Town of Haverstraw, Village of Haverstraw & Village of West Haverstraw

Community Resilience Building Workshop

Summary of Findings

June 2017

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Cover Image: Overlook of Bowline Point Park ©The Nature Conservancy (Gillian Cowley)

OVERVIEW

Municipalities, regional planning organizations, states and federal agencies need to increase resiliency and adapt to the likelihood of extreme weather events and mounting natural hazards. For communities in the Hudson Valley, this need is strikingly evident. Recent devastating events such as Tropical Storm Irene and Superstorm Sandy have reinforced this urgency and compelled communities such as the Town of Haverstraw, the Village of Haverstraw and the Village of West Haverstraw to proactively plan for and mitigate potential risks. Ultimately, this type of planning by community leaders will reduce the exposure and vulnerability of citizens, infrastructure and ecosystems, as well as serve as a model for communities across the Hudson Valley, New York, and the Nation.

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In the fall of 2016, The Nature Conservancy, Historic Hudson River Towns and the Hudson River Watershed Alliance approached officials from the Town of Haverstraw, Village of Haverstraw and the Village of West Haverstraw (collectively referred to in this document as "the Haverstraws") to discuss and identify resilience needs relative to infrastructure, habitat restoration and community resilience. Haverstraws' officials agreed to have their communities participate in an integrated workshop that incorporates current climate projections, identifies areas of risk and develops adaptation strategies. The Community Resilience Building (CRB) Workshop, which is a unique "anywhere at any scale" community-driven process (www.CommunityResilienceBuilding.com), provides a platform to engage elected officials, staff and business leaders from these communities. The purpose of the facilitated, joint-community workshop is ultimately to guide implementation of priority adaptation actions for the Haverstraws. The workshop's central objectives are to:

- Define extreme weather, introduce possible impacts and articulate local natural and climate-related hazards
- Identify existing and future vulnerabilities and strengths
- Develop prioritized actions for the municipalities and broader stakeholder networks
- Identify opportunities for the community to advance actions to reduce risk and increase resilience

This report provides an overview of the top hazards, current community strengths and concerns, and suggested actions to improve community resilience to natural and climate-related hazards today and in the future.

The summary of findings will benefit from further comments, input and updates from workshop attendees and additional stakeholders alike. The collective community leadership will benefit

from the continuous and expanding participation of all those concerned with hazards and community resilience.

PROJECTED FUTURE CONDITIONS

Current climate and environmental conditions (i.e. magnitude and intensity of storms and drought, sea levels, etc.) are projected to change in ways that will profoundly influence our current interaction with natural and man-made resources. Various platforms are available to better understand and evaluate how different climate change scenarios are likely to impact Hudson Valley Communities, including:

- The Nature Conservancy's Natural Resource Navigator
- Scenic Hudson's Sea Level Rise Mapper
- Columbia University's Hudson River Flood Decision Support Tool
- New York Climate Change Science Clearinghouse

As these and other tools indicate, there is a range of climate changes that could manifest over the course of the century. Numerous global, regional and local factors can influence these outcomes making the exact future climate scenario difficult to predict. Thus, it is important to plan for a range of scenarios, as exemplified by the sea level rise projections of NY's Community Risk and Resiliency Act. General trends and rough estimates can be employed for adaptation planning purposes. For example, the riverfront communities of the mid-Hudson region, generally, should be preparing for a *minimum* of 3-6-foot rise in mean sea level by 2100. The entire Hudson Valley region should also consider the potential ramifications of:

- Hotter summers
- Increased frequency and length of heat waves and droughts
- Shorter, milder winters
- Potential for more, or fewer, cold spells
- More winter precipitation
    - If rain = more flooding
    - If snow = 10" of snow or more per storm
- Increased severity and frequency of major storms
- More flooding due to increased precipitation severity and run-off from development

Details on the range of projected future conditions are available through the New York State Water Resources Institute and through the tools referenced above (See Figure 1 and Table 1 for outputs from the tools.).

Town of Haverstraw
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Figure 1. Projected inundation areas (various shades of blue indicating depth) and the projected 100-year floodplains (orange highlighted areas) with 6 feet (72 inches) of sea level rise for a portion of the Haverstraw waterfront. The image was produced using Scenic Hudson's Sea Level Rise Mapper.

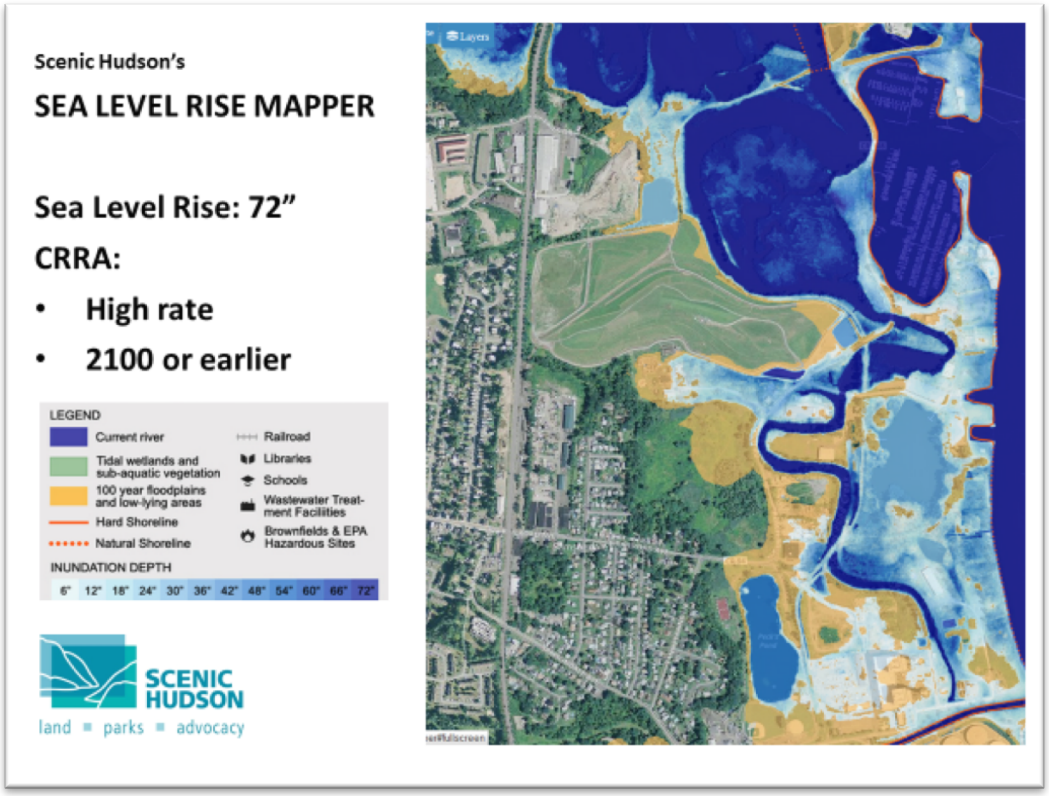

Table 1. Community assets (Infrastructure, Environment and Social) at risk with various sea level rise scenarios and current 100-year storm in Town of Haverstraw (including Village of Haverstraw); information for the Village of West Haverstraw is not included because it lacks direct connectivity to the Hudson River. The output was produced using Columbia University's Center for International Earth Science Information Network Hudson River Flood Decision Support Tool.

Impact Scenarios for Town of Haverstraw (including Village of Haverstraw)			
Type of Impact	**18" of SLR with current 100 YR Storm**	**24" of SLR with current 100 YR Storm**	**36" of SLR with current 100 YR Storm**
Infrastructure			
Total Damaged Buildings	15	22	27
Buildings with Substantial Damage	2	3	1
SPDES Wastewater	1	1	1
Bridges	3	3	4
Power Plants	1	1	1
Power Transmission Lines	3 linear miles		3 linear miles
Environment			
Inundated Land Area	325 acres	336 acres	356 acres
Inundated Impervious Surface Area	111 acres	116 acres	125 acres
Inundated Wetlands	28 acres	28 acres	28 acres
Social			
Social Vulnerability Index of Impacted Census Blocks (Index Score is unitless)	9	9	9
Social Vulnerability Index of Entire Municipality	7	7	7

SUMMARY OF FINDINGS

Top Hazards

During the joint CRB workshop, participants confirmed the top natural hazards for each participating municipality.

1) *Inland Flooding*: Caused by intense precipitation and subsequent runoff, similar to Tropical Storm Irene or Nor'easter Nemo. Hazards for these communities are primarily associated with Minisceongo Creek.

2) *Coastal Storms*: Extreme coastal storms, such as Superstorm Sandy, are capable of producing storm surge and significant coastline flooding. Projected rises in future mean sea levels will increase the impacts of such storms.

3) *Periods of Extended Heat and Drought*: Summers in the Hudson Valley could shift toward higher peak temperatures with more sporadic precipitation events which may stress municipal and private resources, including public water supplies and private wells, while exacerbating challenges faced by already vulnerable communities.

These hazards have growing direct impacts on residents and resources such as natural areas (wetlands, watersheds, parks), roads, drinking and wastewater systems, and other infrastructure such as the Millennium Pipeline.

Areas of Concern

The following locations were identified as areas of concern:

Neighborhoods: Senior housing facilities, affordable housing facilities, Harbors at Haverstraw condominium complex, public and private facilities and structures along Minisceongo Creek, and Church Street residential homes

Ecosystems: Minisceongo Creek, "Tilcon Estuary," mountain/forested resources, waterfront parks

Transportation: Beach Road, Railroad Avenue, Riverside Avenue, Bridge Street, Church Street, Ferry Terminal, Minisceongo rail and road crossings, marinas

Infrastructure: Power plant, wastewater treatment and pump stations, drinking water reservoirs and wells, West Haverstraw Village Hall and Department of Public Works (DPW), Minisceongo Creek channel and floodplains, Theills Elementary School, Fire Stations and Drafting Station, Village of Haverstraw DPW, urban trees, and the Millennium Pipeline

Current Concerns and Challenges Presented by Hazards

The three Haverstraw municipalities, exceptionally integrated and cooperative in terms of municipal services, identified several themes and challenges common to one another, as well as challenges that were community-specific relative to the impacts of natural hazards. In recent years, the Lower Hudson Region has experienced a series of highly disruptive and damaging weather events including Tropical Storm Irene (August 2011), Superstorm Sandy, (October 2012), and winter Nor'easter Nemo (February 2013). Impacts from Irene included significant coastal flooding, heavy-rain induced inland flooding, and wind damage. Sandy caused coastal flooding and extensive power outages across large portions of the region. Nemo dropped more than three feet of snow, knocking out power and isolating residents and neighborhoods. The magnitude and intensity of these events across New York over the course of just 18 months has increased awareness of natural hazards, along with climatic change, and motivated communities to comprehensively improve resilience at the municipal, county, and regional level.

This series of extreme weather events highlighted how hazard impacts vary across the municipalities, from the low-lying coastal area to the forested uplands. The eastern border of both the Town of Haverstraw and the Village of Haverstraw is the Hudson River, which exposes both communities to damage from coastal flooding and storm surge (Figure 2, Figure 3). The heavily forested western uplands, which are preceded by dense commercial and residential development, experience the effects of tree damage from wind, snow, and ice as well as damage from inland flooding during heavy precipitation events. Longer periods of elevated heat, particularly in July and August, raised concerns about heat pockets and citizen well-being. In many Hudson riverfront communities, the combination of these issues presents a challenge to preparedness, response, and mitigation priorities and requires comprehensive, yet tailored, actions for locations throughout the planning area. However, the Haverstraws are very well prepared to deal with many of these challenges.

Workshop participants agree that all three communities are experiencing more intense and frequent storm events. The impacts, particularly during Tropical Storm Irene and Superstorm Sandy, affected the daily activities of most residents and many businesses. The coastal areas of the Hudson Valley tend to be comprised of significant rail and road infrastructure, energy infrastructure, historic sites, and/or park land that experience greater impact from major storms and increases in average tidal ranges, resulting in more routine flooding events, especially the low-lying places. Additionally, there is a general concern about the need and challenges of being prepared with contingency plans for seasonal worst case scenarios (i.e. major hurricanes (Cat-3 or above)) particularly in the late fall/winter versus summer due to more intense fall and winter storms. Even though these communities already cooperate extensively, there is strong indication that expanding joint planning and response opportunities can be helpful, and that exploring and implementing additional shared services may yield significant rewards in the future.

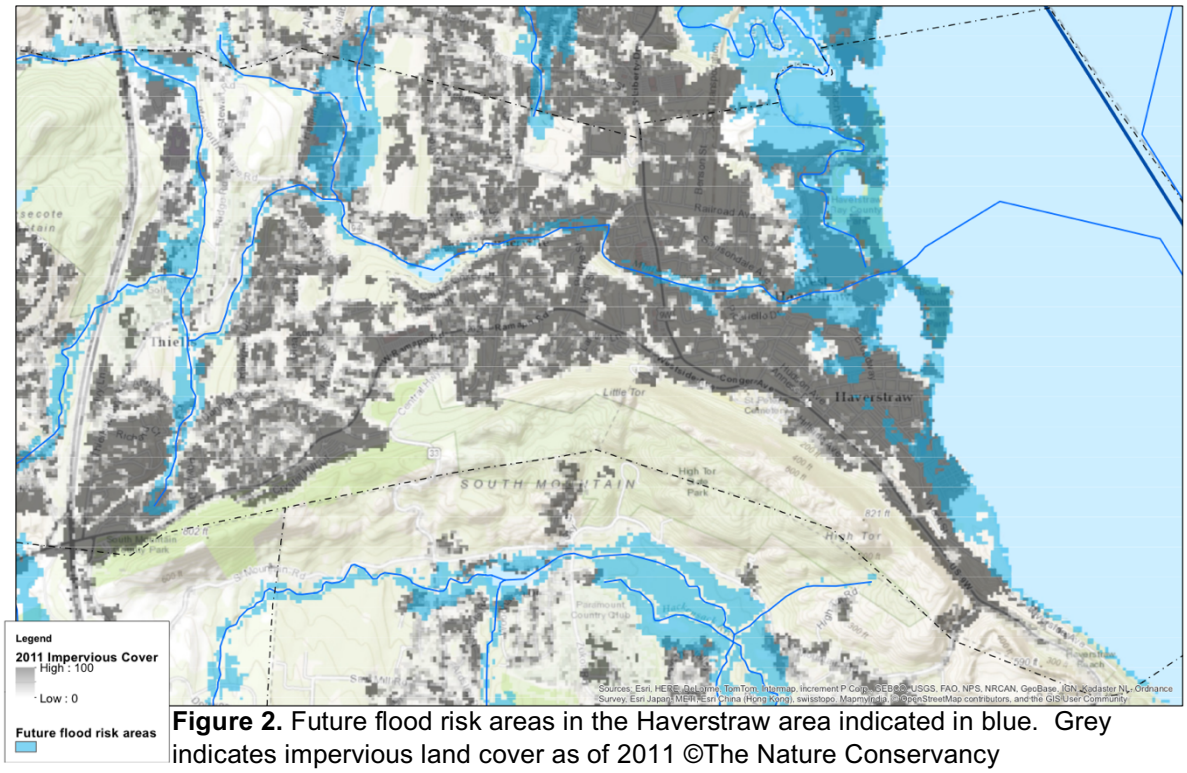

Figure 2. Future flood risk areas in the Haverstraw area indicated in blue. Grey indicates impervious land cover as of 2011 ©The Nature Conservancy

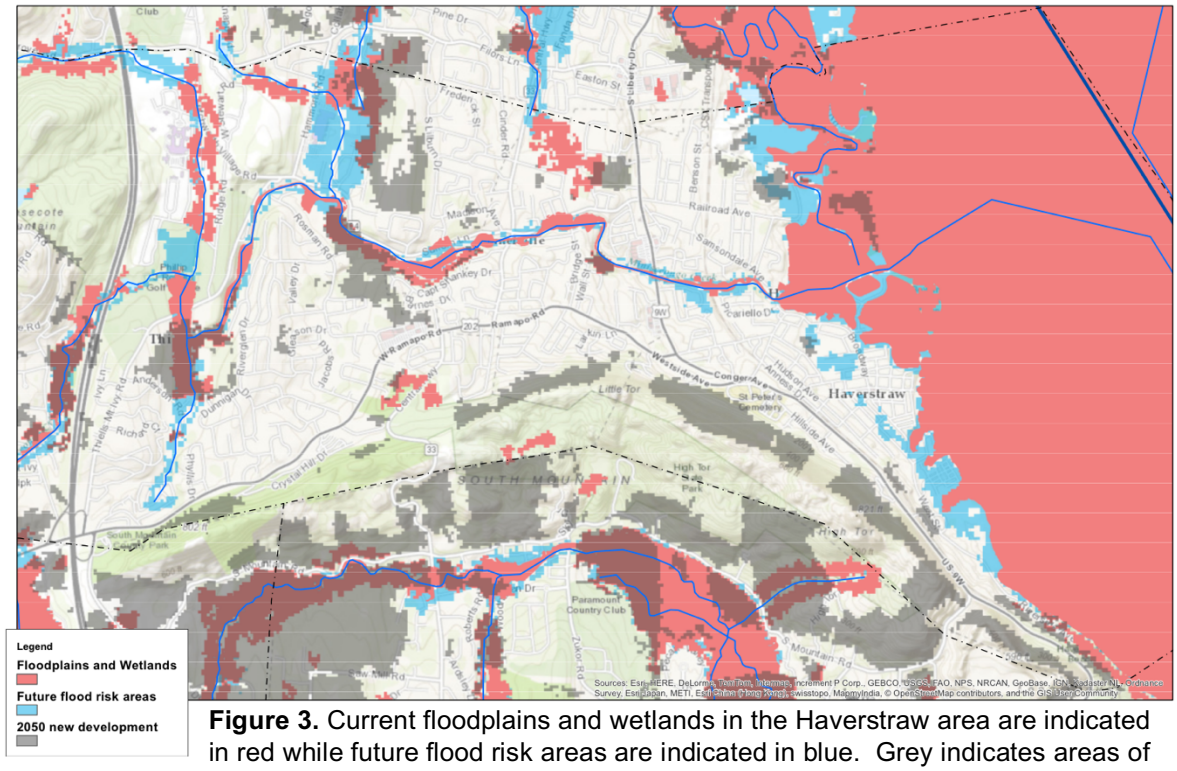

Figure 3. Current floodplains and wetlands in the Haverstraw area are indicated in red while future flood risk areas are indicated in blue. Grey indicates areas of future development. In areas that grey overlaps with red or blue, future development should be avoided or follow special building permits and requirements. ©The Nature Conservancy

Current Strengths and Assets

Because of recent experiences with extreme weather, the Haverstraws are well acquainted with the existing strengths within their respective communities (Figure 4). The county and municipalities have a long-standing practice of participating in joint response exercises for emergency management professionals resulting in protocol upgrades when necessary. Reinforcing and expanding these supportive practices and defining assets will generate greater benefits to the community through increased preparedness for future storms, and addressing the long-term impacts of ongoing increases in storm surge, sea level, air temperature, precipitation, and drought.

- Clearly, the responsive and committed leadership of the elected officials and department staff is a very appreciated strength in all three communities.
- All three communities, in combination with Rockland County, have solid, highly experienced and well-coordinated emergency management professionals with access to adequate resources in times of need. The "Code Red" and Reverse 911 programs are on-going strengths as are the joint police force, two community centers, healthcare centers, volunteer firefighters and emergency management services (EMS).
- Persistent upgrades to the wastewater treatment facility and numerous other engineering upgrades are identified as projects that have improved the resilience of all three communities.
- Supportive social services such as Volunteer Organization Aiding in Disaster (VOAD) and other faith-based organizations are important community assets that clearly provide significant assistance to the community.

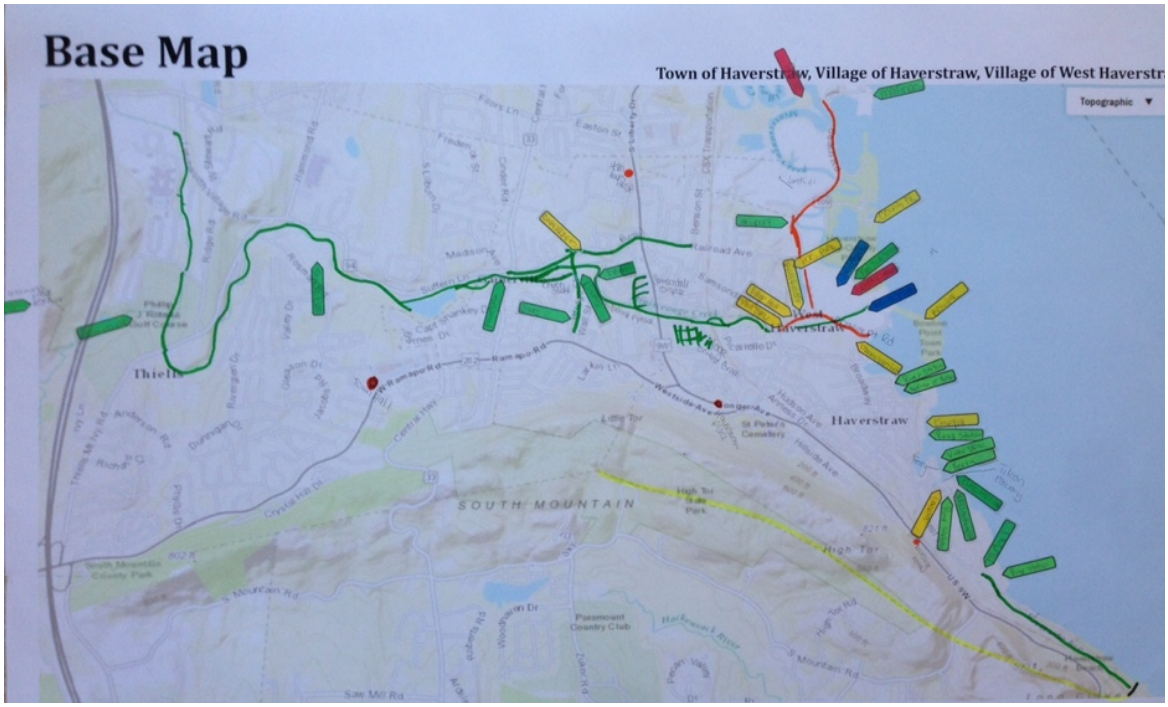

Figure 4. Workshop participants map their current community assets and areas of concern within the Haverstraws

Specific Categories of Concerns and Challenges

Hudson River Tributaries

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Minisceongo Creek, almost entirely contained within the boundaries of the three communities is *the single most important challenge* described by participants. Increased storm water and debris flows, likely derived from increasing storm intensity and associated run-off, are causing changes to the form and function of the stream channels, and pose some danger to downstream areas. These changes threaten to destabilizing homes, businesses and other community assets, including schools. Also, there is some uncertainty associated with the condition of the four dams located along the Minisceongo whose reservoirs have filled with sediment. There is also a lack of coordination and communication between the county and county-wide organizations who may be working on culvert right-sizing and other stream management issues and the less involved municipalities.

Flood-vulnerable Roadways

Road flooding prevents emergency management services from reaching stricken areas, and reduces public access to evacuation routes and critical facilities like gas stations, grocery stores, hospitals and pharmacies. In addition, impassable roads can limit access to necessary emergency sheltering.

Although Route 9w and 202 are largely out of harm's way, their stream crossings are likely to become more susceptible to future flooding impacts. The many culverts and storm drains through the municipalities are also of concern, particularly those in low-lying areas. Although current "blue sky" conditions do not generally disrupt this area, future sea level rise, coupled with either coastal or inland flooding, is likely to significantly impact areas such as Beach Road, Riverside Avenue, Bridge Street, and Church Street. Other flooding and sea level rise challenges were identified with the ferry and harbor condominium parking garage.

A corner on Broadway, Town of Haverstraw
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Resilience of the Local Business Community

While local businesses are often among the first community sectors to provide support following a disruptive event, there are also businesses that have experienced structural loss in the past or may otherwise be impacted by employee transportation challenges. The local business community can significantly benefit from a support network. Greater attention to the recovery of the business community will not only improve economic resilience, it can also improve social resilience by supporting uninterrupted access to goods and services as well as hasten a return to normalcy following significant weather related events.

Improve Resilience of Public Infrastructure

Several public facilities including public buildings, fire department substations and drafting stations, and waterfront parks were identified as strengths to the communities, but are vulnerable to either inland or coastal flooding. The community leadership should consider examining opportunities for guidance in best retrofit practices in the short-term but also begin developing relocation opportunities for future implementation.

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Top Recommendations to Improve Resilience

A common thread throughout the workshop discussions is the recognition that government services, residents, businesses and other stakeholders likely need to improve preparation by completing a coordinated, community-based contingency planning effort that covers a longer time horizon and addresses broader areas of concern. A second strong commonality was that improved and expanded community coordination and collaboration can significantly improve resilience with the region. These and additional highlights are addressed below.

Highest Priorities

- Establish a community-based, multi-community watershed coalition focusing on the multitude of challenges presented by Minisceongo Creek.
    - Immediate actions should include a technical watershed assessment to guide implementation of restoration actions to improve the value of this important asset while identifying opportunities for natural, green and grey infrastructure, where appropriate.
    - Engage with groups like the Hudson River Watershed Alliance and, locally, Cornell Cooperative Extension and the Rockland County Soil and Water Conservation District to facilitate the launch of this effort.
    - Conduct structural assessments of each of the four dams along Minisceongo Creek in cooperation with the NYS DEC Dam Safety Program.
- Assess the level of flow/passage along Minisceongo Creek.
    - Coordinate with the appropriate county organizations to identify and prioritize culvert and road crossing constraints along the entire Creek.
    - Secure funding as part of the integrated watershed planning effort to reduce flow restrictions through upgrades and/or culvert replacements.
- Develop a more robust engagement between the business community and the three municipalities around providing recovery support following significant weather-related events.
    - Municipalities and the county should consider additional training and education for business owners regarding best practices to increase resilience before, during, and after major events.
    - Seek ways to improve and increase alternative power sources for critical businesses such as gas stations, drug stores, and restaurants after major disasters.
    - Seek to develop additional services for businesses such as a helpline and coordinated cleanup efforts.
- In preparation for proposed power plant upgrades, identify clear opportunities to incorporate resilient building and property maintenance codes and verify that permits are in place and followed. For example, upgrades should ensure that waterfront fuel storage infrastructure is properly secured and will not be carried out into the river. Look to New York State for guidance and recommended best practices.

- Ensure Theills Elementary School is integrated into the comprehensive vulnerability assessment and eventual action plan for Minisceongo Creek improvements.
- Develop a comprehensive plan to increase the resiliency of West Haverstraw Village Hall and DPW. Required actions include elevating at-risk mechanicals, hardening appropriate systems, and developing secure emergency access under multiple extreme scenarios.
- Ensure full engagement from diverse stakeholders in the Local Waterfront Development Plan.
- Identify and integrate key projects, practices, and/or policies that will increase resilience along the each of the municipal waterfronts.

Moderate Priorities

- Develop better platforms and content to appeal and reach a broader audience on risk reduction and resilience across the three municipalities.
- Examine long-term flood proofing or relocation options for high-risk residential buildings and neighborhoods; particularly along the Hudson and Minisceongo Creek shorelines.
- Continue to proactively provide mitigation projects (e.g., Minisceongo Creek Projects) to County during Natural Hazard Mitigation Plan updates.
- Seek to define current and future vulnerabilities at all three waterfront parks. Develop a resilience management plan to ensure continued use as a public amenity and design approaches to maximize the risk reduction capacity of the parks.
- Develop an integrated asset management plan that considers the additive and reinforcing aspects of various actions to improve resilience to the Wastewater Treatment Plant including installing barriers surrounding the plant, elevating access roads, hardening the facility and raising onsite office spaces before conditions present a serious threat.
- Assess conditions likely to impact the S.W. Johnson Firehouse, other substations and drafting stations, and retrofit or relocate to ensure facilities are better able to cope with extreme weather events and climate change.
- Develop a plan to relocate Village of Haverstraw and West Haverstraw DPW facilities to alternate lower risk locations and engage in discussions to consider a consolidated facility at a new, more resilient location.
- Conduct comprehensive assessment of the current road network under various weather and climate scenarios:
    - Determine locations and actions to improve the resilience of road network.
    - Actions to consider include upgrade drainage via capital improvement plan; improve signage to safely redirect traffic under extreme conditions; develop list of flooded properties serviced by vulnerable road network; conduct outreach to floodplain residents to discuss options.
- Look to develop a comprehensive emergency management plan for Harbor Condominium and garage facility; Outreach to local municipal emergency management structure to ensure close coordination with proposed Harbor plan.
- Integrate sustainable, resilient flood proofing options into redevelopment plans.

- Look to identify and integrate preferred watershed management practices to enhance resilience through current natural resource inventory and other open space update efforts in the future.

Lower Priorities

- Encourage local marina operators to develop appropriate measures and maintenance plans to reduce risk to customers, property and Hudson River.
- Assess current and ongoing exposure issues due to extreme weather events associated with the Millennium Pipeline:
    - Seek to enhance resilience by hardening system and re-evaluating contingency plan in the event of catastrophic rupture of pipeline in the Haverstraws
    - Integrate into Minisceongo Creek watershed management plan
- Assess existing and ongoing issue with homes on Church Street due to erosion.
- Integrate flooding concerns and retrofit opportunities at baseball fields into larger watershed planning effort for Minisceongo Creek.
- Ensure ferry terminal managers are actively contributing to municipal and county dialogues on resilience.
- Conduct a current needs assessment for green infrastructure to help alleviate localized flooding and pressure on storm water systems.
- Address current lack of urban tree inventory and management plan.

Street Corner in Haverstraw
©The Nature Conservancy (Gillian Cowley)

WORKSHOP PARTICIPANTS

Name	Municipal Affiliation	Title
Chris Jensen	Village of Haverstraw	Rockland County Emergency Services
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Nicole Laible	Village of Haverstraw	Environmental Management Assistant
Robert (Bobby) Drexler	Village of Haverstraw	Director of Public Works
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Alex Guarino	Town of Haverstraw	Assistant to Supervisor
Michael Kauker	Town of Haverstraw	Planning and Development Consultant
Sal Corallo	Town of Haverstraw	Planning Board Chair
Cathy Kopf	Village of West Haverstraw	Village Treasurer/Deputy Village Clerk
Katie Welsh	Village of West Haverstraw	Assistant to Mayor
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RECOMMENDED REPORT CITATION

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Appendix I: CRB Workshop Presentation

Slide #1 Resource for investigating climate change and hazard vulnerability.

Climate and Flooding Overview

- Predicting the future is inherently uncertain
- Data and models can supplement local knowledge
- Resources available to inform decisions:
  - TNC Natural Resource Navigator www.naturalresourcenavigator.org
  - Scenic Hudson Sea Level Rise Mapper http://scenichudson.org/slr/mapper
  - Columbia Hudson River Flood Mapper http://www.ciesin.columbia.edu/hudson-river-flood-map/

Slide #2 Regional climate projections for the southern Hudson Valley to 2050. Data from TNC Natural Resource Navigator.

Changes in climate by 2050

Summer max temperature	+4.6 degrees F
Days above 95 deg F	8.6 more days
Winter min temperature	+5.5 degrees F
Days below freezing	25.8 fewer days
Annual total precip	+1.3 inches
Winter precip	+1 inch
Summer precip	-0.6 inches

Slide #3 Summary of expected climate changes.

What it could mean

- Hotter summers
- More heat waves and droughts that last longer
- Shorter, milder winters
- Potential for more or less cold spells
- More winter precipitation
  - If rain = more flooding
  - If snow = 10" of snow

Slide #4 Predicted changes in extreme precipitation magnitude and frequency for 2040-60. Data from the Northeast Regional

Changes in climate by 2050: extreme precipitation

	10-yr Event	100-yr Event
Current event rainfall	4.5"	8.1"
Future event rainfall	5.2"	9.2"
% increase in rainfall	15.5%	14.0%
Future recurrence interval of current rainfall amount	5 years	62 years

Projected 3.3% increase in pavement and buildings in Minisceongo Creek watershed

Slide #5 Summary of expected impacts of changes in extreme precipitation.

What it could mean

- Big storms will be slightly bigger
- Big storms will be about twice as likely in any year
- The same amount of rainfall could cause more flooding due to development

Slide #6 County and municipal data on past flood frequency and impacts from the NYS DOH.

Building vulnerability to flooding

	Village Of Haverstraw	Town of Haverstraw	West Haverstraw
# res prop in flood zone	0	3	7
#NFIP policies	52	23	21
$ paid NFIP claims	$7,768	$370,691	$4,069,161
# repetitive properties (losses)	0		1 (2 losses)

Slide #7 Socioeconomic impacts under projected flooding scenarios with sea level rise. Social vulnerability index scores indicate relative risk of harm and lower ability of community to recover from flooding impacts. Data from Columbia Hudson River Flood Mapper.

Social vulnerability

Impact Scenarios for Town of Haverstraw (including Village of Haverstraw)			
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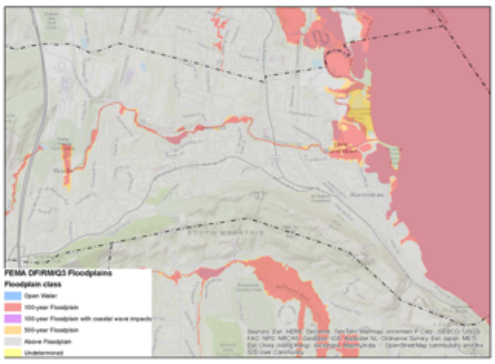
Social			
Social Vulnerability Index of Impacted Census Blocks (Index Score is unitless)	9	9	9
Social Vulnerability Index of Entire Municipality	7	7	7

Slide #8 Areas important to reducing and mitigating flood damage, including floodplains, wetlands, and natural riparian areas. These areas are expected to be important to maintaining stream function and reducing and capturing floodwaters under current conditions. (map data from TNC Natural Resource Navigator)

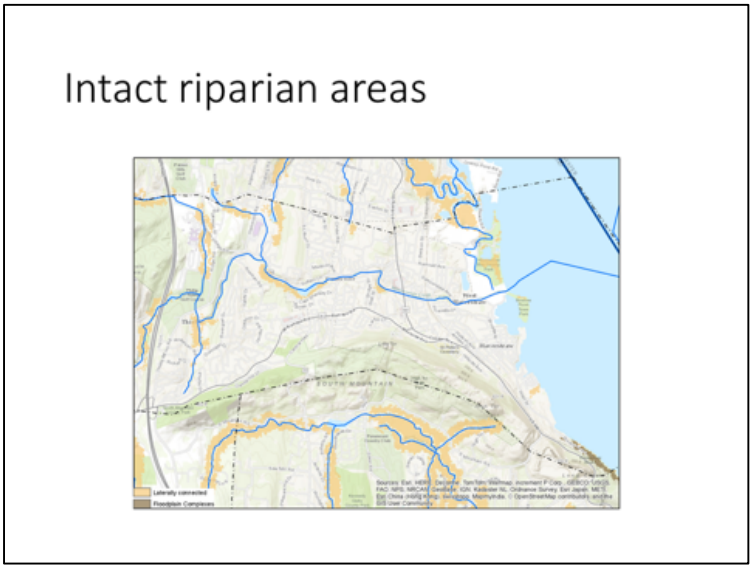
How to minimize flood damage

Slide #9 FEMA-mapped 100-yr floodplains are very likely to flood (1% chance of flooding in any given year). Development in floodplains is at risk of damage and may also worsen flooding downstream.

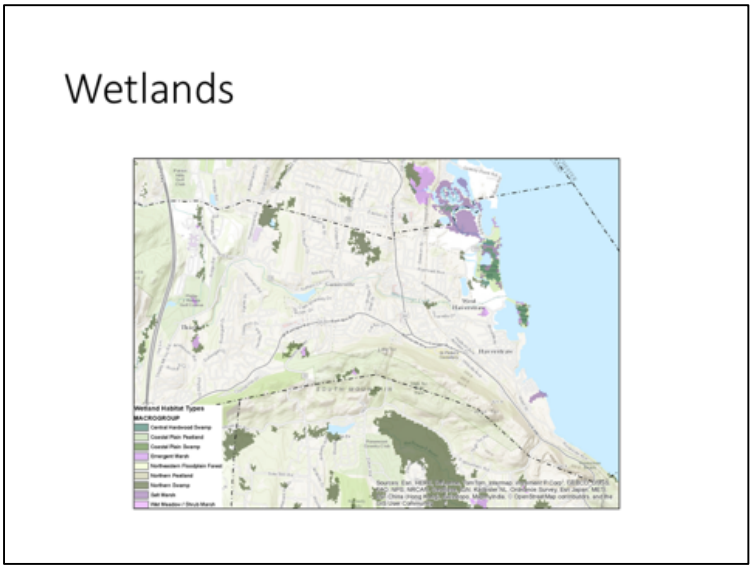
FEMA floodplains



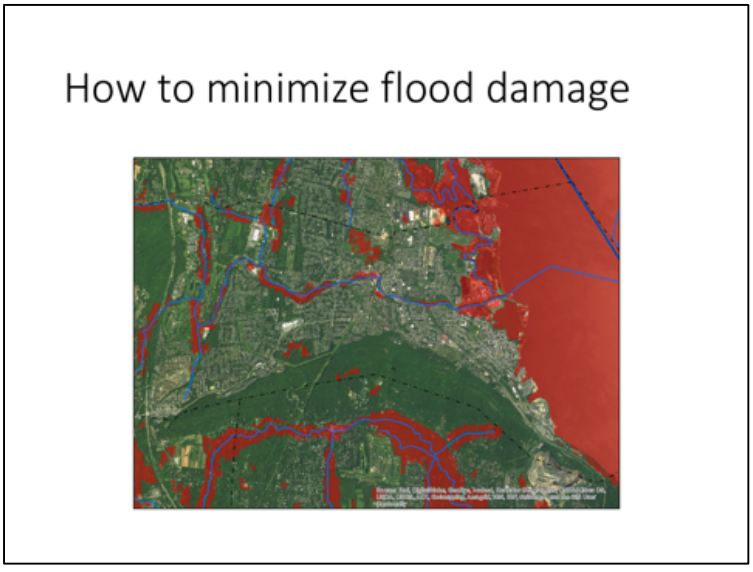
Slide #10 Intact riparian areas both within and outside the floodplain support the ability of streams to process floodwaters and maintain stable stream banks.



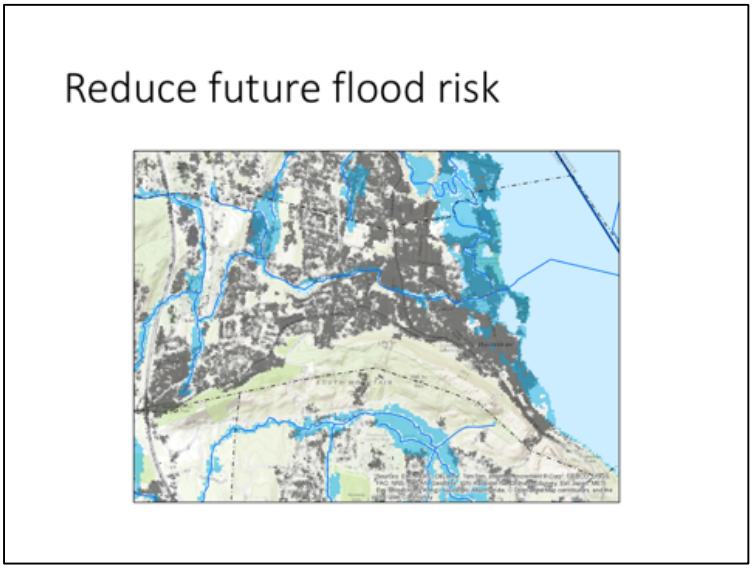
Slide #11 Wetlands of all kinds and sizes help to capture and slowly release stormwater, reducing the frequency and severity of flooding. Tidal wetlands on the Hudson River also help to reduce the impacts of storm surge.



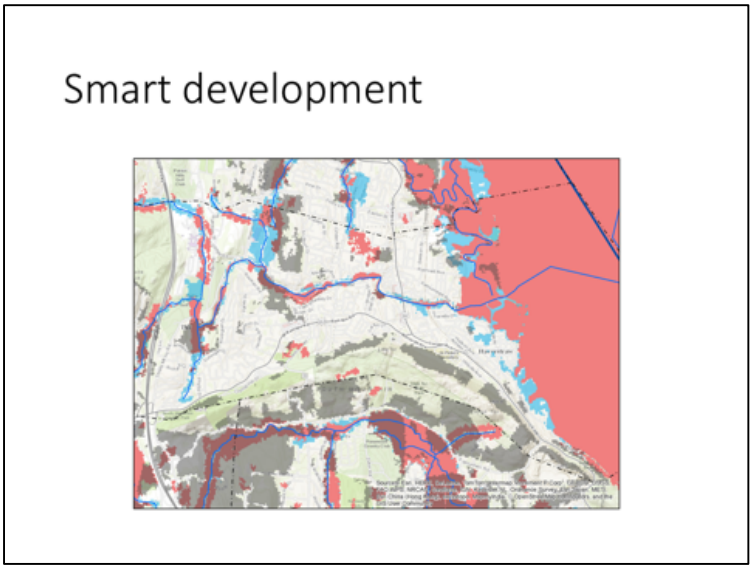
Slide #12 Keeping development out of these critical areas helps to maintain the services these natural systems currently provide to the community.



Slide #13 Increased extreme precipitation and sea level rise is expected to increase flood risk, both by increasing severity and frequency in existing flooded areas, as well as expanding flooding to areas where it currently doesn't occur (blue). Grey areas indicate the locations of existing infrastructure which may be at greater risk of flooding in the future.

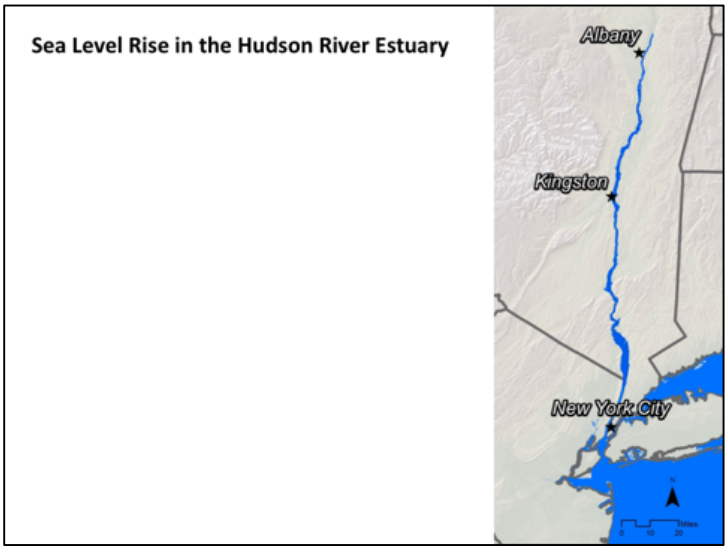


Slide #14 Projections of new development patterns to 2050 (grey) show potential overlap with critical natural areas (red) and future flood risk (blue).

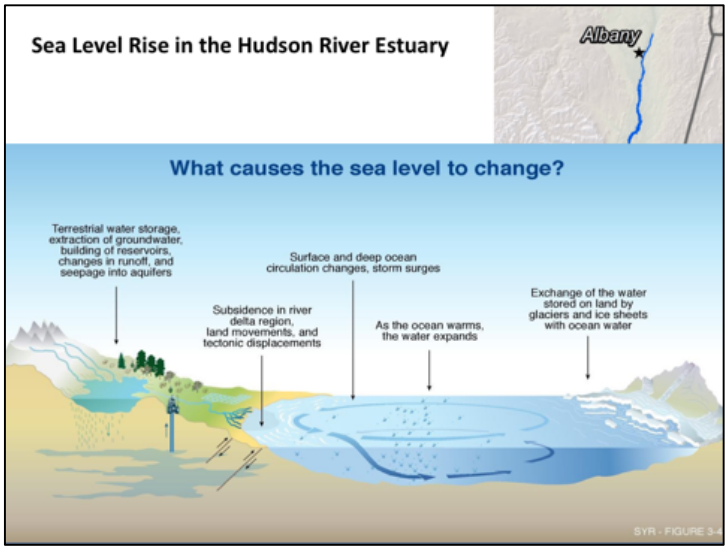


Appendix II: SLR Mapper and SLAMM Presentation

Slide #1 This entire length of the river is an estuary (to the federal dam in Troy), meaning it is connected to the ocean and experiences daily tides.



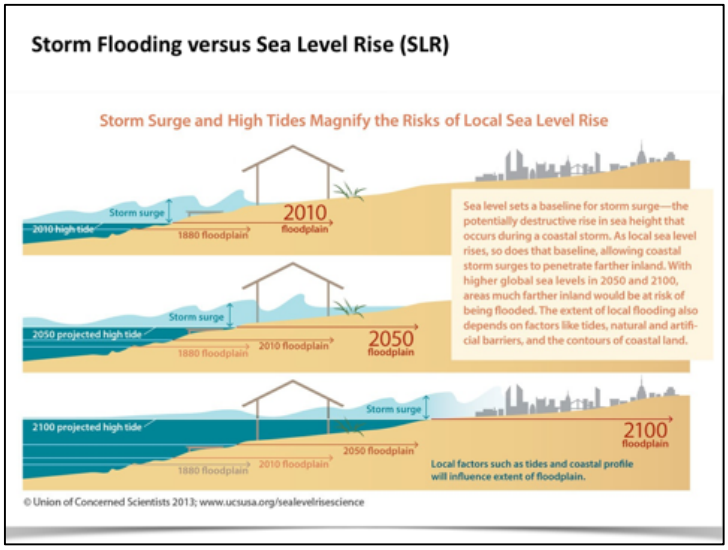
Slide #2 The primary causes of sea level rise globally: warming ocean water expands, increase water delivery to oceans from ice on land.



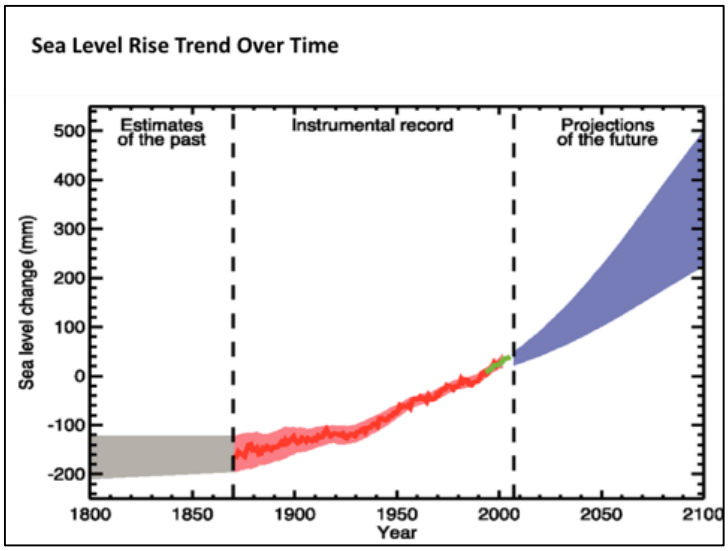
Slide #3 Tidal flooding caused by rising sea levels- this kind of flooding happens even without a storm event.

Photo: Charleston, SC- tide-flooded roadway (from UCS blog)

Slide #4 Sea level rise and storm surge compound flooding problems. Higher mean sea levels will cause storm surge events to arrive on land on a higher level, exposing more people and infrastructure to risk.



Slide #5 Although sea level has been rising since the early 1900's, the rate of rise is quickening. There is uncertainty in projections of SLR (and climate change) into the future. Therefore, planning for multiple scenarios is necessary.



Slide #6 NYS Community Risk and Resiliency Act establishes several scenarios which should be considered when undertaking coastal projects. The Low and Low-Medium Scenarios have or will soon be surpassed and more attention should be given the Medium, High-Medium and High scenarios.

COMMUNITY RISK and RESILIENCY ACT

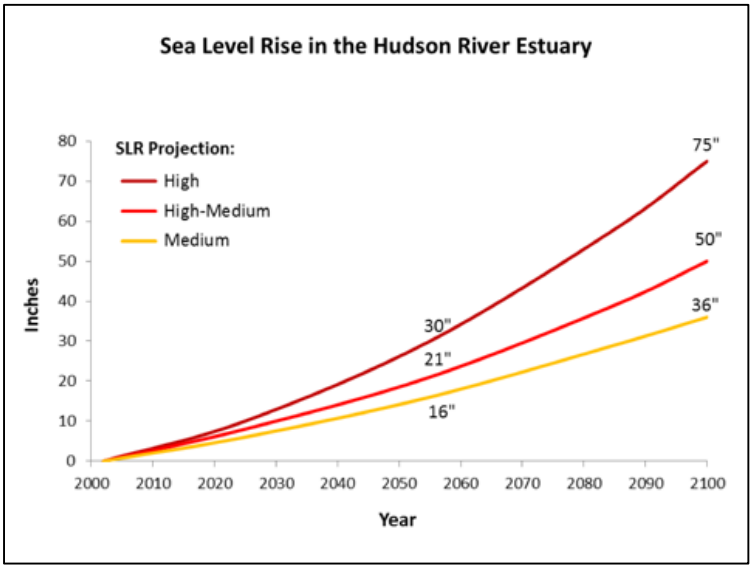
Enacted in September 2014

- **Consideration of sea level rise, storm surge and flooding in facility siting, permitting and funding**
- **Adoption of official sea level rise projections**

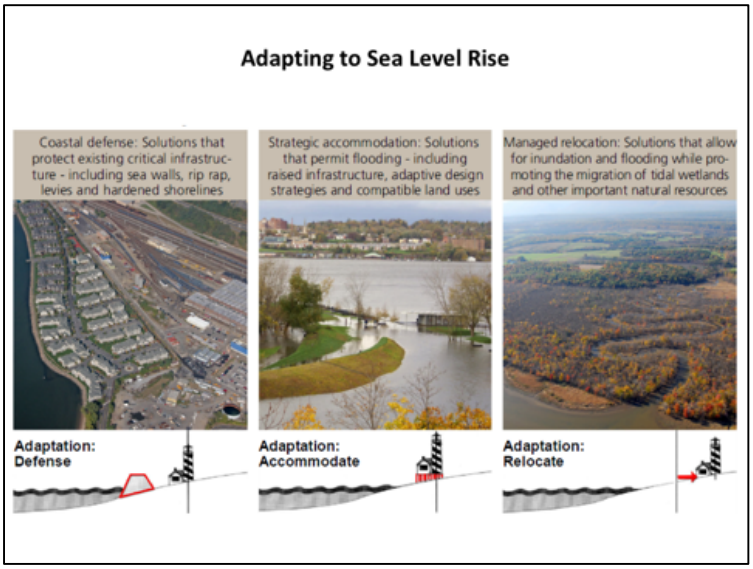
Lower Hudson Region Projections

Time Interval	Low	Low-Medium	Medium	High-Medium	High
2020s	2 inch	4 inches	6 inches	8 inches	10 inches
2050s	8 inches	11 inches	16 inches	21 inches	30 inches
2080s	13 inches	18 inches	29 inches	39 inches	58 inches
2100	15 inches	22 inches	36 inches	50 inches	75 inches

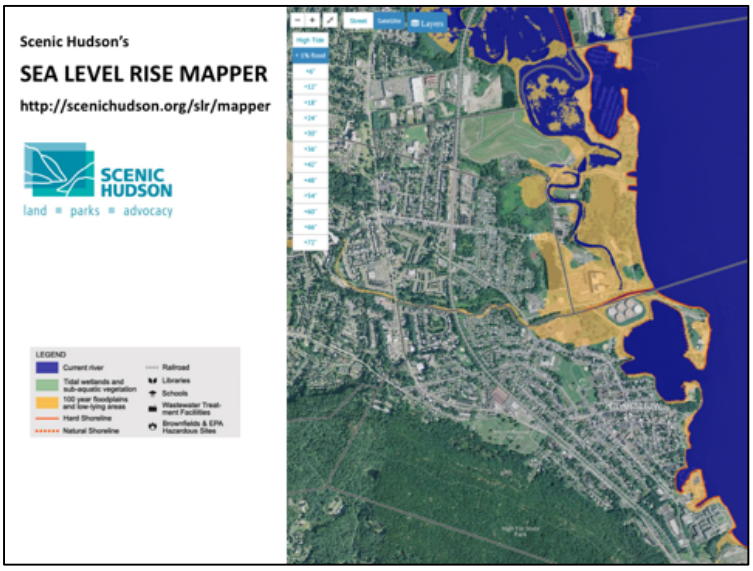
Slide #7 Graphical representation of the Community Risk and Resiliency Act projections (Medium, High-Medium, High).



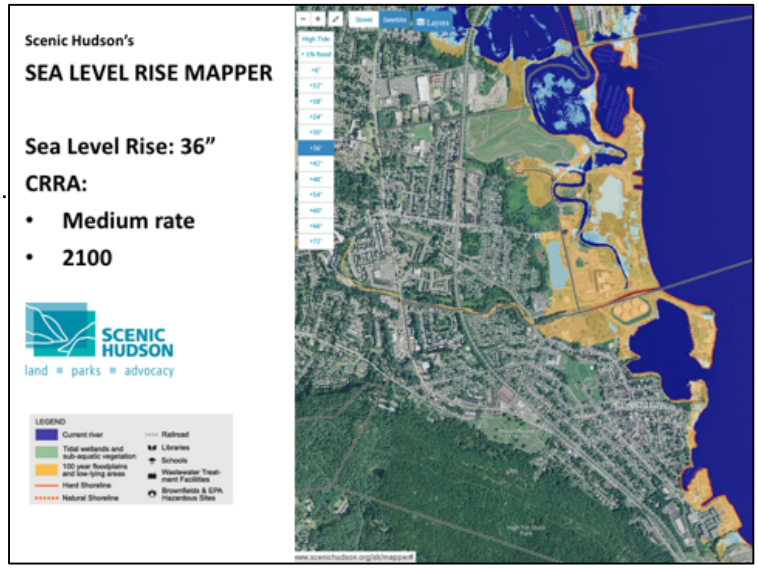
Slide #8 There are three broad categories of adaptation strategies: Defend, Accommodate and Relocate.



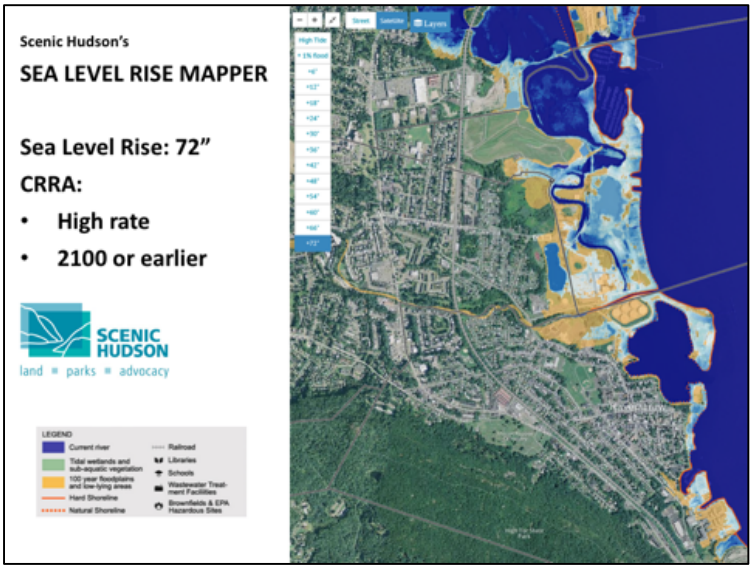
Slide #9 Village and Town of Haverstraw shoreline and floodplains impacted by a 1% flood. Affected resources include park land, Minisceongo Creek, marinas, and, too a lesser extent, wastewater treatment plant.



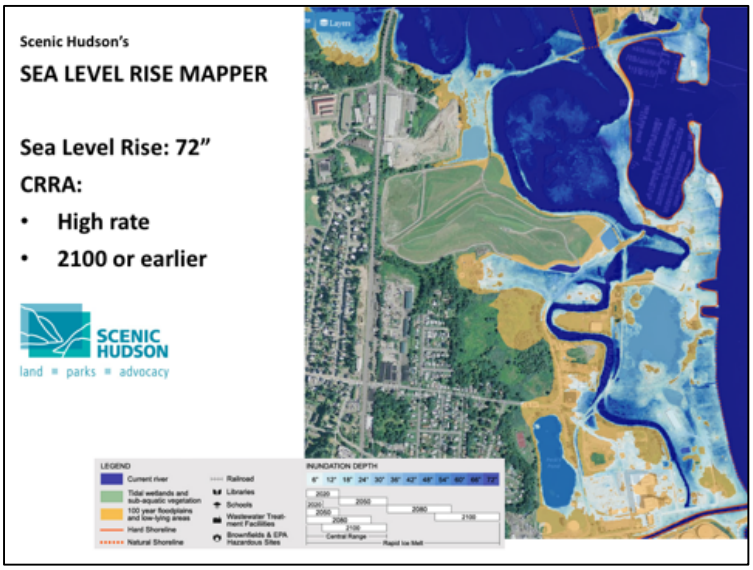
Slide #10 Projected impacted areas with 36" of sea level rise which include open space, bulk storage facilities, marinas and Minisceongo Creek.



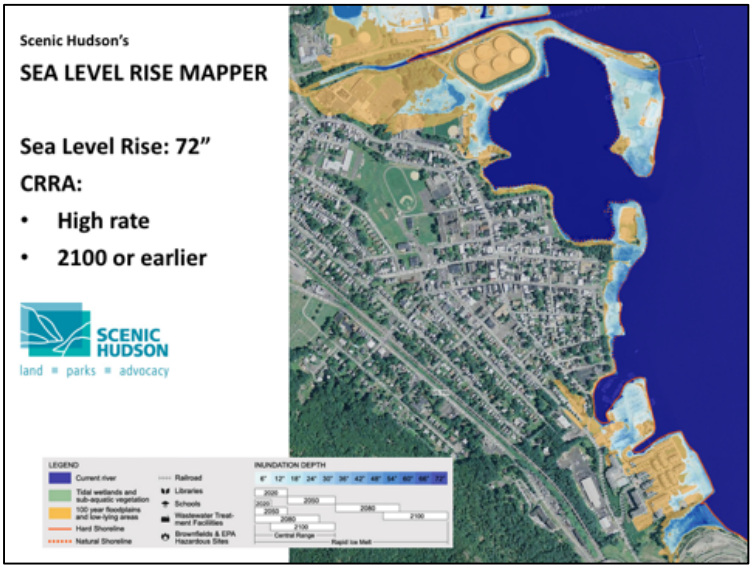
Slide #11 Affected- Ferry landing, Bowline Point, Parkside Apartments at the Harbors, Haverstraw Bay Park, Haverstraw Marina, Hudson Water Club, infrastructure. Dense residential areas are above risk.



Slide #12 Affected (north to south)- marinas, Haverstraw bay park, WWTP?, power infrastructure?

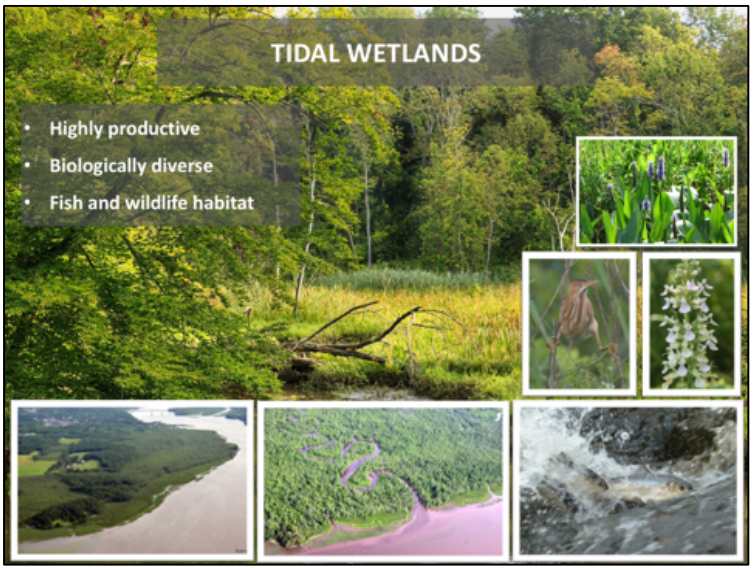


Slide #13 Affected- North to south: Powline Point park, Emiline Park, Ferry landing, Riverside/Parkside apartments (open space mostly), ball fields are in future floodplain



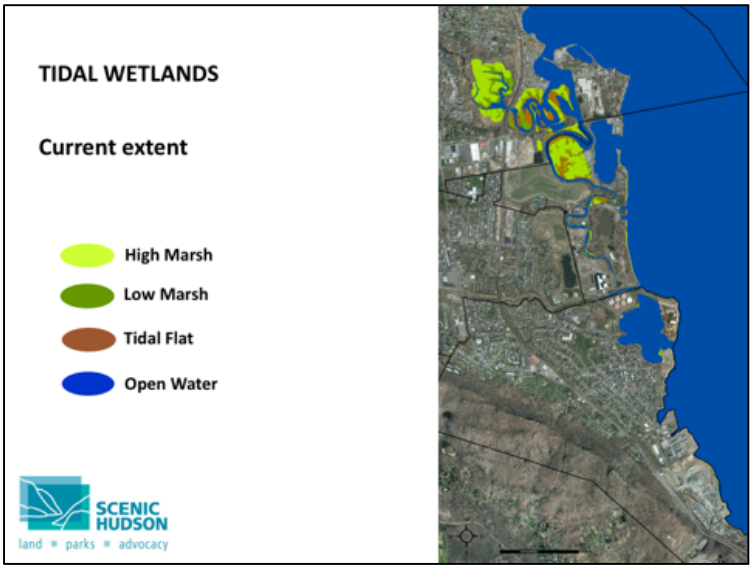
Slide #14 Tidal wetlands are an important resource for the estuary and are also impacted by SLR.

Slide #15 Tidal wetland functions/values include…

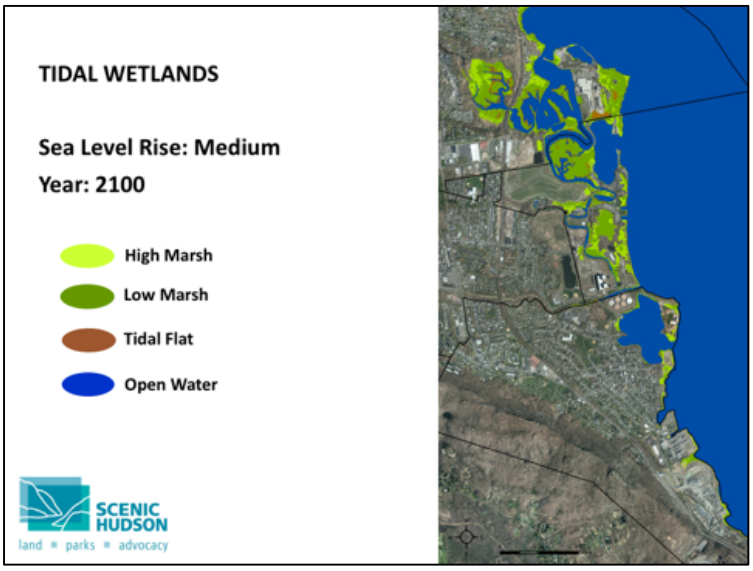


Slide #16 And tidal wetlands are also an important resource to people, protecting some waterfront communities from the impacts of storms, and providing economic and recreational opportunities.

Slide #17 Current locations of different types of tidal wetlands (not including submerged aquatic vegetation).

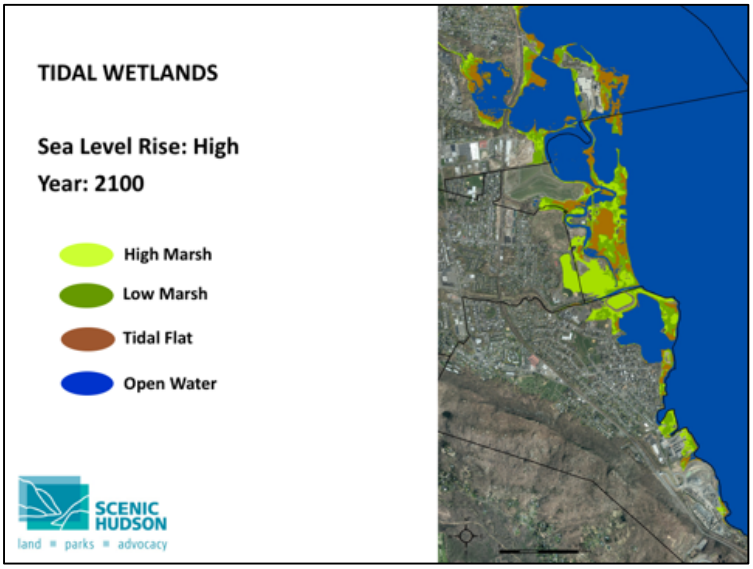


Slide #18 Future projected locations of tidal wetlands under High SLR by year 2100.

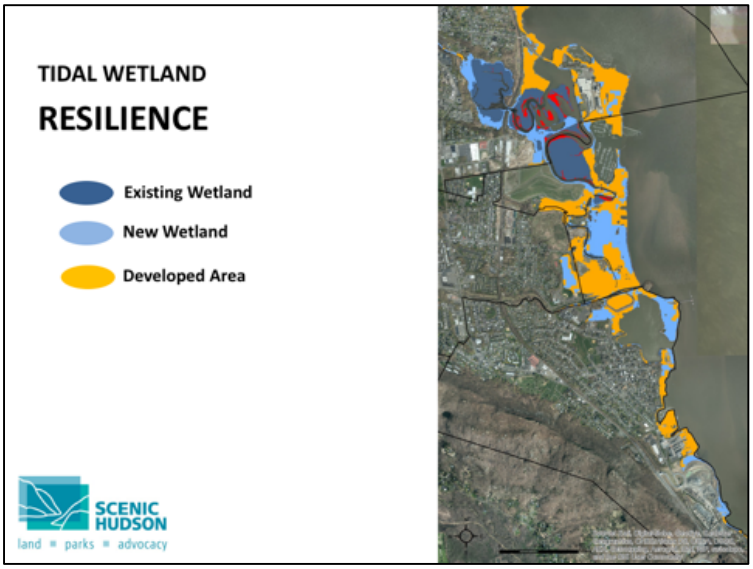


Slide #19 Haverstraw Bay Significant Coastal F&W habitat (~ six miles, both sides of river); Haverstraw Bay- extensive shallow areas with brackish water, fish nursery, spring and fall waterfowl migration.

Wetland expansion in response to SLR will follow a similar footprint.



Slide #20 Another way to look at tidal wetlands: current wetland areas (dark blue) and future wetland areas. Areas in orange are where existing development is in the pathway of wetlands projected to advance with SLR (indicating a blocked route for wetlands and a vulnerability to SLR for development).



Slide #21 Likelihood of existing wetland areas becoming too deep for intertidal wetlands with SLR.