but we knew what we came up with had to be something that could actually be accomplished inside the complex political ecosystem in which we operated.

- Henk Ovink, TOO BIG, 2018
## SUMMARY OF PERMITS & APPROVALS

<table>
<thead>
<tr>
<th>Type</th>
<th>Name of permit or approval</th>
<th>Permitting / Regulatory agency</th>
<th>Other agencies involved</th>
<th>likelihood</th>
<th>hurdle?</th>
<th>Description of permit</th>
<th>Requirements / Prerequisites*</th>
<th>Delivrables / submissions</th>
<th>Approx timeframe (min, typ, max)</th>
<th>strategy and timeframe considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permit</td>
<td>Section 10</td>
<td>USACE</td>
<td>NYSDOE, NYCCP, NMFS, USFWS, USEPA, USGS, SHPO</td>
<td>DEFINITELY REQUIRED</td>
<td>see component approvals / reviews</td>
<td>Section 10 of the Rivers and Harbors Act requires authorization from the USACE for the construction of structures in or over any navigable water of the United States, excavation/dredging or disposition of material in these waters or any obstruction or alteration in a &quot;navigable water&quot; (all tidal waters are navigable waters of the US). Issue in conjunction w/ Section 404.</td>
<td>CZM Consistency; NEPA Compliance; EFH Assessment; ESA, FWCA, NMFS; Modeling for sedimentation &amp; erosion to determine impact to navigation channels and shoreline; Navigation study to avoid navigational conflicts and ensure navigation safety Response to public comments</td>
<td>EFH Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit</td>
<td>Section 404</td>
<td>USACE</td>
<td>Same as above, plus NYSDEC</td>
<td>DEFINITELY REQUIRED</td>
<td>see component approvals / reviews</td>
<td>Section 404 of the Clean Water Act, as amended, requires authorization from the USACE to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Issue in conjunction w/ Section 10.</td>
<td>CZM Consistency; NEPA Compliance; EFH Assessment; ESA, FWCA, NEPA, WQC.</td>
<td>Demonstrate lack of practicable alternatives to accomplish project purpose Document that project benefits offset detrimental impacts</td>
<td>Same as above for Section 10</td>
<td></td>
</tr>
<tr>
<td>Permit</td>
<td>Protection of Waters</td>
<td>NYSDEC</td>
<td>State or local SEORAs lead agency</td>
<td>DEFINITELY REQUIRED</td>
<td>see component approvals / reviews</td>
<td>Under Article 15 of the Environmental Conservation Law a permit is required from the NYSDEC for: Disturbance of the bed or banks of a &quot;protected stream&quot; or other watercourse; Construction, reconstruction or repair of dams and other impoundment structures; Construction, reconstruction or expansion of dock and mooring facilities; and Excavation or placement of fill in &quot;navigable waters&quot; and their adjacent and contiguous wetlands. The Protection of Waters Program regulates waterways based on the designation given to the specific body of water.</td>
<td>SEQRA, CZMP/LWRP for activities in State coastal zone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit</td>
<td>Tidal Wetlands</td>
<td>NYSDEC</td>
<td>State or local SEORAs lead agency</td>
<td>DEFINITELY REQUIRED (given how DEC defines tidal wetlands)</td>
<td>see component approvals / reviews</td>
<td>Under Article 25 of the Environmental Conservation Law a permit is required from NYSDEC for almost any activity that will alter wetlands or the adjacent areas. In general, tidal wetlands consist of all the salt marshes, non-vegetated as well as vegetated flats and shorelines subject to tides. Adjacent areas extend up to 300 feet inland from the wetland boundary (up to 150 feet inland within NYC). Official tidal wetlands maps showing the exact locations of NY's regulated wetlands are on file at NYSDEC regional offices and in the County Clerks' Offices.</td>
<td>Same as above for Protection of Waters permit, plus underwater land approval or easement</td>
<td>Same as above for Protection of Waters permit, plus underwater land approval or easement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit</td>
<td>Freshwater Wetlands</td>
<td>NYSDEC</td>
<td>None</td>
<td>UNLIKELY only for on-shore components</td>
<td>see component approvals / reviews</td>
<td>This permit allows an applicant to perform an activity or erect a structure that will impact a NYSDEC-regulated freshwater wetland or an adjacent area. Generally, the permit applies to freshwater wetlands that are 12.4 acres or larger in area or smaller wetlands deemed to be of unusual local importance, and which appear on the Freshwater Wetlands regulatory maps.</td>
<td>None</td>
<td>Same as above for Protection of Waters permit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* approvals, reviews, etc. required prior to issuing of permit
WE ARE HERE

30% Design → Design Development → Final Design → Construction

Notice Of Intent → Final Scope of Work

Scoping Meeting → Public Hearing

Draft Environmental Impact Statement DEIS (NEPA, SEQRA)

Public Comment Period 45 days

Close of Public Comment Period

Final Environmental Impact Statement FEIS

NEPA: ROD Record Of Decision SEQRA: Finding

PERMITS:
USACE:
- Section 10 Permit
- Section 404 Permit

NYS DEC:
- Protection of Waters Permit
- Tidal Wetland Permit
- Water Quality certification

Joint Permit Application

NYS DOS & NYC DCP: Coastal Consistency Review

NYS Office of General Services: Underwater Land

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

NEW YORK STATE

NEW YORK DEPARTMENT OF STATE

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

UNITED STATES

DEPARTMENT OF THE INTERIOR

NOAA

US DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

MARCH 3, 1843

NYC PLANNING

DEPARTMENT OF CITY PLANNING CITY OF NEW YORK

US ARMY CORPS OF ENGINEERS

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

ENVIRONMENTAL PROTECTION AGENCY
COMMUNICATE & COLLABORATE
COMMUNICATE WITH EACH OTHER

ENGINEER

ENGINEER

LANDSCAPE ARCHITECTS
COMMUNICATE WITH THE PUBLIC(S)
COMMUNICATE WITH THE REGULATORS

DESIGN OBJECTIVES = PURPOSE & NEED

PURPOSE AND NEED

The project design objectives are directly related to the project purpose and need as documented in the Final EIS scoping document. It should be noted that a single EIS is being prepared for the combined Living Breakwaters and Tottenville Shoreline Protection projects. The purpose and need is laid out in the Coastal and Social Resiliency Initiatives for Tottenville Shoreline, Staten Island, NY - Environmental Impact Statement Final Scope of Work, released on April 1, 2016, and states:

Specifically, the goals and objectives related to the Proposed Actions’ purpose and need are listed below:

Risk Reduction
- Attenuate wave energy;
- Address both event-based and long-term shoreline erosion / preserve beach width; and
- Address the impacts of coastal flooding [note: refers to TSPP only].

Ecological Enhancement
- Increase diversity of aquatic habitats consistent with the Hudson-Raritan Estuary plan priorities (e.g., oyster reefs and fish and shellfish habitat).

Social Resiliency
- Foster community education on coastal resiliency directly tied to and building off the structural components of this resiliency initiative;
- Increase physical and visual access to the water’s edge;
- Enhance community stewardship of on-shore and in-water ecosystems; and
- Increase access to recreational opportunities.
EXPLORE & ITERATE
<table>
<thead>
<tr>
<th>TOMBOLO</th>
<th>PERIODIC TOMBOLO</th>
<th>STRONG SALIENT</th>
<th>SUBDUED SALIENT</th>
<th>NO SINUOSITY / MINIMAL IMPACT</th>
<th>ERODED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very little wave energy reaches the shore, sediment builds up behind the breakwater, connecting it to the shoreline, and the beach is stable with little transport along the shore.</td>
<td>One or more of the breakwater segments is periodically backed by tombolos with a periodic trapping of littoral material followed by a release of a &quot;slug&quot; of sediment to the downdrift shoreline.</td>
<td>Somewhat higher wave energy reaches the lee of the structures; characterized by a balanced sediment budget; longshore moving material enters and leaves at approximately the same rate.</td>
<td>Yet higher wave energy reaches the shoreline; the shoreline response is not as pronounced and the amplitude of the salient is of lower relief.</td>
<td>High wave energy reaches the beach, resulting in little, if any, shoreline response.</td>
<td></td>
</tr>
</tbody>
</table>
EXPERIMENT & VALIDATE
MATERIALS

NAVIGATION AID

REEF RIDGES

REEF STREETS

BIO-ENHANCING CONCRETE UNITS

INTERNAL REEF RIDGE RIP RAP STONE #1: D₅₀ = 40"

INTERNAL REEF RIDGE RIP RAP STONE #2: D₅₀ = 36", 24", 19"

REEF RIDGE ROTATION AXIS

TOE ARMOR STONE:

ARMOR STONE: D₅₀ = 40"

CORE STONE: D₅₀ = 4"

GEOTEXTILE

INTERNAL CORE STONE

Dₕₜ = 16"

MARINE MATTRESS

HT = 12"

REEF RIDGE CORE STONE

Dₘᵢₙᵢₜ = 24" Dₘᵢₘᵢ = 30" Dₘᵢₜᵢ = 36"

REEF RIDGE EXTERIOR STONE

D₁₃₂₀ = 15" Dₙ₉ᵢₜ = 24" Dₚ₉ₜᵢ = 36"

STONE ARMOR UNIT

Dₙ₉ᵢₜ = 40"

STONE TOE ARMOR UNIT

Dₚ₉ₜᵢ = 48"

ECOncrete TOE ARMOR UNIT

Dimension: 48" x 48" x 48"

ECOncrete TIDE POOLS

Dimension: 44" x 48" x 37
ECOconcrete®
PHYSICAL MODELING

[Diagram of an engineering model showing various components and measurements.]

[Image of the physical model being constructed with colored stones arranged in a specific pattern.]
HARD SUBSTRATE LIVING BREAKWATER HABITAT

- Surface Complexity
- Water Retaining Tide Pools
- Horizontal Intertidal Surfaces
- Steep Subtidal Surfaces
- Stone Size Diversity
- Porosity
- Surface Complexity

- Striped Bass
- American Lobster
- Scup
- Rye
- Topgull