Our Mission:
Scenic Hudson is dedicated to protecting and restoring the Hudson River, its riverfront and the majestic vistas and working landscapes beyond as an irreplaceable national treasure for America and a vital resource for residents and visitors.
Revitalizing Hudson Riverfronts:
Resilient waterfronts in an era of Sea Level Rise

Hastings-on-Hudson

Jeffrey Anzevino, AICP
Hastings-on-Hudson
January 11, 2017

Photo: Jeff Anzevino
Revitalizing Hudson Riverfronts: Resilient waterfronts in an era of Sea Level Rise

Hastings-on-Hudson

- Smart Growth
- Prioritize Water-dependent and -enhanced uses
- Capitalize on Connections!
- Resilient to Sea Level Rise and Flooding
- Public involvement

Jeffrey Anzevino, AICP
Hastings-on-Hudson
January 11, 2017

Photo: Jeff Anzevino
View of Hastings-on-Hudson, oil on canvas, John Ludlow Martin, 1856
Hastings-on-Hudson at the turn of the 20th Century

Harlem, NY Quadrangle, 1894, USGS 15’ Series
Illustrated Conservation and Development Strategies for Creating Healthy, Prosperous Communities

www.revitalizinghudsonriverfronts.org

I. Promote Riverfront Development in Areas with Existing Infrastructure

II. Encourage Water-Dependent and Water-Enhanced Uses on the Waterfront

III. Connect People to the River

IV. Protect Natural Resources

V. Protect Scenic Resources

VI. Promote Good Urban Planning & Sustainable Design

Climate Change: Adaptation & Mitigation
Illustrated Conservation and Development Strategies for Creating Healthy, Prosperous Communities

RENLALIZING HUDSON RIVERFRONTS
Illustrated Conservation & Development Strategies for Creating Healthy, Prosperous Communities

SCENIC HUDSON
1) Promote Riverfront Development in Areas with Existing Infrastructure
Promote Riverfront Development in Areas with Existing Infrastructure

1) Takes advantage of existing infrastructure
2) Close to existing services.
3) Provides opportunities to reuse historic building stock
4) Encourages walking, bicycling, & a healthful lifestyle
5) Protects open space and farmland
6) Helps mitigate against a warming planet
Compact and Walkable
Adaptive Reuse of Historic Buildings
2) Encourage Water-dependent and Water-enhanced Uses
Water dependent = Marinas
Water enhanced = restaurants, hotels
Non-water dependent
3) Connecting People to the River—and Beyond
Connecting People to the River—and Beyond

WHAT TO CONNECT
• Business Districts
• Neighborhoods
• Historic Sites
• Parks
• Educational Institutions
• Other communities
• Cross-river connections
Connecting People to the River—and Beyond
Connecting People to the River—and Beyond
What kinds of connections?

WAYS TO CONNECT: physically & visually

- Walkways both to and along the river
- Trolleys
- Boat docks, launches, and tours
- View corridors
How to create connections?

- Voluntary trail easements
- Incentive zoning or require by Special Use Permit
- Along sidewalks and roads
- Banners or artwork to draw people along
- Convert abandoned rail lines to rail trails
- Establish water trail sites; promote them as a network
- Provide docking facilities for boats
- Program festivals, farmers markets, concerts
Establish a Continuous riverfront greenway

100/100 Rule
Maintain 100-foot minimum setback or avoid development in 100-year floodplain, whichever is greater

Benefits:
- Provides place for rising water to go
- Open space
  - Public access
  - Recreation
  - Habitat protection
Greenway: Built Riverfront

Maintain 75-foot minimum setback
- Public Access
- Water dependent & enhanced uses
- Minimum 16-foot multi-use path
  - Preferably permeable
  - Raise grade to 500-year floodplain

Built Riverfronts
4) Protect Natural Resources
How?
How?

*Live crib wall:* A box-like arrangement of interlocking logs, timbers, precast concrete, or plastic structural members. The crib is filled with layers of backfill and live cuttings that root inside the crib and beyond into the slope.

*Joint planting:* Riprap with live stakes tamped into the joints between the rocks.
**How?**

- **Live crib wall:** A box-like arrangement of interlocking logs, timbers, precast concrete, or plastic structural members. The crib is filled with layers of backfill and live cuttings that root inside the crib and beyond into the slope.

- **Joint planting:** Riprap with live stakes tamped into the joints between the rocks.

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*NOTE: Rooted/seeded condition of living plant material does not represent time of installation.*
5) Protect Scenic Resources
Protect Scenic Resources
6) Promote Good Urban Planning & Sustainable Design
Promote Good Urban Planning & Sustainable Design
Promote Good Urban Planning & Sustainable Design
Where conditions allow:

a) Promote riverfront greenway corridor
b) Preserve and restore floodplains
c) Locate critical infrastructure above the 500-year floodplain
d) Update policies for resilience
e) Promote green development
THE HUDSON RIVER ESTUARY AND SEA LEVEL RISE

- Approximately 150 miles long
- Strong tidal influence
- 78 municipalities
THE HUDSON RIVER ESTUARY & SEA LEVEL RISE:
Past, present and future

- The Hudson River is over 12” higher than a century ago
- 21st Century SLR rate is higher and projected to continue accelerating

Hudson River Sea Level 1856-2014 observed at Manhattan

- 1856-2014: 2.8mm/yr
- 1990-2014: 4.6mm/yr
- 2000 - 2014: 7.8mm/yr

Observation Data from NOAA
THE HUDSON RIVER ESTUARY & SEA LEVEL RISE:
Past, present and future

[Diagram showing historical and projected sea level changes over time.]
A tide that causes a minor flood today is a nuisance (white arrow). In the future, higher sea levels will allow high tides to push water deeper into coastal communities, affecting more homes, businesses, and infrastructure. Extensive moderate flooding—now usually associated with storms and high winds—is expected to become more common, simply from high tides.
Responses to SEA LEVEL RISE:

- **Coastal defense**: Solutions that protect existing critical infrastructure - including sea walls, rip rap, levees and hardened shorelines.
- **Strategic accommodation**: Solutions that permit flooding - including raised infrastructure, adaptive design strategies and compatible land uses.
- **Managed relocation**: Solutions that allow for inundation and flooding while promoting the migration of tidal wetlands and other important natural resources.

**Adaptation: Defense**

**Adaptation: Accommodate**

**Adaptation: Relocate**
Responses to SEA LEVEL RISE:

- Flood Warning & Evacuation
- Relocation
- Acquisition
- Elevated Building
- Drainage Improvements
- Levee/Floodwall
- Shoreline Stabilization
- NNRF Beach & Dune Restoration
- Breakwaters & Groins
- Programmatic Measures
- Maritime Forest
- Tidal Marsh
- Estuary
- Barrier Island

SCENIC HUDSON
### Lower Hudson River sea level rise projections

**Rapid polar ice cap melt?**

<table>
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<th></th>
<th>Low</th>
<th>Low-Medium</th>
<th>Medium</th>
<th>High-Medium</th>
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<td>22”</td>
<td>36”</td>
<td>50”</td>
<td>75”</td>
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### Risk Tolerance: selecting an approach to planning

<table>
<thead>
<tr>
<th>Ice caps intact (Conditions Better)</th>
<th>Ice caps melt (Conditions Worse)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan for Better</td>
<td>SAFE</td>
</tr>
<tr>
<td>Plan for Worse</td>
<td>SAFE But overinvested</td>
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The Hudson River Sustainable Shorelines Project aims to develop science-based recommendations for shore zone management to enhance natural benefits while meeting protection needs.

https://www.hrnerr.org/hudson-river-sustainable-shorelines/
Benefits of sustainable shorelines

Provide erosion control and protect upland land use by absorbing energy from waves and currents

Provide alternative options to bulkheads and rip rap revetments

Protect water by capturing polluted runoff

Provide pathways for wetland migration in gradual-slope areas

Increase coastal greenery, which adds to beauty, takes in carbon dioxide, and provides habitat

Increase biodiversity of habitats with rocks, plants and natural debris

Minimize cost over life span of shoreline stabilization, as opposed to hardened protection

https://www.hrnnerr.org/hudson-river-sustainable-shorelines/
case study: Esopus Meadows

before

A degrading bulkhead was replaced with softer stabilizing alternatives that still provide shoreline protection. A stone toe was placed at the high tide line and soft gabions positioned above it help hold the soil in place.

after
RESILIENT WATERFRONT DESIGN

Green streets
12” Sea Level Rise

SEA LEVEL RISE MAPPER: http://scenichudson.org/slr.mapper
24” Sea Level Rise

SEA LEVEL RISE MAPPER: http://scenichudson.org/slr/mapper
36” Sea Level Rise

SEA LEVEL RISE MAPPER: http://scenichudson.org/slr/mapper
48” Sea Level Rise

SEA LEVEL RISE MAPPER: http://scenichudson.org/slr/mapper
60” Sea Level Rise

SEA LEVEL RISE MAPPER: http://scenichudson.org/slr/mapper
72” Sea Level Rise

SEA LEVEL RISE MAPPER:  http://scenichudson.org/slr.mapper
Public involvement

• Early and often in the planning process
• Often required
• Projects often improved
• Benefits of public “buy-in”
• Don’t overlook disenfranchised people
CONCLUSION
• Smart Growth
• Prioritize Water-dependent and -enhanced uses
• Capitalize on Connections!
• Resilient to Sea Level Rise and Flooding
• Public involvement
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Questions?
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