #2 - HAMLET OF SPARKILL

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

N

0 350
Feet

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office

SCALE 1 " = 350 '

DATE 11/8/2021

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FIG. 4-14

Figure 4-15: William Street Bridge

Figure 4-16: Sparkill Palisades Fire Department, a Critical Facility, during Tropical Storm Irene in 2011 (photo provided by Lawrence Vail)

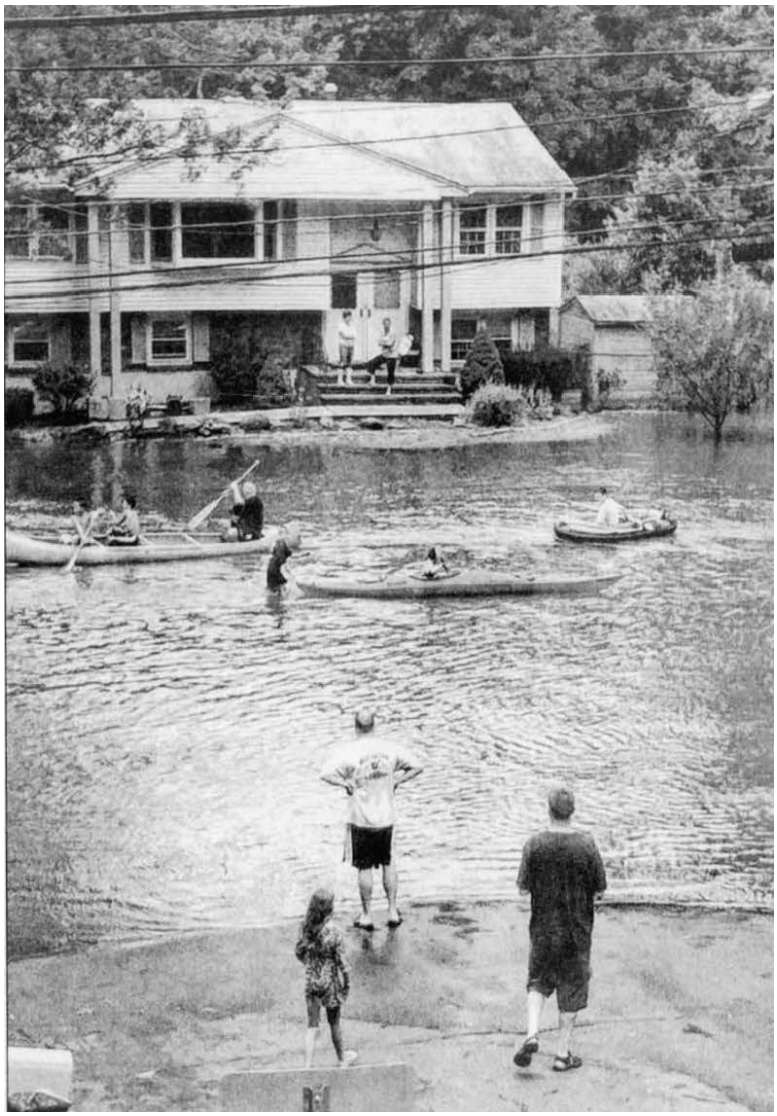

Figure 4-17: Photograph Taken during Tropical Storm Irene of Flooding along Route 340 near the Intersection with Van Terrace

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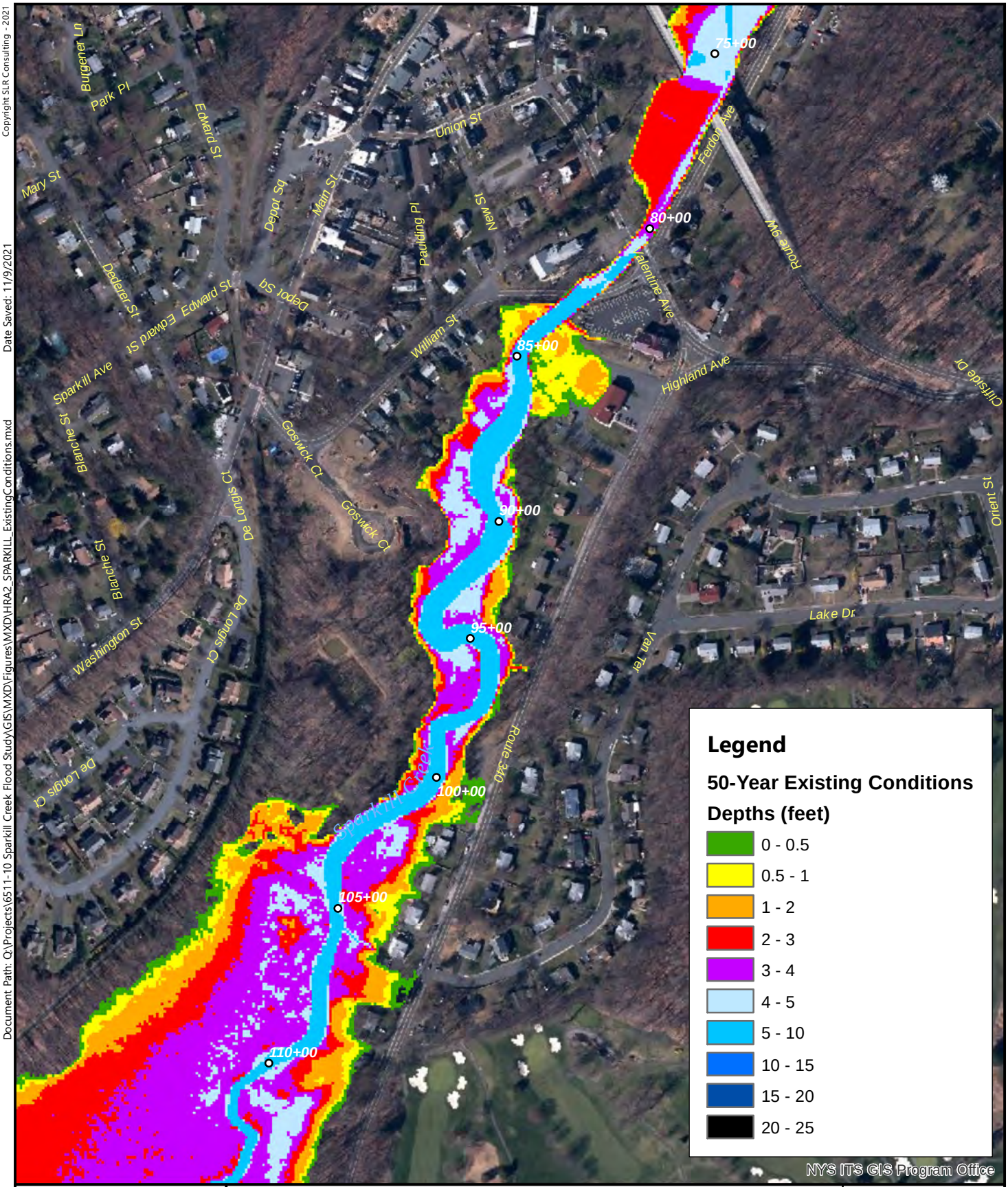

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231 MAIN STREET
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NEW PALTZ, NY 12561
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HRA #2 - 50-YEAR EXISTING CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

N
0 350
Feet

SCALE 1 " = 350 '
DATE 11/9/2021
PROJ. NO. 16511.00010

FIG. 4-18

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office

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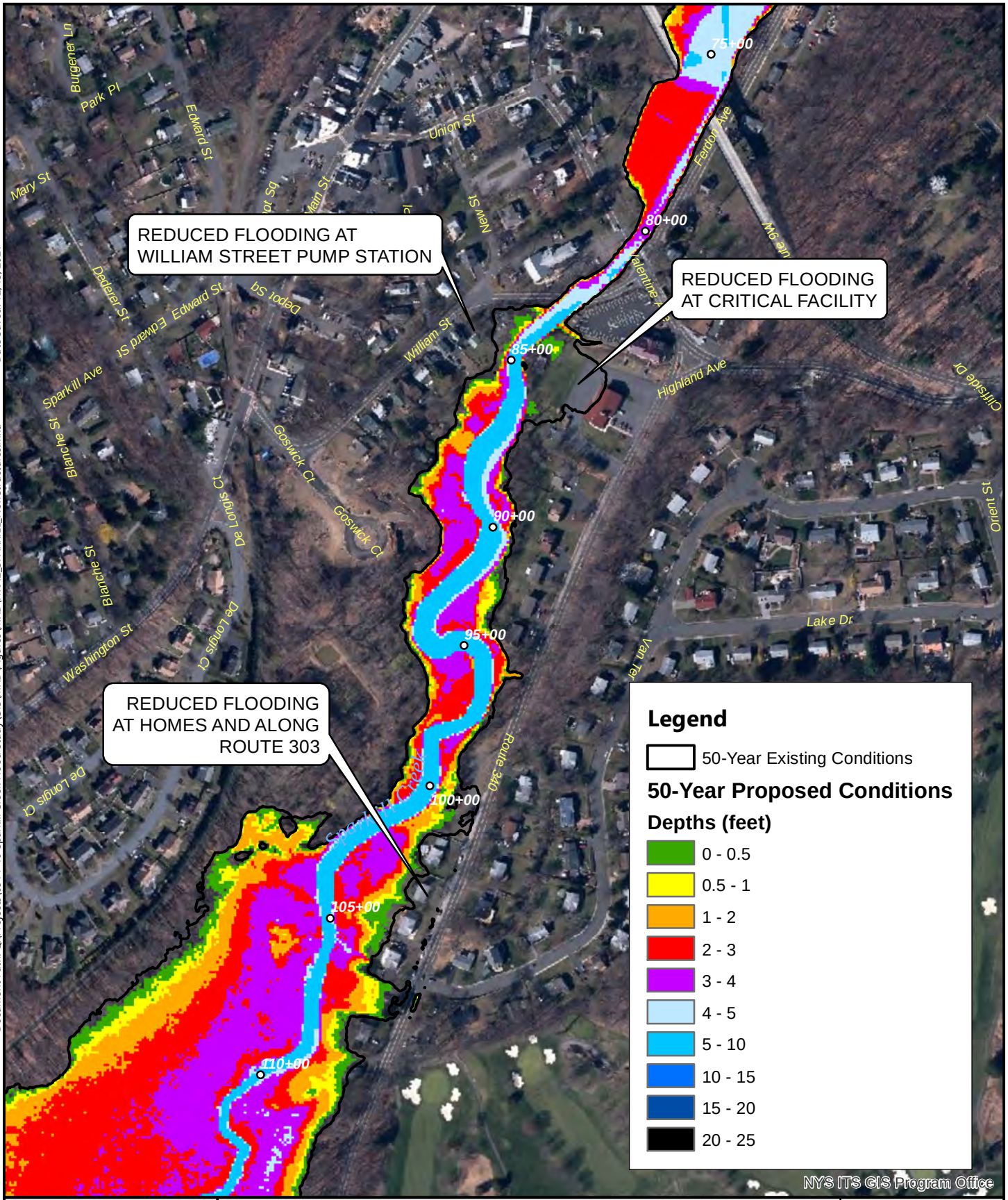

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HRA #2 - 50-YEAR PROPOSED CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

N

0 350
Feet

SCALE 1 " = 350 '

DATE 12/15/2021

PROJ. NO. 16511.00010

FIG. 4-19

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office

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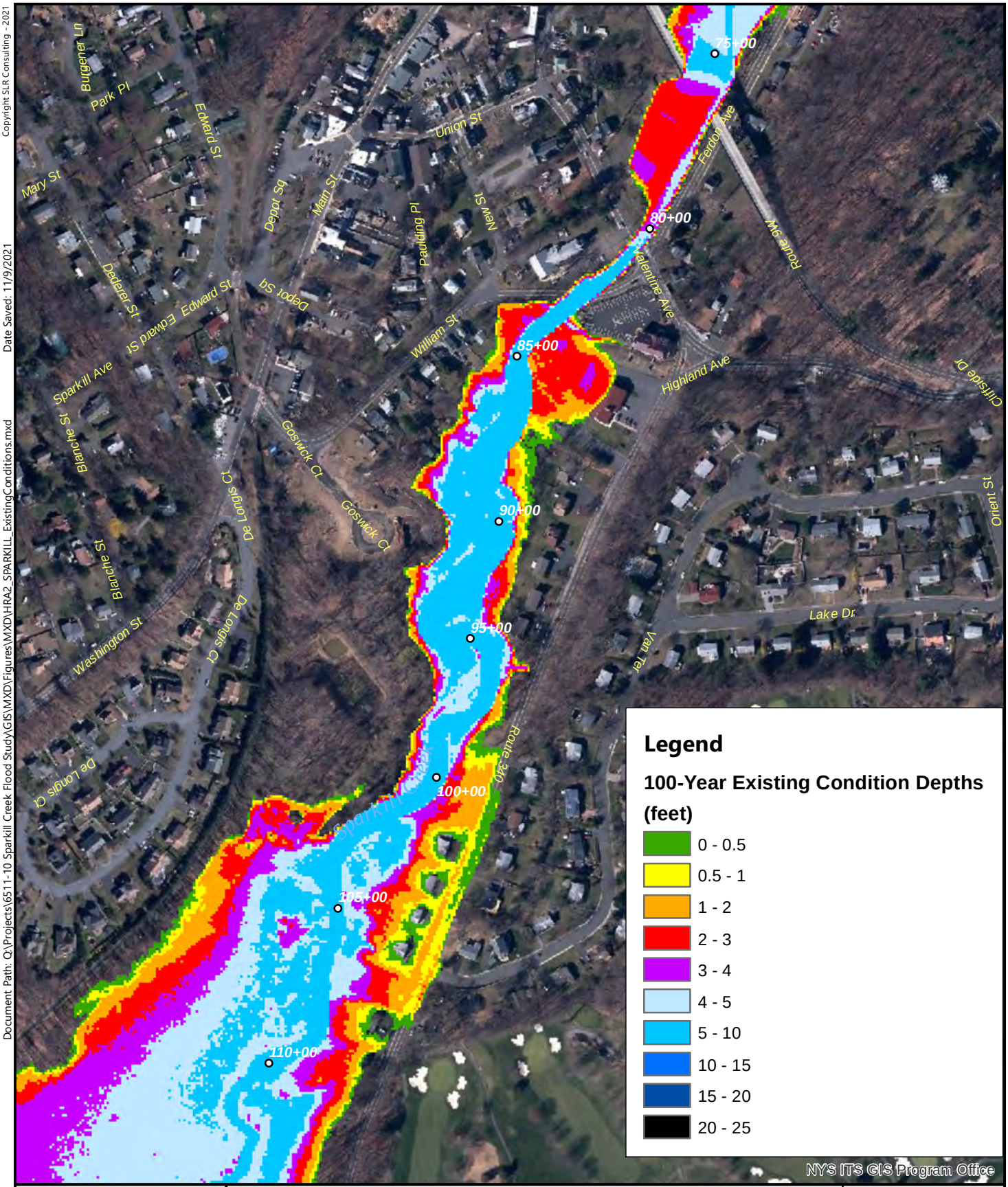

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HRA #2 - 100-YEAR EXISTING CONDITIONS FLOOD DEPTHS

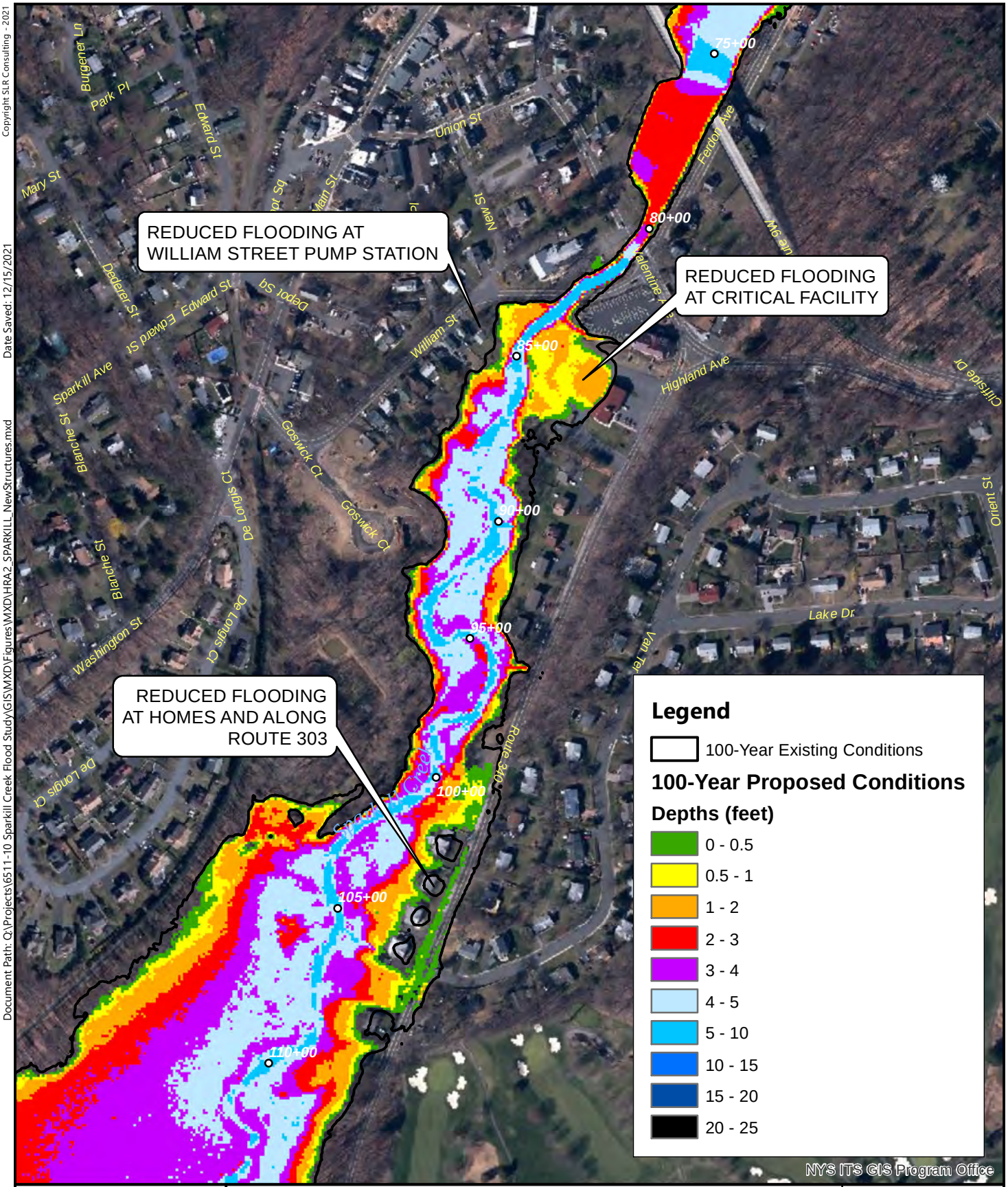
SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

N
0 350
Feet

SCALE 1 " = 350 '
DATE 11/9/2021
PROJ. NO. 16511.00010

FIG. 4-20

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office



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SUITE 102
NEW PALTZ, NY 12561
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HRA #2 - 100-YEAR PROPOSED CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

N
0 350
Feet

SCALE 1 " = 350 '
DATE 12/15/2021
PROJ. NO. 16511.00010

FIG. 4-21

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office

Floodproofing and elevation of pumps and electrical equipment are recommended at the sanitary pump station in Sparkill to ensure that it can continue to function as required during extreme weather events. Floodproofing should extend above the modeled 100-year flooding depths of 2.0 feet, plus adequate freeboard of at least 2 feet.

Approximately 415 feet downstream of Valentina Avenue is a 5-foot-high concrete dam spanning Sparkill Creek. The structure has an 8-foot-wide active spillway (Figure 4-22). This dam is registered in the NYSDEC dam inventory under the name of Boss Pond Dam. Constructed in 1814, the hazard code A or low hazard class dam is included in the hydraulic model as an inline structure that spans the active channel and extends across the left overbank, forming the adjacent impoundment at Eleanor Stroud Park. Removing the entire structure and restoring the immediate river reach upstream to more natural conditions would reduce water surface elevations at the spillway by approximately 3.4 feet and 2.6 feet during the 10-year and 100-year storms, respectively. The reductions in water surface elevations extend 690 feet upstream and have minimal influence on the performance of the Valentina Avenue and William Street bridges. Nonetheless, the dam serves no apparent function and creates an ecological barrier for aquatic organism passage; its removal should be considered.

The recommended concepts for HRA 2 are illustrated in Figure 4-23.

Figure 4-22: Boss Pond Dam Spillway

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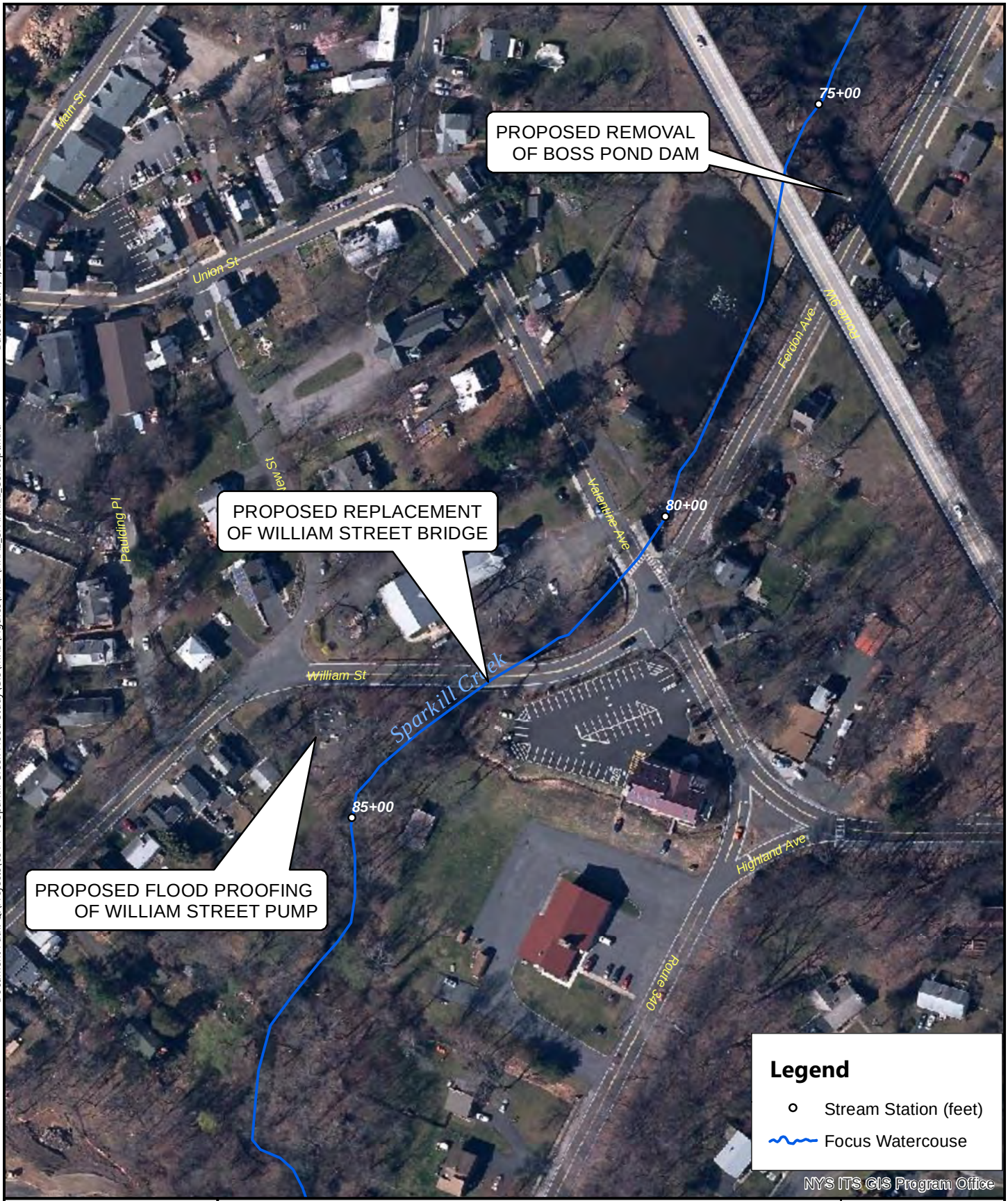

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HRA #2 - CONCEPT MAP

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

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Feet

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office

SCALE 1 " = 150 '
DATE 1/7/2022
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FIG. 4-23

4.3 HIGH RISK AREA #3 – OAK TREE ROAD AND PALISADES INTERSTATE PARKWAY

HRA 3 is located along Sparkill Creek in the hamlet of Tappan, in the vicinity of Oak Tree Road and the Palisades Interstate Parkway (PIP) (STA 125+00 through STA 165+00). Stream crossings within HRA 3 include a former railroad bridge (now no longer used as a railroad and possibly part of the current or future Joseph B. Clarke Rail Trail) just north of the New York/New Jersey state line at STA 165+00, the Rockland County-owned Oak Tree Road crossing over Sparkill Creek at STA 149+24, and a PIP northbound and southbound lane culvert near STA 126+26 (Figure 4-24). The watershed size at this location is approximately 10 square miles. Data collected by FEMA indicates that, as of 2019, two properties along Oak Tree Road in Tappan were identified as repetitive loss or severe repetitive loss.

A railroad bridge with a 38.5-foot span crosses the creek at the rail trail and currently passes up to the 10-year flow. Removing this structure or replacing it with an adequately sized bridge would reduce water surface elevations by approximately 1 foot immediately upstream of the crossing, with reductions propagating almost 1,000 feet upstream to near STA 175+00. Replacing or removing the bridge would result in moderate reductions in upstream flooding at the commercial district in New Jersey. The replacement of this bridge with an adequately sized structure, or removal of the bridge if it is not a planned component of the Joseph B. Clarke Rail Trail, is recommended.

Oak Tree Road was flooded during Tropical Storm Irene in August 2011 (Figure 4-25). The Oak Tree Road bridge spans 29.5 feet and does not currently pass even the 10-year flows. This is due in part to the backwater from the 21.7-foot-wide culvert under the PIP, just downstream. The hydraulic performance at the Oak Tree Road bridge is reduced during flood conditions because of the tailwater condition caused by the undersized culvert that carries the PIP over Sparkill Creek. Hydraulic modeling was used to evaluate a scenario in which the current PIP crossing is replaced with a new structure with a 60-foot span, the Oak Tree Road bridge is replaced with a span of 73 feet, a floodplain is created on the right bank at the current location of a business, and the channel is regraded and increased in size downstream of Oak Tree Road. The floodplain bench simulated in the hydraulic model had a bench width ranging from 70 to 170 feet and extended for approximately 900 linear feet along the right bank, from STA 139+00 to STA 148+00. Excavation depths ranged from 2 to 6 feet below existing grade. The channel was adjusted to accommodate the replacement bridges. Relocation of the business on the right bank of Sparkill Creek, downstream of Oak Tree Road, would be required. This conceptual layout is illustrated in Figure 4-26. Under this scenario, water surface elevations would be reduced by almost 2 feet for the 100-year flows, and the Oak Tree Road crossing would pass up to the 50-year flows, as depicted in the profiles in Figures 4-27a and 4-27b. Existing and proposed flood depths for the current 50-year storm are shown in Figure 4-28 and Figure 4-29, respectively. Existing and proposed flood depths for the current 100-year storm are shown in Figure 4-30 and Figure 4-31, respectively. A summary of the proposed replacement structures and the findings of the hydraulic analysis, evaluated under current conditions and under future conditions projecting for changes in hydrology due to climate change, are listed on Table 4-1.

Replacing the culvert under the PIP is required to optimize the flood reduction benefits at Oak Tree Road. Implementing the measures described above without replacing the PIP culvert would negate the flood reduction benefits. Furthermore, as mentioned in Section 4.2, the PIP is influenced by the tailwater

condition created by the William Street bridge and should be considered when evaluating alternatives at the PIP crossing. A rigorous and detailed hydraulic and hydrologic analysis is recommended as a component of the design of these replacement structures.

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HIGH RISK AREA #3 - OAK TREE ROAD & PIP

SPARKILL CREEK FLOOD & RESILIENCE STUDY

SD115 ROCKLAND COUNTY NEW YORK

SCALE 1 " = 500 '

DATE 11/8/2021

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FIG. 4-24

Figure 4-25: Oak Tree Road Bridge during Tropical Storm Irene (photo provided by Lawrence Vail)

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NEW PALTZ, NY 12561
845.633.8153

HRA #3 - CONCEPT MAP

SPARKILL CREEK FLOOD & RESILIENCE STUDY

SD115

ROCKLAND COUNTY
NEW YORK

SCALE 1 " = 500 '

DATE 11/8/2021

PROJ. NO. 16511.00010

FIG. 4-26

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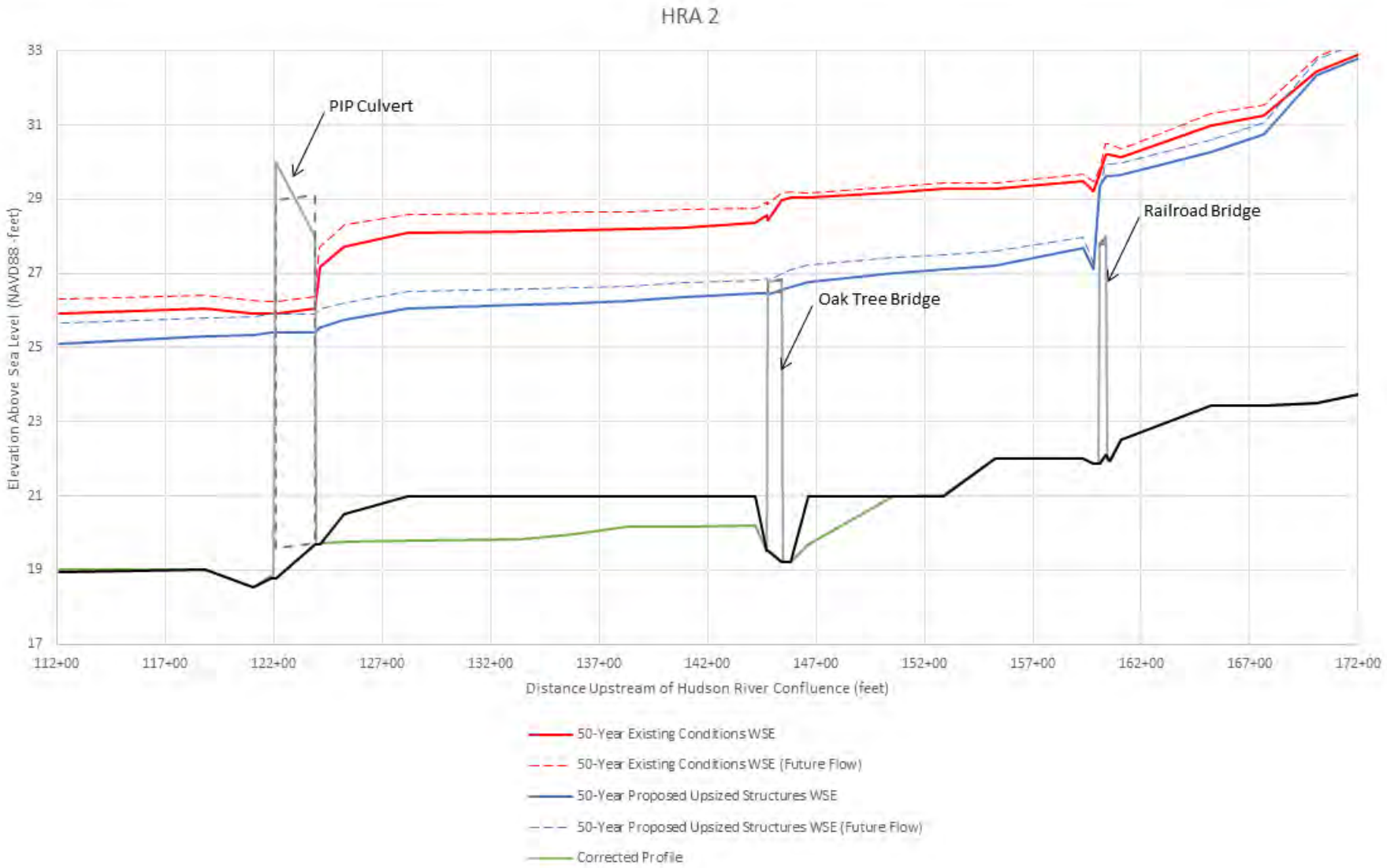


Figure 4-27a: Reach Profile for 50-Year Flows Under Current Conditions and After Adjusting the Channel and Structures Through HRA 3

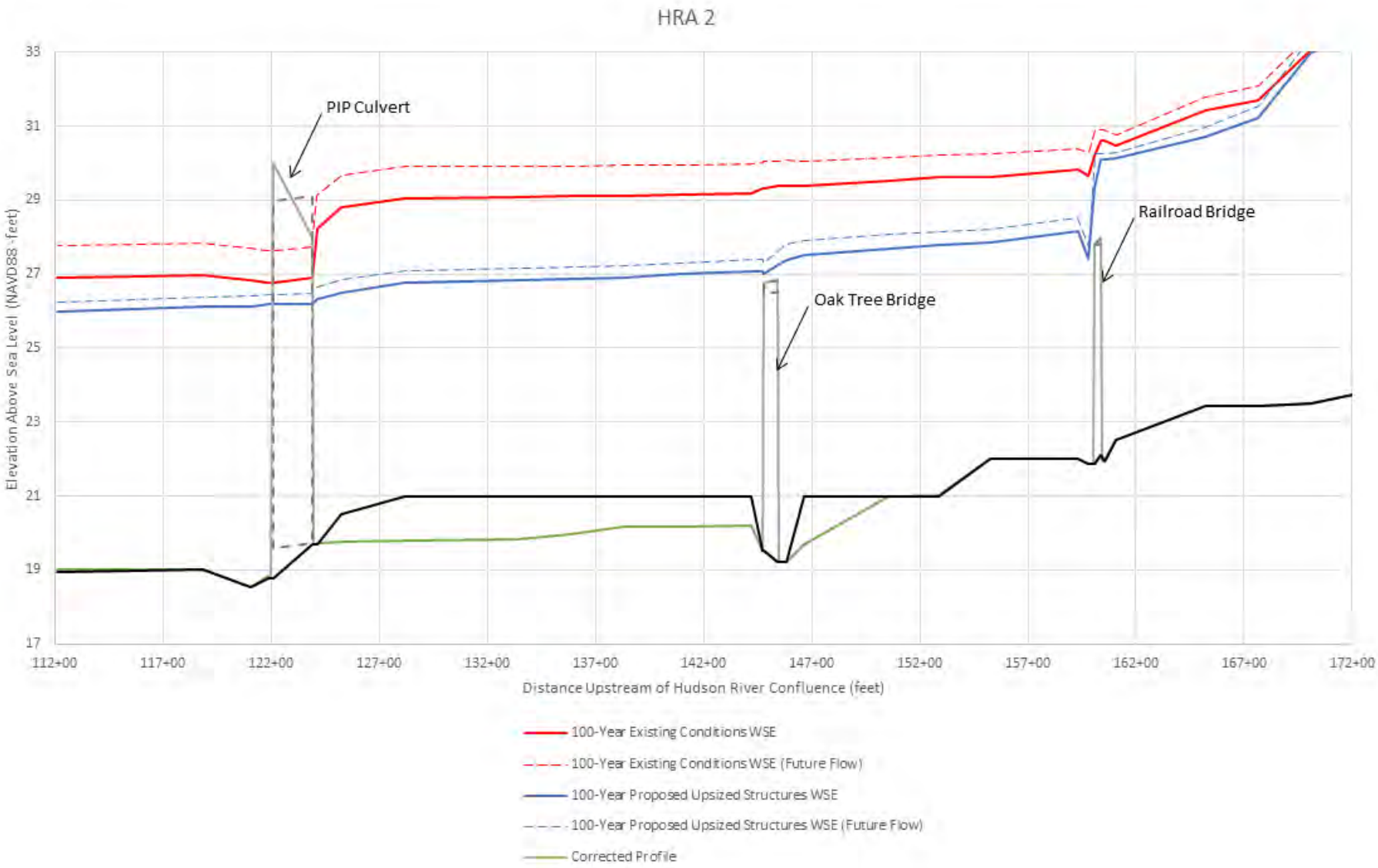
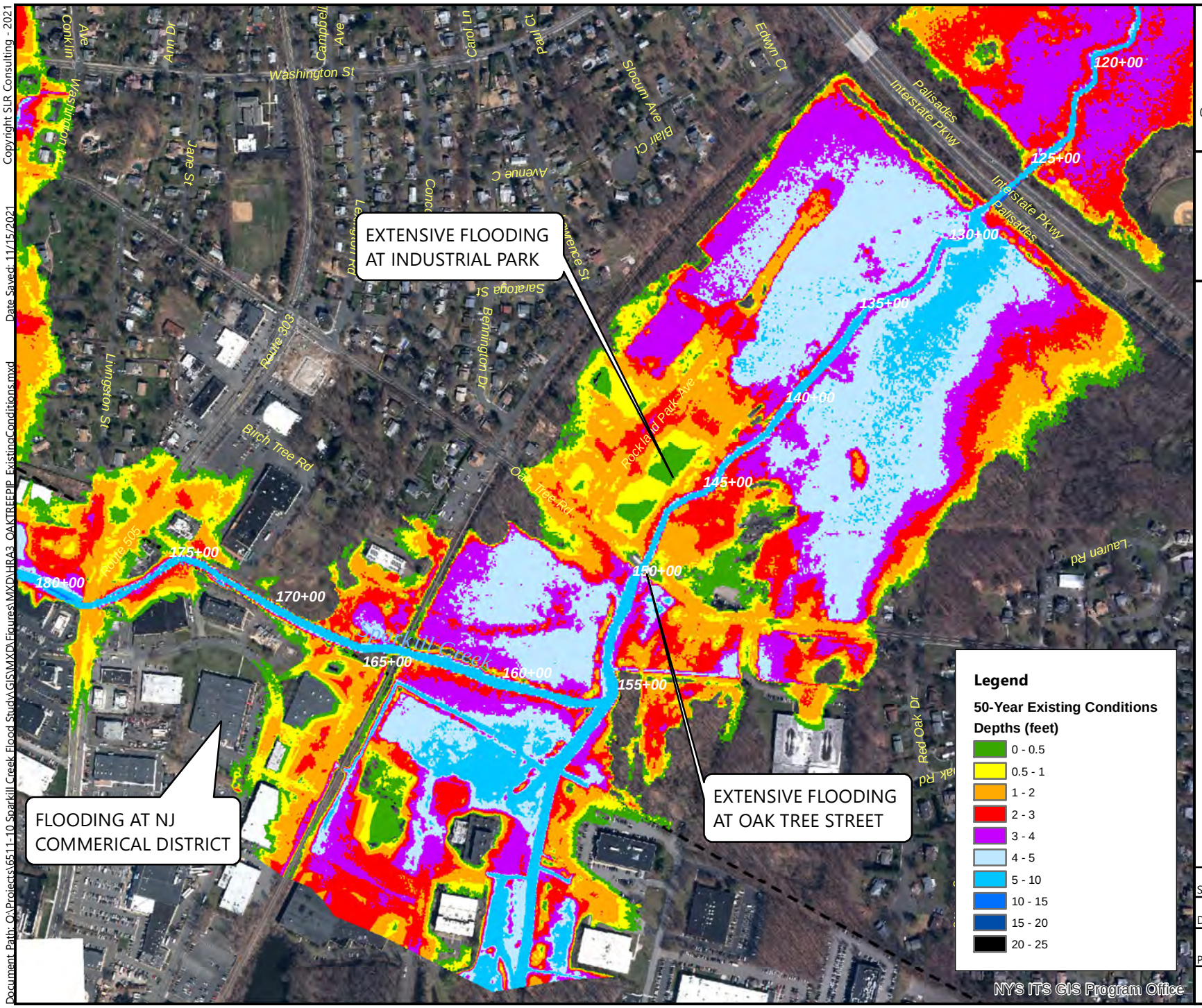


Figure 4-27b: Reach Profile for 100-Year Flows Under Current Conditions and After Adjusting the Channel and Structures Through HRA 3



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231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA #3 - 50- YEAR EXISTING CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY

SD115

ROCKLAND COUNTY
NEW YORK

SCALE 1 " = 550 '

DATE 11/15/2021

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FIG. 4-28

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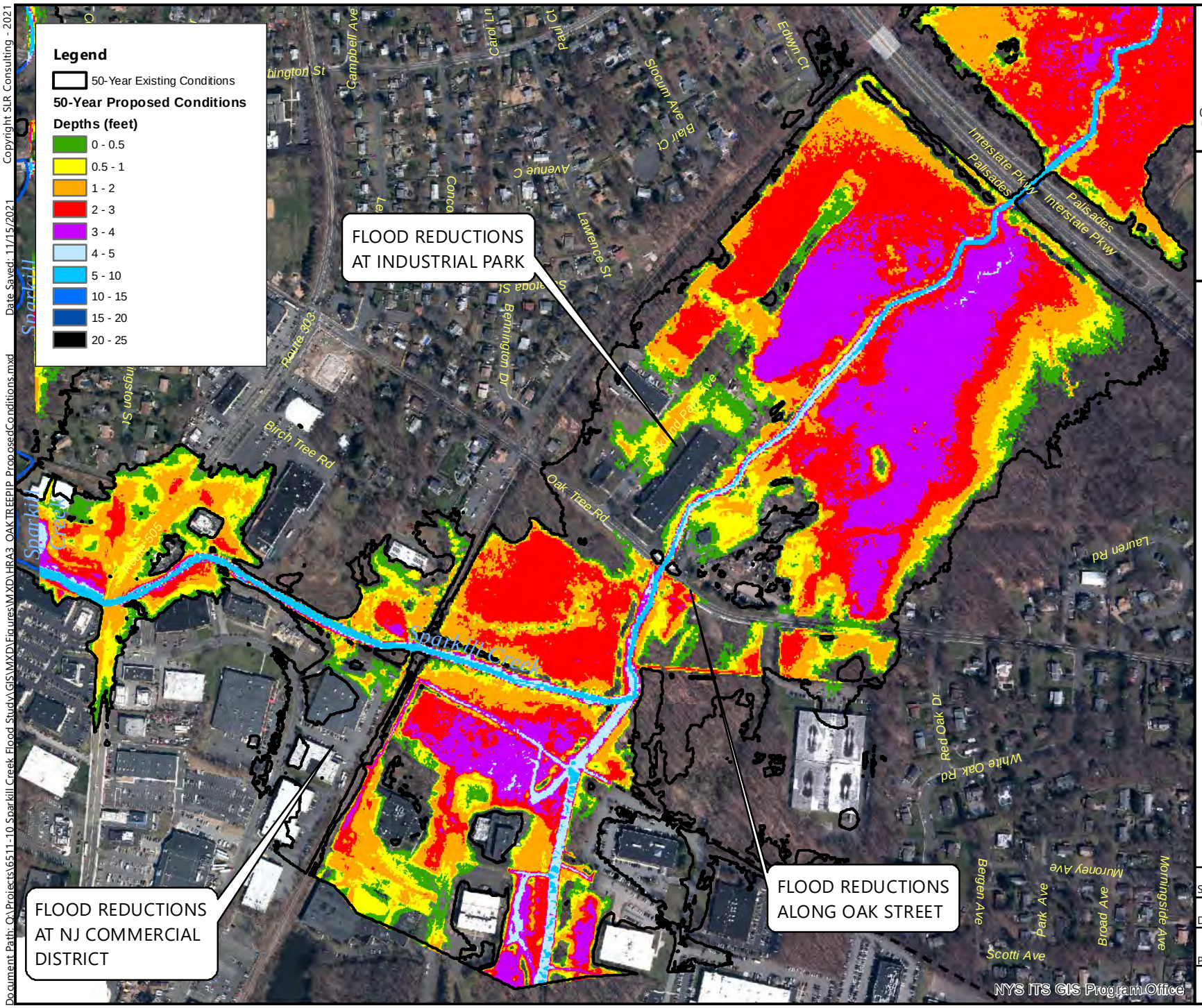

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Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
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HRA #3 - 50-YEAR PROPOSED CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY

SD115

ROCKLAND COUNTY

NEW YORK

SCALE 1 " = 550 '

DATE 11/16/2021

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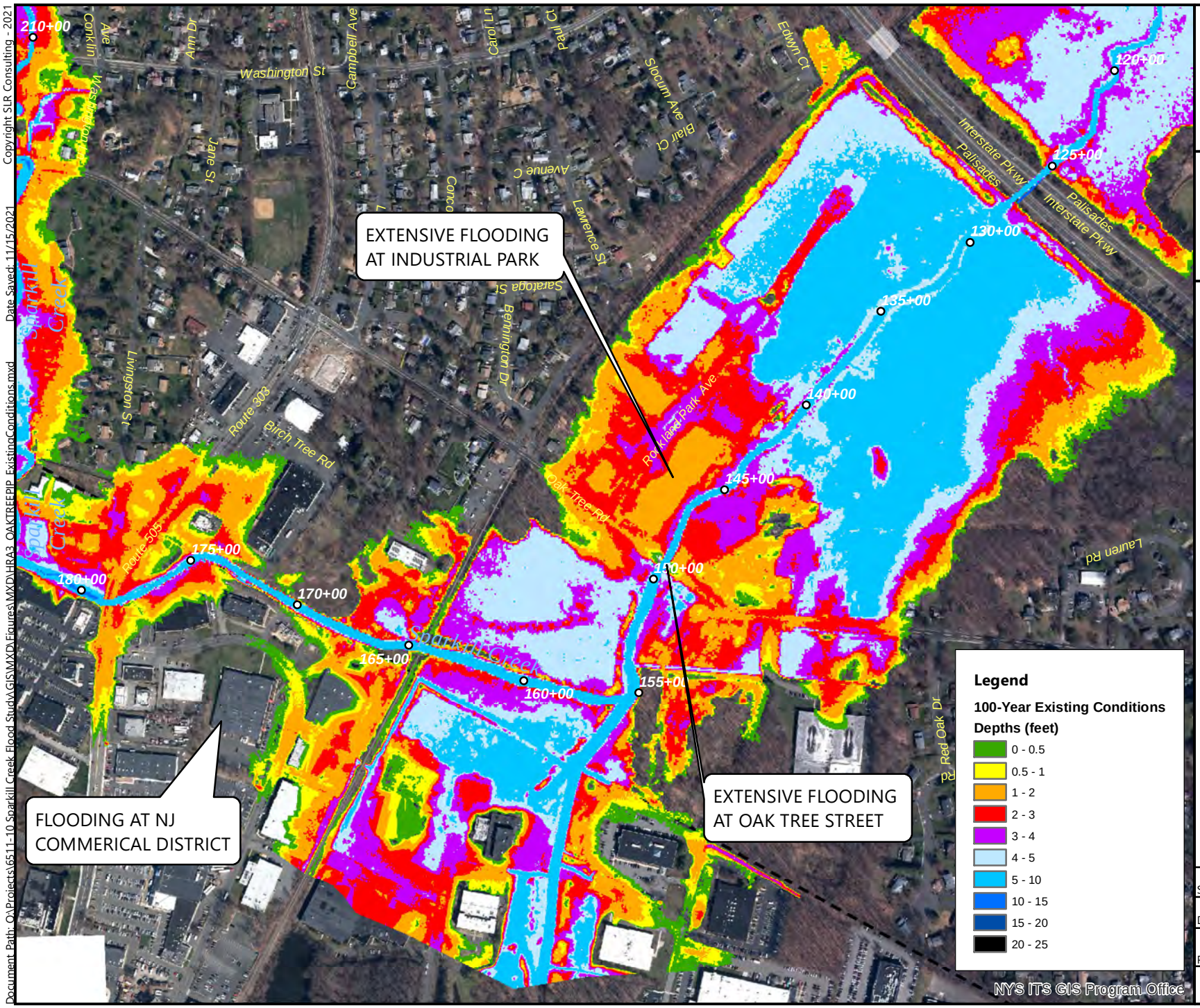
FIG. 4-29



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NEW PALTZ, NY 12561
845.633.8153

HRA #5 - 100- YEAR EXISTING CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY

SD115

ROCKLAND COUNTY

NEW YORK

SCALE 1 " = 550 '

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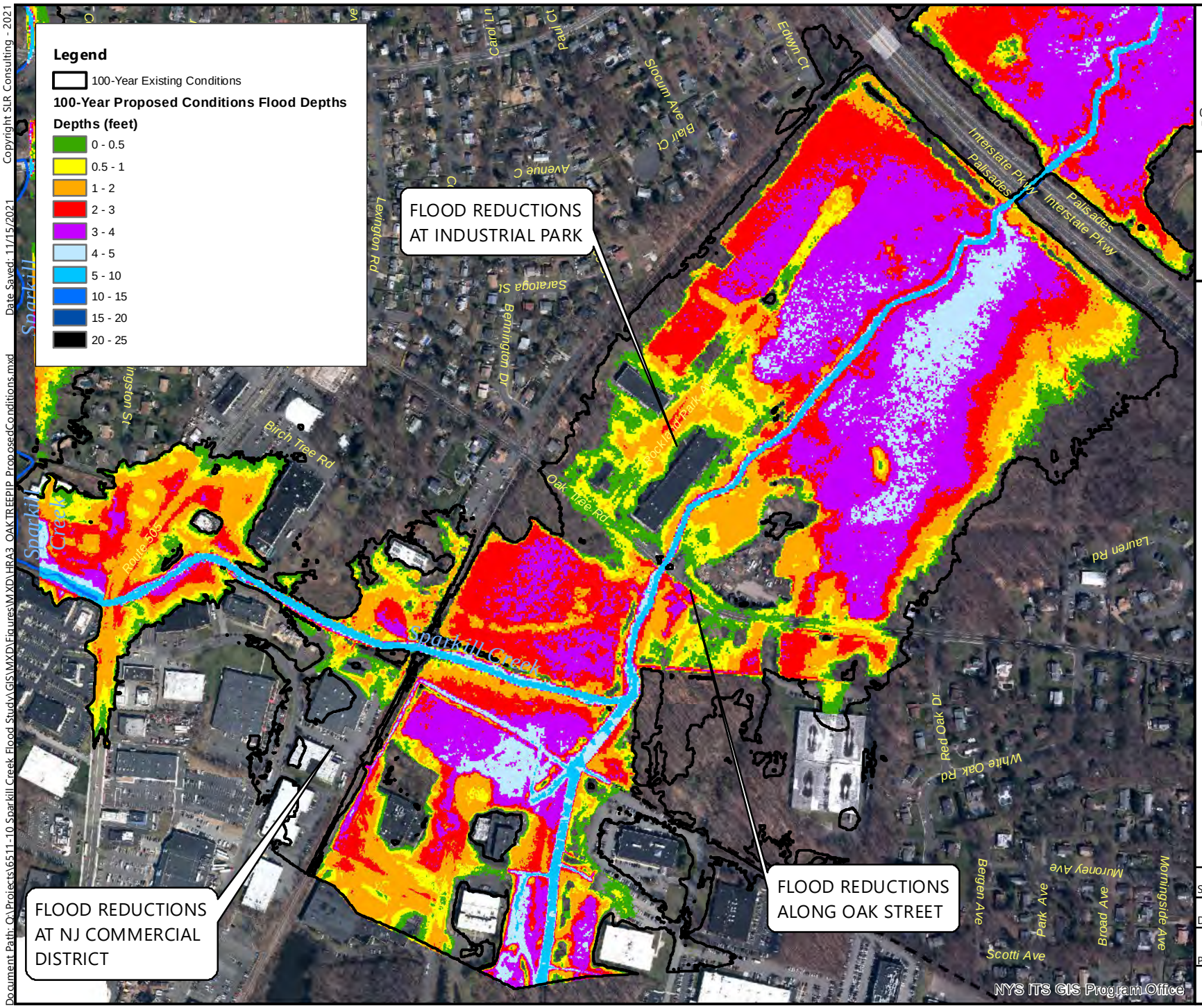
FIG. 4-30



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

HRA #3 - 100-YEAR PROPOSED CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY

SD115

ROCKLAND COUNTY

NEW YORK

SCALE 1 " = 550 '

DATE 11/16/2021

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FIG. 4-31

Date Saved: 11/15/2021

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Table 4-1: Summary of Hydraulic Modeling Analysis for HRA 3

Stream Crossing	Existing Structure	Primary Owner	Existing Flood Capacity	Modeled Replacement Structure	Replacement Structure Flood Capacity	
					Current Hydrology	Projected Future Flows to Account for Climate Change
Abandoned Railroad	38.5' span x ~5.2' rise Open Bottom Bridge	CSX Transportation	10-Year	Removal	<10-Year	N/A
				60' Span Bridge	<10-Year	10-Year
Oak Tree Road	29.5' span x ~7.2' rise Open Bottom Arch Bridge	Rockland County	<10-Year	73' Span Bridge	<10-Year	50-Year
PIP (Northbound and Southbound)	21.7' span x 9.4' rise Concrete Box Culvert	Palisades Interstate Parkway	100-Year	60' Span Bridge	100-Year	100-Year

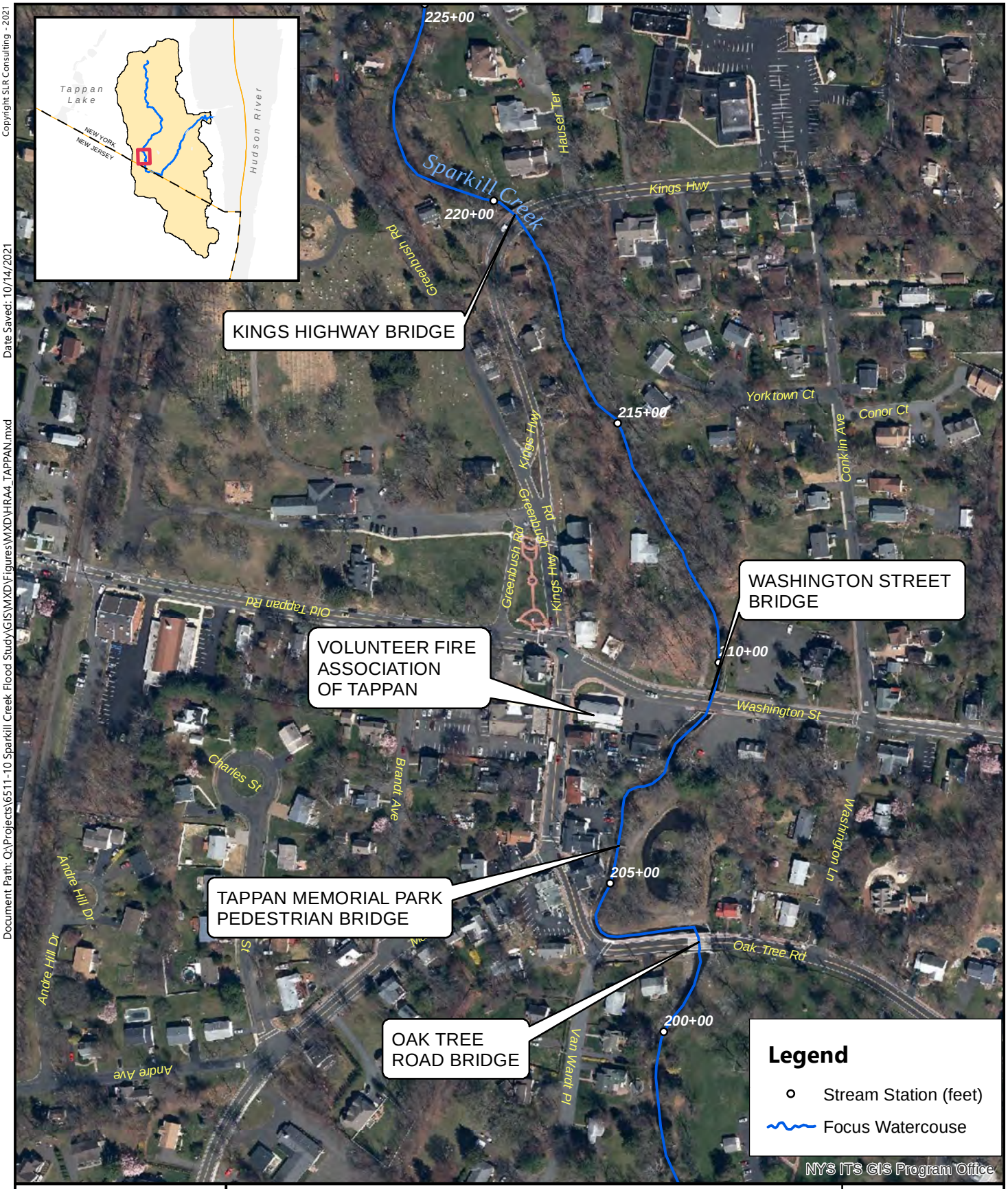
4.4 HIGH RISK AREA #4 – HAMLET OF TAPPAN

HRA 4 runs along Sparkill Creek from STA 200+00 to STA 220+00 and includes from the Kings Highway bridge, south to the Oak Tree Road bridge, in the hamlet of Tappan (Figure 4-32). The watershed of Sparkill Creek at this location is over 5 square miles. Within HRA 4 is the Volunteer Fire Association of Tappan, a critical facility located adjacent to Sparkill Creek at 123 Washington Street (Figure 4-33). Data collected by FEMA indicates that, as of 2019, multiple properties within HRA 4 in Tappan were identified as repetitive loss or severe repetitive loss, including on Washington Street, Oak Tree Road, Van Ward Place, and Kings Highway.

Beginning at the upstream end of HRA 4, Sparkill Creek passes under the Kings Highway bridge, which has a span of 22 feet. Moving downstream, Sparkill Creek becomes highly channelized as it flows between vertical stone masonry and concrete walls. An 18-foot-wide Rockland County-owned bridge crosses the creek at Washington Street (Figure 4-34). Sparkill Creek then passes through Tappan Memorial Park, where it flows adjacent to a small pond and takes a hard, near 90-degree bend to the left, followed by another hard bend to the right. A small pedestrian bridge spans the channel at 27.4 feet within the park. Continuing downstream, a 40-foot-wide county-owned bridge crosses the creek at Oak Tree Road.

In HRA 4, Sparkill Creek passes through Tappan Memorial Park, where it flows adjacent to a small pond and takes a hard, near 90-degree bend to the left, followed by another hard bend to the right before passing under the Oak Tree Road bridge.

HRA 4 was extensively flooded during Tropical Storm Irene in 2001 (Figure 4-35). Based on hydraulic analysis, field assessment, and comparison of each structure's span to the channel's bankfull width, it was determined that all structures within HRA 4 are inadequately sized and are unable to convey even the 10-year flood event. The channelized sections of the creek are also hydraulically undersized and contribute to flooding in Tappan.



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HIGH RISK AREA #4 - HAMLET OF TAPPAN

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

N

0 250
Feet

SCALE 1 " = 250 '

DATE 11/8/2021

PROJ. NO. 16511.00010

FIG. 4-32

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office

Figure 4-33: Volunteer Fire Association of Tappan, a Critical Facility adjacent to Sparkill Creek

Figure 4-34: Washington Street Bridge and Channelized Section of Sparkill Creek

Figure 4-35: Flooding on Sparkill Creek along Oak Tree Road at Van Wardt Place during Tropical Storm Irene (Photo provided by Lawrence Vail)

A proposed set of flood reduction improvements was evaluated. Under this scenario, the Kings Highway bridge and the Washington Street bridge would be replaced with adequately sized structures, each with a span of 50 feet. The Oak Tree Road bridge would be replaced with a new bridge with a span of 60 feet. Floodplain would be enhanced along both sides of Sparkill Creek in key areas, requiring the relocation of several structures immediately adjacent to the creek. Floodplain benches upstream of Washington Street along the right and left banks would measure approximately 550 feet long and would extend from STA 209+50 to STA 215+00. Floodplain bench widths would range from 65 to 115 feet and would be excavated 4 to 6 feet below the existing grade. The channel restoration between Washington Street and Oak Tree Road, from STA 202+00 to STA 209+08, would include floodplain benches along the left and right banks. Floodplain bench widths would range between 40 and 115 feet and would be excavated from 3.5 to 7.0 feet below the existing ground. Downstream of Oak Tree Road, the floodplain bench along the left bank would extend from STA 197+95 to STA 201+70, measure 150 feet at its widest, and on average be 3 feet below existing grade. Undersized and channelized sections of the Sparkill Creek channel would be widened to the bankfull width of 39 feet, and Sparkill Creek through Tappan Memorial Park would be realigned to eliminate the two hard bends and better align the channel with the Oak Tree Road bridge, leaving the existing channel through the park to act as an overflow during large flood events. The pedestrian bridge in the park would no longer be necessary and would be removed. A conceptual layout showing the improvements described above is depicted in Figure 4-36.

Under this scenario, the flood mitigation improvements would result in substantial flood reductions in HRA 4, including a 5.5-foot reduction in water surface elevation during the 100-year flood at the Kings Highway crossing and, similarly, reductions of almost 2 and 3 feet at Oak Tree Road and Washington Street, respectively. Both the Kings Highway and Washington Street bridges would pass the future 100-year flow events under these conditions. The Oak Tree Road bridge would pass up to the future 50-year flow event but would become flanked on river right during the 100-year flow event. Existing and proposed flood depths for the 10-year storm are shown in Figure 4-37 and Figure 4-38, respectively, for the 50-year storm in Figure 4-39 and Figure 4-40, and for the 100-year storm in Figure 4-41 and Figure 4-42. A summary of the proposed replacement structures and the findings of the hydraulic analysis, evaluated under current conditions and under future conditions projecting for changes in hydrology due to climate change, are listed on Table 4-2.

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HRA #4 - CONCEPT MAP

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NEW YORK

N

0 250
Feet

SCALE 1 " = 250 '

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FIG. 4-36

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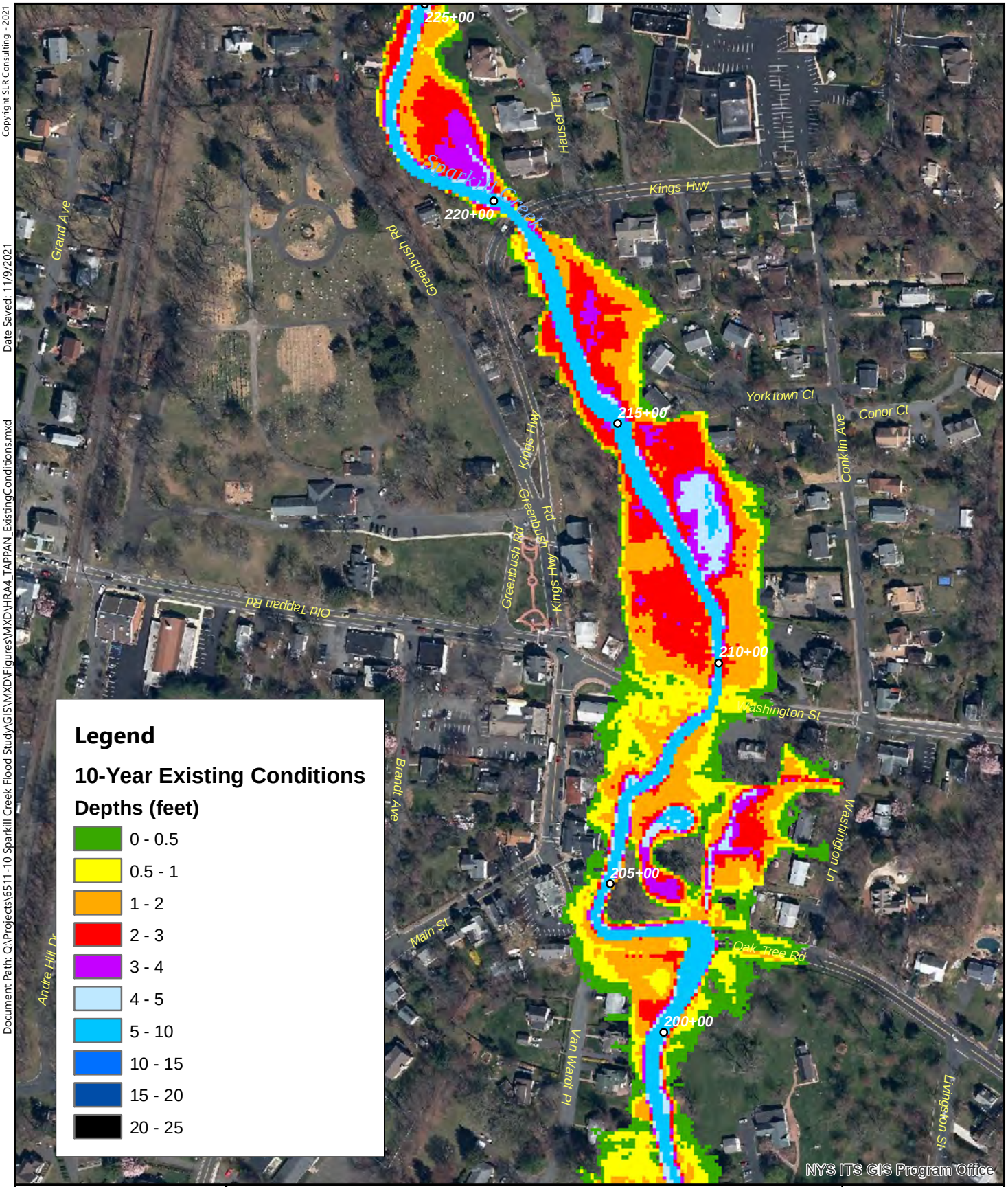

Legend

10-Year Existing Conditions Depths (feet)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25

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HRA #4 - 10-YEAR EXISTING CONDITIONS FLOOD DEPTHS

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SD115
ROCKLAND COUNTY
NEW YORK

N

0 250
Feet

SCALE 1 " = 250 '
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FIG. 4-37

SOURCE: 2016 AERIAL PHOTO, NYS ITS GIS Program Office

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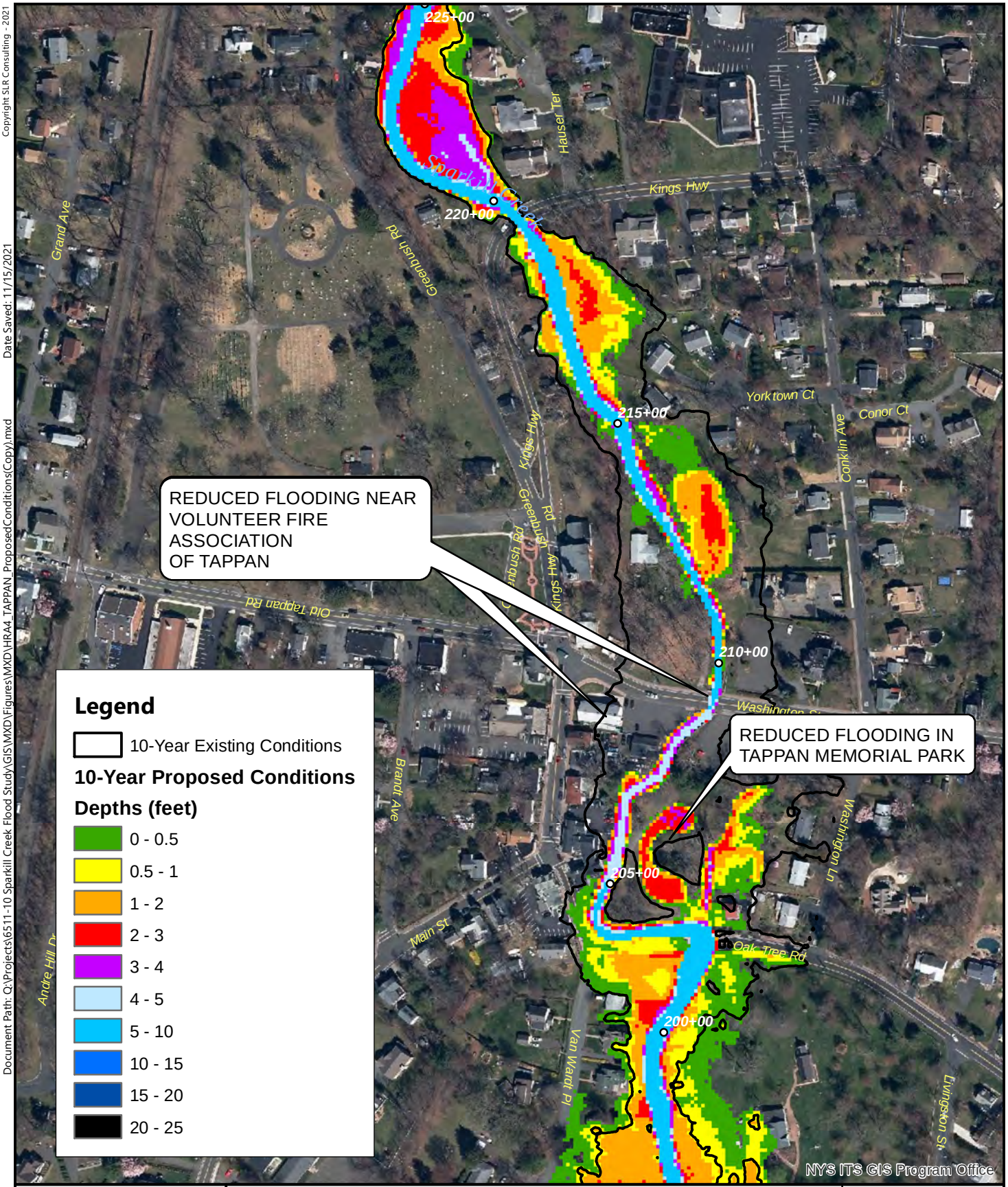

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HRA #4 - 10 YEAR PROPOSED CONDITIONS FLOOD DEPTHS

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NEW YORK

N
0 260
Feet

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FIG. 4-38

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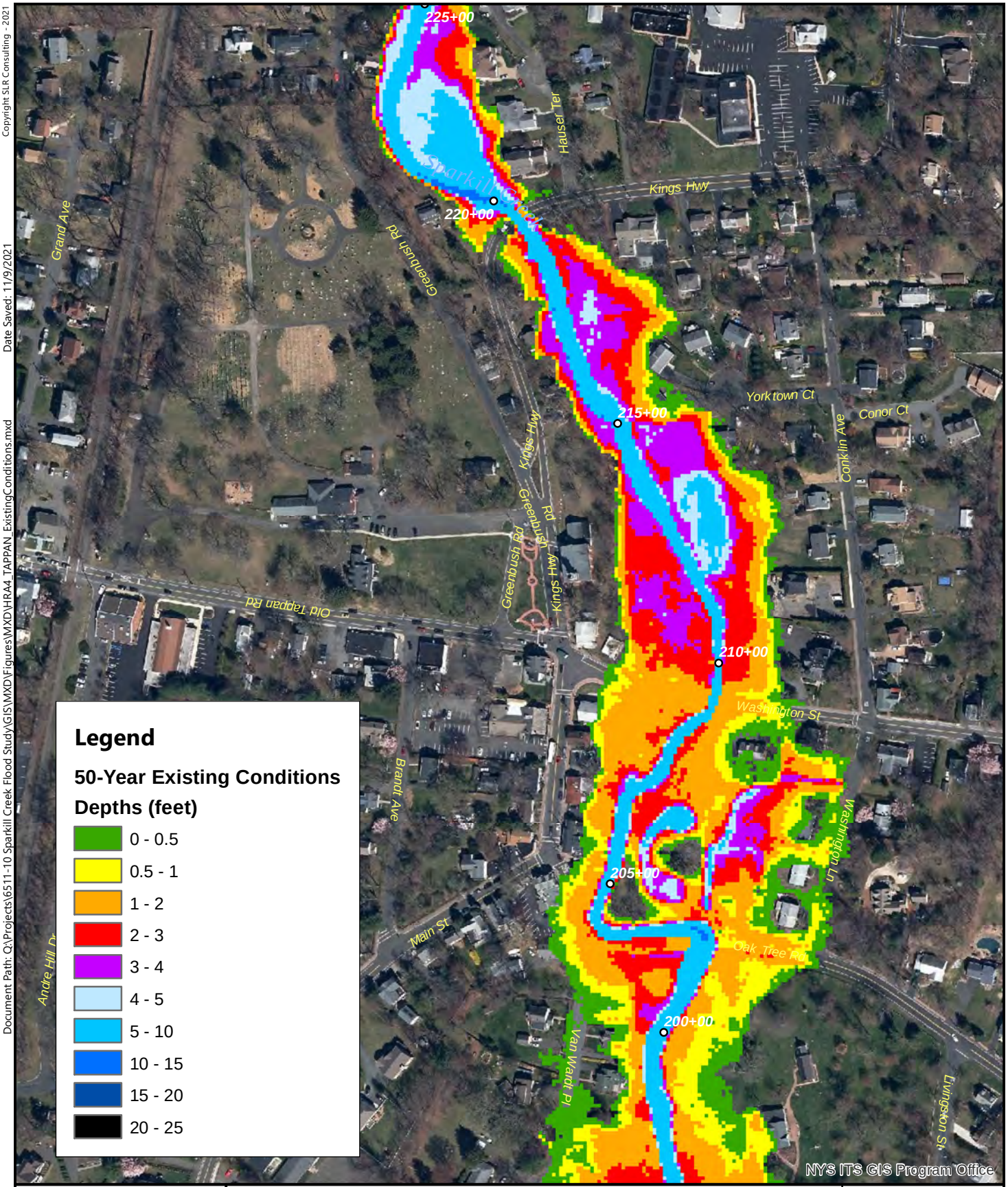

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HRA #4 - 50-YEAR EXISTING CONDITIONS FLOOD DEPTHS

SPARKILL CREEK FLOOD & RESILIENCE STUDY
SD115
ROCKLAND COUNTY
NEW YORK

N

0 250
Feet

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FIG. 4-39

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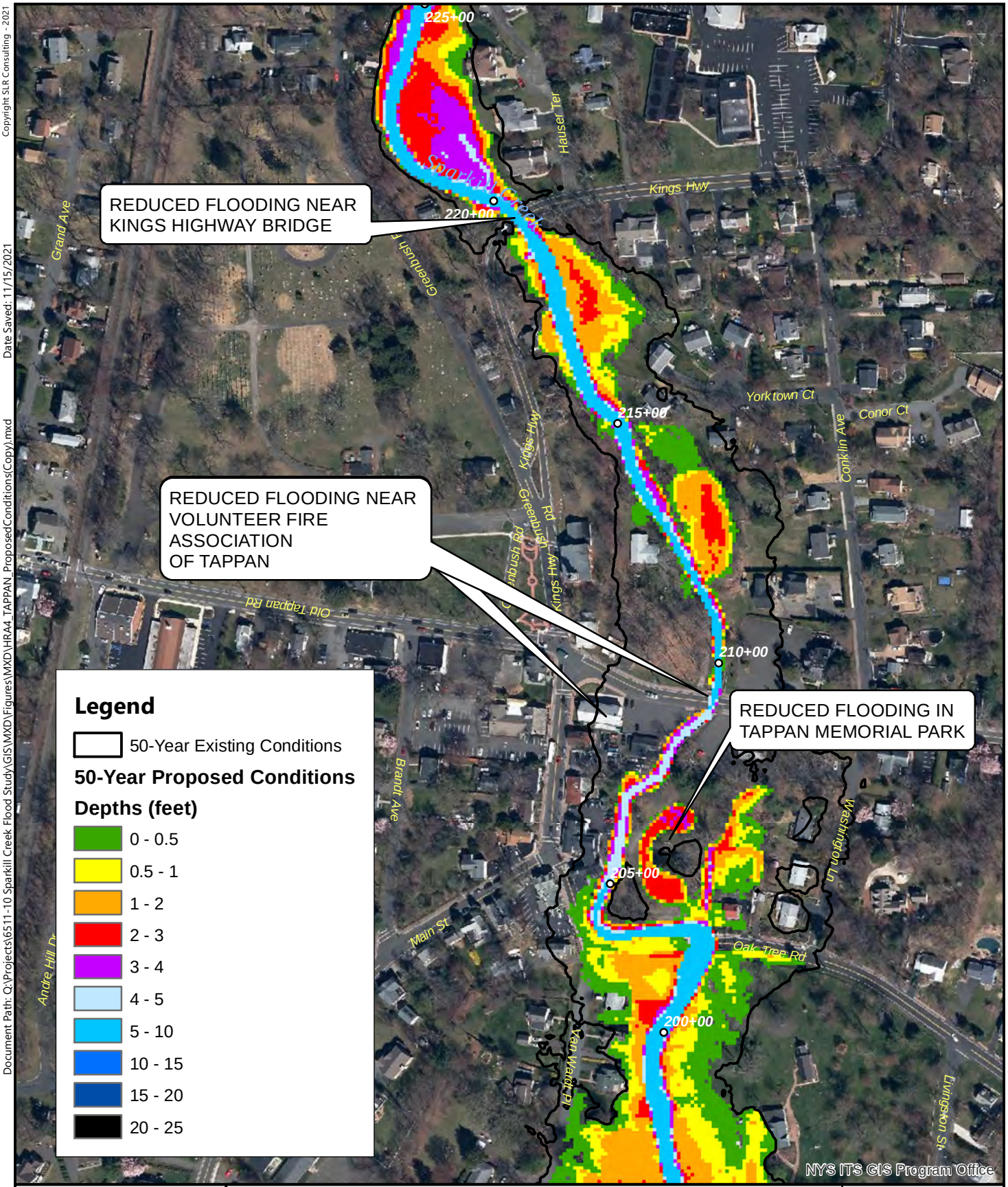

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HRA #4 - 50 YEAR PROPOSED CONDITIONS FLOOD DEPTHS

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SD115
ROCKLAND COUNTY
NEW YORK

N
0 260
Feet

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FIG. 4-40

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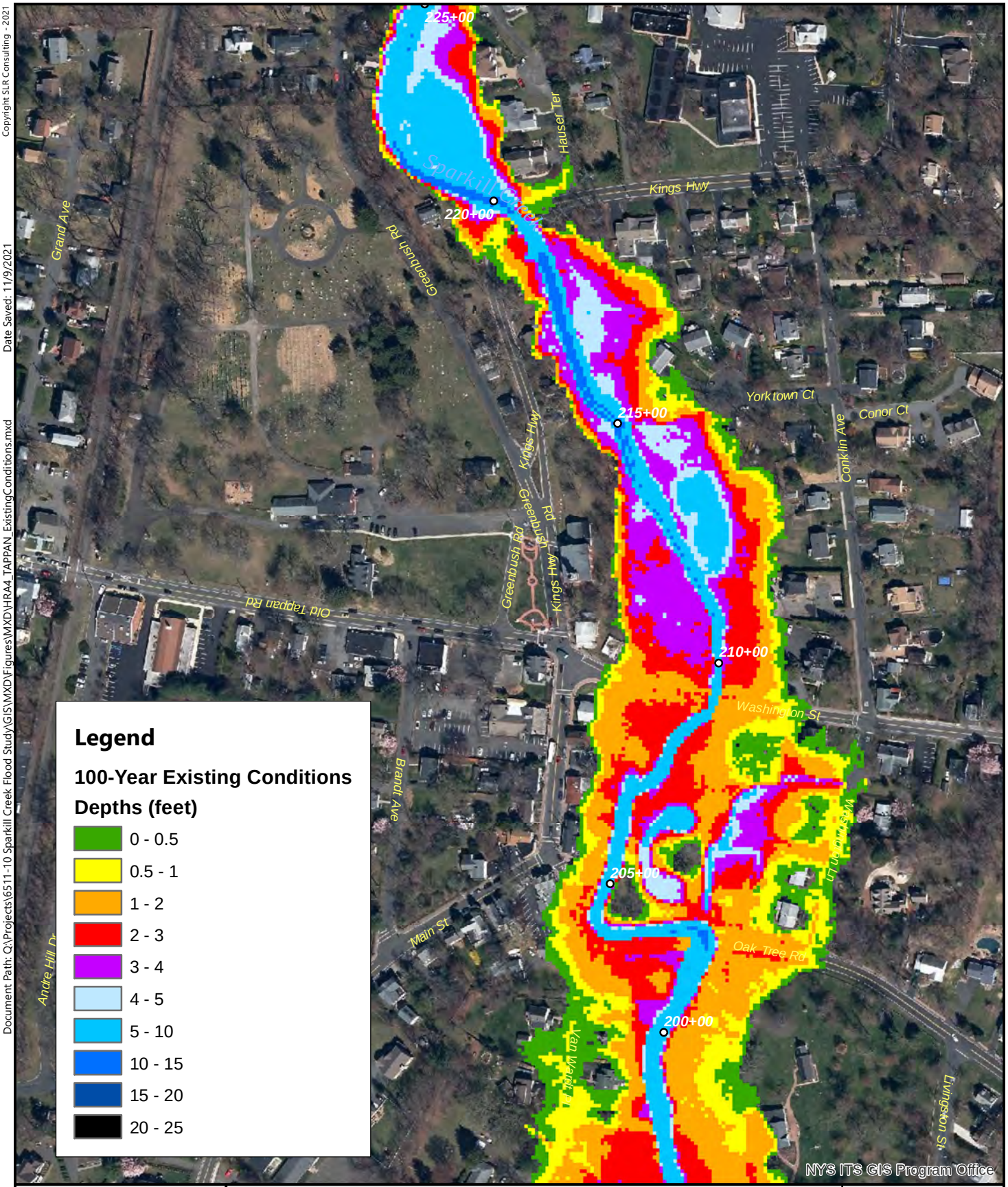

Legend

100-Year Existing Conditions Depths (feet)

- 0 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25

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HRA #4 - 100-YEAR EXISTING CONDITIONS FLOOD DEPTHS

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N

0 250
Feet

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FIG. 4-41

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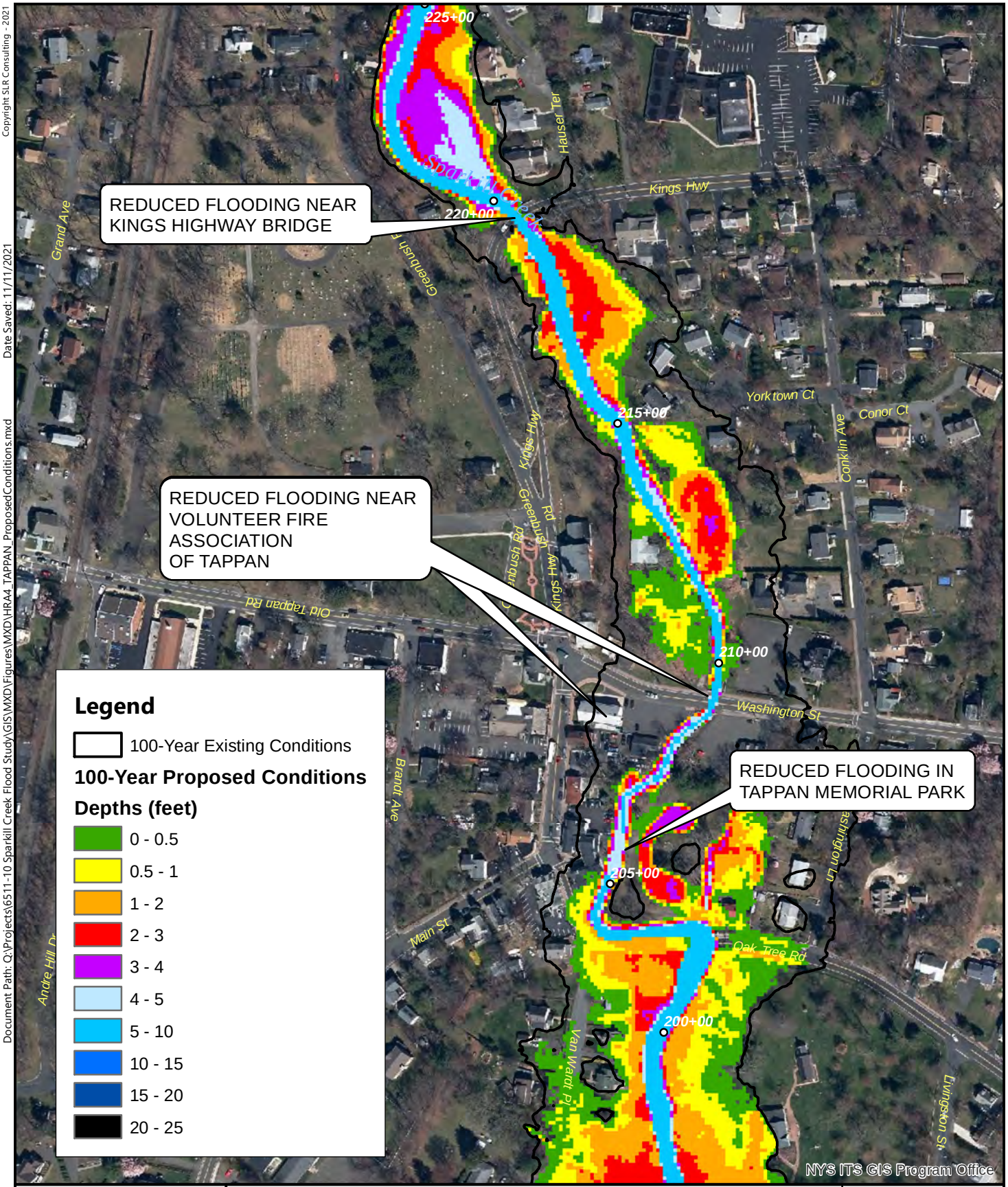

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HRA #4 - 100 YEAR PROPOSED CONDITIONS FLOOD DEPTHS

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N
0 260
Feet

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FIG. 4-42

Table 4-2 Summary of Hydraulic Modeling Analysis for HRA 4

Stream Crossing	Existing Structure	NAACC Crossing Code / Aquatic Passability Score	Existing Flood Capacity	Modeled Replacement Structure	Replacement Structure Flood Capacity	
					Current Hydrology	Projected Future Flows to Account for Climate Change
Kings Highway	22' span x ~7' rise Concrete Open Bottom Bridge	*xy4102434973948048* / 0.86 out of 1.0 *insignificant barrier*	10-Year	50' Span Bridge	100-Year	50-Year
Washington Street	18' span x ~6' rise Concrete Open Bottom Bridge	*xy4102185273946749* / 0.98 out of 1.0 *insignificant barrier*	<10-Year	50' Span Bridge	100-Year	50-Year
Park Pedestrian Bridge	27' span x ~6.5' rise Wooden Footbridge	*N/A* No NAACC Assessment Available	<10-Year	Recommended Removal	N/A	N/A
Oak Tree Road	40' span x ~6' rise Concrete Open Bottom Bridge	*xy4102056873946842* / 0.89 out of 1.0 *insignificant barrier*	<10-Year	60' Span Bridge	50-Year	50-Year

4.5 HIGH RISK AREA #5 – PALISADES INTERSTATE PARKWAY AND STATE ROUTE 303

HRA 5 includes the PIP and State Route 303 at Kings Highway, in the hamlet of Tappan (Figure 4-43). The watershed of the creek at this location is 4.6 square miles.

Each of the two culverts that span the northbound and southbound lanes of the PIP (owned by Palisades Interstate Parkway Commission) has a span of 27 feet (Figure 4-44). Their NAACC crossing code is *xy4103207773941537*, and their aquatic passability score is 0.89 out of 1.0, an *insignificant barrier*. The State Route 303 crossing (owned by NYSDOT), north of the intersection with Kings Highway, is carried by twin-barrel concrete box culverts that measure 10 feet wide and 8 feet high (Figure 4-45). The NAACC crossing code for the culverts is *xy4102990773944169*, and they were assigned a score of 0.89 out of 1.0 for aquatic passability: *insignificant barriers*. The structures currently pass up to the 500-year flows.

In the hydraulic analysis for HRA 5, the culvert crossings at the PIP and at Route 303 were evaluated. The PIP culverts pass up to the 100-year flow without overtopping the roadway. The PIP culverts create a backwater that influences the flooding of the Rockland County Sewer Facility on the right bank upstream, as well as the neighborhoods off Kings Highway (Bell Lane and Julia Court) on the left bank. Replacement of the PIP culverts would reduce the depth and frequency of, but would not eliminate, flooding of the sewer facility and the neighborhoods off Kings Highway. These areas are located on flat, low-lying terrain and will remain flood prone even if the PIP culverts were to be replaced with larger structures.

HIGH RISK AREA #5 - PIP & ROUTE 303

SPARKILL CREEK FLOOD & RESILIENCE STUDY

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FIG. 4-43

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Figure 4-44: Looking Upstream at Northbound Palisades Interstate Parkway Bridge Outlet

Figure 4-45: Looking Downstream at Route 303 Culvert Inlets

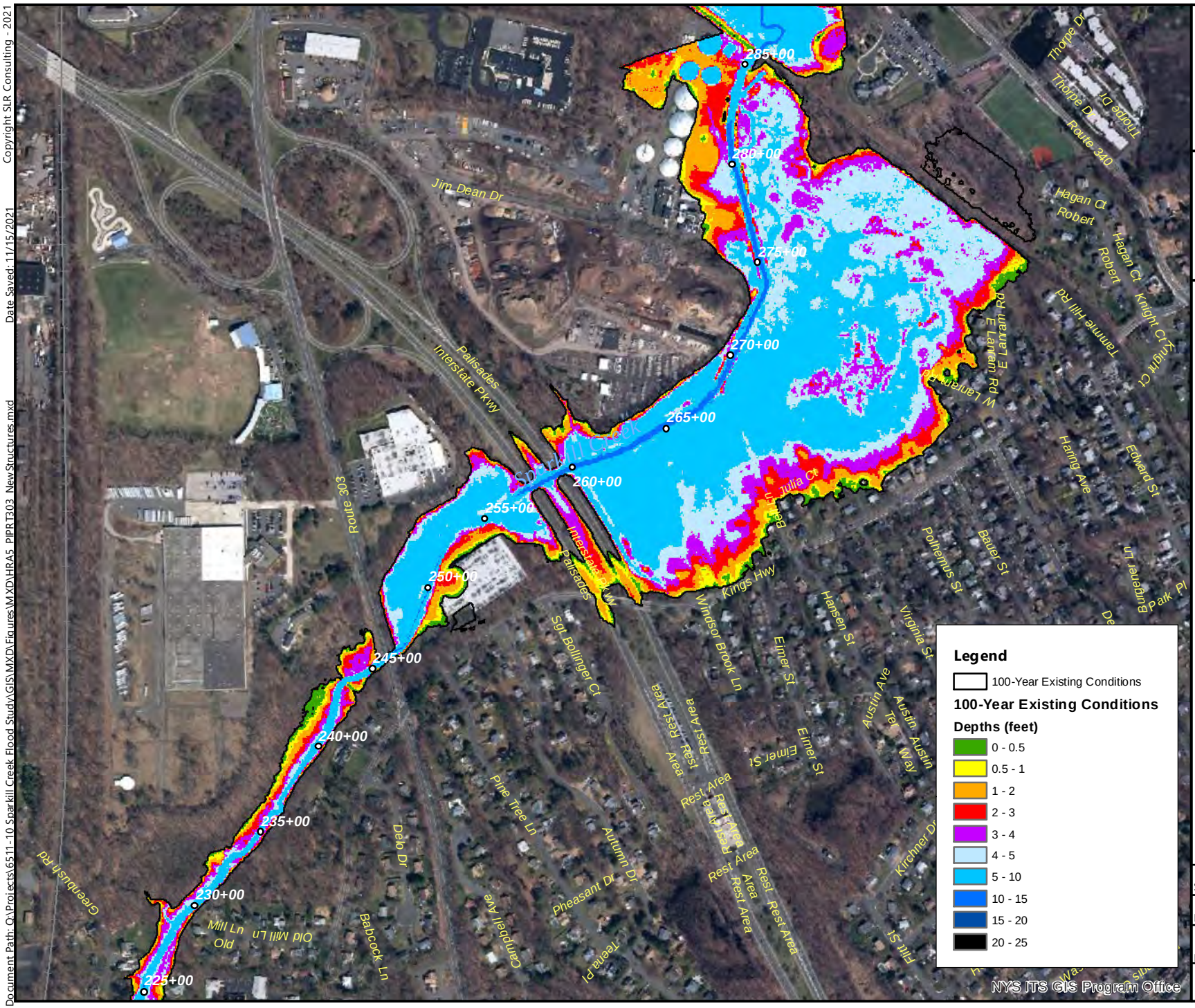
The State Route 303 crossing can pass up to the 500-year flood event without overtopping. Similar to the PIP culverts described above, the State Route 303 culvert creates a backwater that influences upstream

flooding in the vicinity of the CubeSmart facility located on the left bank between Sparkill Creek and Kings Highway. Replacement of the State Route 303 culvert would reduce the depth and frequency of, but would not eliminate, flooding in the vicinity of the CubeSmart facility, which is located on flat, low-lying terrain and will remain flood prone even if the culvert is replaced.

Figure 4-46 depicts the extent of flooding during the current and future 100-year flood event under existing conditions. Figure 4-47 depicts the extent of flooding during the current and future 100-year flood event if the culverts at the PIP and State Route 303 were to be replaced with adequately sized structures.

When the PIP and State Route 303 culverts are due for replacement, a detailed hydrologic and hydraulic analysis is recommended as part of replacement design. The most current regulations and guidance from the New York State Department of Transportation (NYSDOT) and NYSDEC regarding stream crossing geometry and hydraulic performance should be applied, as well as updated assessments of projected future flows. Replacement structures with a span of at least 48 to 50 feet are anticipated. As part of the recommended analysis, the installation of additional culverts adjacent to the existing PIP culverts should be evaluated.

It is recommended that individual flood protection measures or property buyouts be sought out for residential structures along Bell Lane and Julia Court that currently experience flooding. Flood protection measures should be sought out for the CubeSmart facility and the Rockland County Sewer Facility if these buildings experience flooding.



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HRA #5 - 100-YEAR EXISTING CONDITIONS FLOOD DEPTHS

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FIG. 4-46

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