

**HOW TO PROMOTE  
RESILIENCE, ECOLOGY,  
AND ACCESS AT THE  
WATER'S EDGE**

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every sale, purchase, and payment must be properly documented to ensure the integrity of the financial statements. This includes recording the date, amount, and purpose of each transaction, as well as the names of the parties involved.

Secondly, the document highlights the need for regular reconciliation of bank accounts and credit cards. By comparing the company's records with the bank statements, any discrepancies can be identified and corrected promptly. This helps to prevent errors and ensures that the financial data is up-to-date and accurate.

Another key aspect is the proper classification of expenses. It is crucial to categorize each expense correctly according to the company's chart of accounts. This allows for a clear understanding of where the money is being spent and facilitates the preparation of financial reports. For example, expenses related to marketing should be recorded in a different category than those related to general administration.

Finally, the document stresses the importance of maintaining a clear and organized system for storing all financial documents. This includes invoices, receipts, and bank statements. A well-organized system makes it easier to find and verify information when needed, which is essential for audits and tax reporting.



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# Letter from Waterfront Alliance President and CEO

March 13, 2018



We live in an increasingly urbanized and coastal world, in which more than one billion people worldwide live at or near the waterfront. These increased populations also carry the threat of further environmental degradation. At the same time, our harbors and waterways have been rediscovered as tremendous assets—places for recreation, education, transportation and employment. With good environmental stewardship, the waterfront is a place where humans and nature can co-exist for mutual benefit. The waterfront has never been more important.

How, where, and what we design at the water's edge are open questions with profound consequences for us both now and for generations to come. The Waterfront Edge Design Guidelines (WEDG), developed by the Waterfront Alliance, is a powerful tool for communities and landowners alike to find common ground to promote ecology, access and resiliency.

Our waterfronts need WEDG, but who controls the waterfront? People and entities almost as numerous as grains of sand on the beach. Marinas, park administrators, real estate developers, to name just a few, along with many government agencies charged with regulating and administering the waters that surround us. These varied stakeholders make daily decisions that affect our preparedness for the next flood, the quality of our environment, and if and how we can enjoy the shared resource of our waterfront.

At its heart, WEDG is a communications vehicle translating the best available science and waterfront design ideas into an accessible suite of best practices. For developers, maritime businesses, professionals, government regulators and most important communities to give them information they need to make the best choices. WEDG is an instrument to promote democratic and positive design decisions coastal cities—decisions that need to be made right in a rapidly changing world.

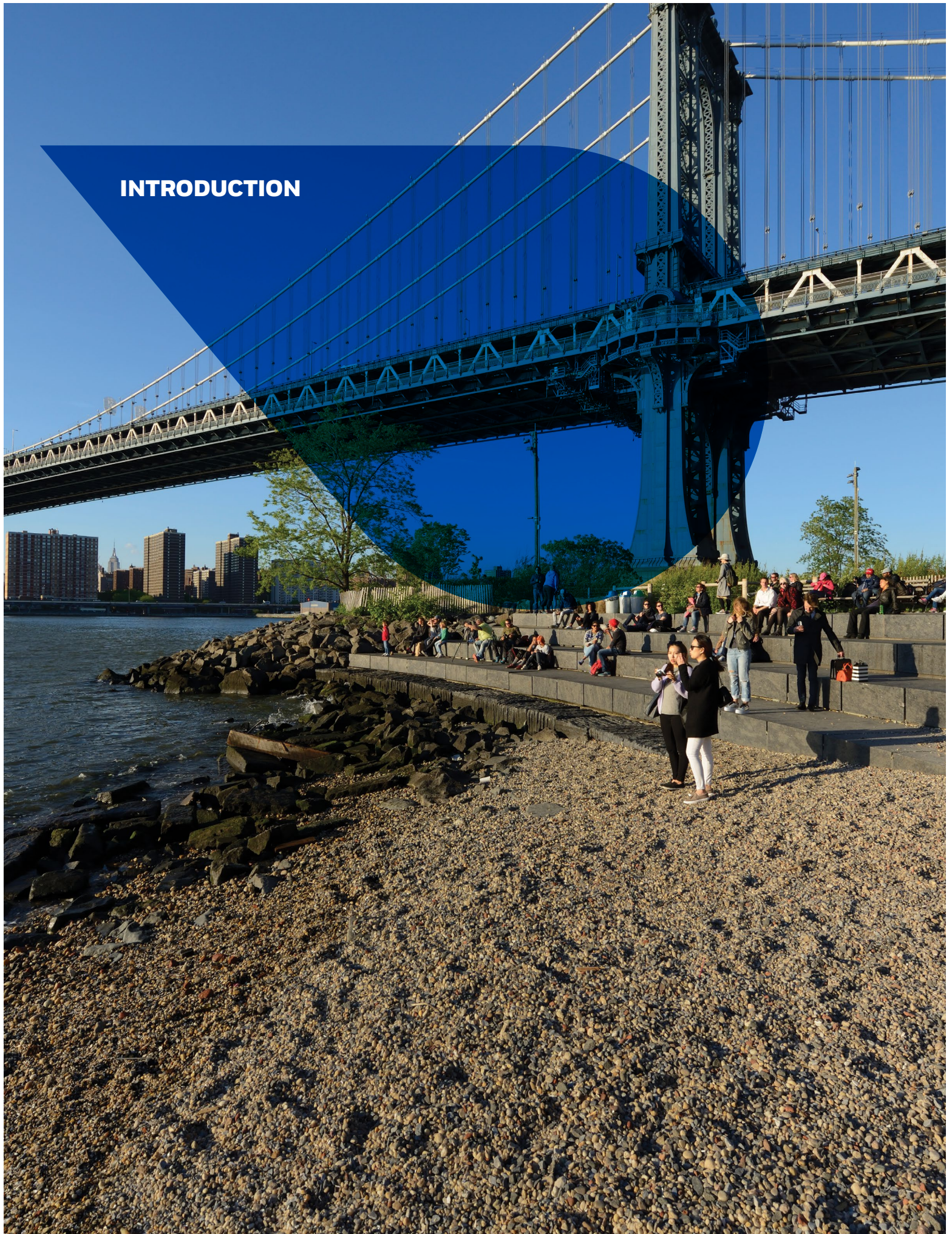
A handwritten signature in blue ink, which appears to read "Roland Lewis". The signature is fluid and cursive, written in a professional style.

Roland Lewis  
President and CEO  
Waterfront Alliance





# INTRODUCTION





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# Let's create the best waterfront possible. How?

Habitat for fish and wildlife, a place to enjoy the outdoors, a transportation network, our first line of defense against coastal storms—these are just some of the benefits coastlines provide. When a concerted effort is made, some balance between these functions can be achieved, even in our densest urban waterfronts.

From intricate ecosystems to overlapping jurisdictions and land use policies, waterfront design is complex, even for the most seasoned planners, practitioners, and communities, and is becoming even more so with the growing risk of coastal flooding due to sea level rise. In the United States alone:

- > We have spent over \$47 billion in claims through the National Flood Insurance Program since 1978, 40% of which has come in just the last 10 years
- > We lose an average of nearly 80,000 acres of coastal wetlands per year
- > Our coastal areas comprise more than 40% of the population, though many people are disconnected from their waterfronts

We need mechanisms and guidance to lead us at every scale: national, regional, local, and property. For this reason—and with help from hundreds of experts in design, science, community development, engineering, and insurance—the Waterfront Alliance developed WEDG® (Waterfront Edge Design Guidelines) to address these challenges, influencing real-time decision-making to support better outcomes. By influencing real projects with sound guidance, educating professionals, and engaging and supporting community groups, it is our aim to not only influence those individual decisions, but to shift the field of practice for waterfront design toward balancing resilience, ecology, and access for all.



WEDG employs an evidence-based system of credits and guidelines focused on resilience, ecology, and access as the three key pillars of excellent waterfront design:

- > **Resilience:** Reduce risks or adapt to the sea level rise and storm flooding through setbacks, structural protection, and other integrative landscaping measures.
- > **Ecology:** Protect existing aquatic habitats and use designs, materials, and shoreline configurations to improve the ecological function of the coastal zone, and strive to be consistent with regional ecological goals.
- > **Access:** Be equitable and informed by the community, enhancing public access, supporting a diversity of uses, from maritime, recreation, and commerce where appropriate, thereby maximizing the diversity of the harbor and waterfront.

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## Background



Since our inception in 2007, the Waterfront Alliance has advocated for better waterfront edge design, from our Design the Edge program, to our advocacy in support of more resilient, ecologically-sound, and accessible waterfronts within our region. The need for guidance for good waterfront design, long a source of frustration for public and private entities alike, was identified as a priority in the 2011 decennial update of the New York City Comprehensive Waterfront Plan. Following this recommendation, with an increasing sense of urgency brought on by Hurricane Sandy in 2012, the Waterfront Alliance worked with more than 100 experts to launch the first version of WEDG in 2015. Recognizing a need for nationally applicable guidance, the Waterfront Alliance received philanthropic support from The Rockefeller Foundation, New York Community Trust, and Doris Duke Charitable Foundation to develop this version of WEDG, released in 2018. Based on additional case study testing, minor language edits and scoring changes were made to a subset of credits to reflect lessons learned through the review process.

WEDG is a credit system and series of guidelines and that are the result of a collaboration between government agencies, not-for-profit organizations, technical experts, and other waterfront stakeholders. A tool to guide and enhance projects on a voluntary basis, WEDG distills the complexities of waterfront science, engineering, and social engagement into comprehensive and easy to communicate design concepts and best practices.

Acknowledging the diversity of waterfront uses, from industrial maritime activity to public parks, WEDG leads users through a series of considerations that enable design teams to tailor solutions to their project and context. In this way, it helps translate complex science into a digestible format, facilitating not only better decisions but serving as a communication tool between landowner, design team, regulator, and community.



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# How to use WEDG

WEDG is a tool for professionals, communities, and landowners to use prior to and during the design process for waterfront projects. While it may provide guidance for projects that do not have a waterfront edge, it is intended for properties directly touching a body of water along tidal areas and the coast. WEDG is for:

## **Professionals and landowners: WEDG is changing the way we design**

WEDG provides a menu of best practices, supporting communication between all interested parties in the waterfront design decision-making process: clients, community members, and government agencies alike. It is also a reference or starting point for considering the key components that inform permitting, risk reduction, and community support throughout the process of design and construction.

## **Communities: WEDG supports advocacy for better waterfronts**

Improved public access to the water, resilience, and healthy ecosystems have many positive benefits for health and wellbeing, and promote stewardship of our environment. But how do we define what a “good” waterfront looks like, and how can we ensure that public spaces are developed with community interests in mind? WEDG provides precedents and resources for informed community engagement and advocacy with waterfront decision-making processes, increasingly important with growing coastal populations and rising costs of living, and flood insurance premiums.

## **Government agencies: WEDG promotes better-prepared permit applications**

Regulatory jurisdiction at or near the waterfront is extremely complex. WEDG was developed in partnership with regulators, incorporating the key elements of environmental, planning, and design or code requirements into its assessment methods and credit system. As a result, WEDG provides its users with the tools for better preparation for the permit review process.

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WEDG provides resources for professionals, landowners, and communities, including an annual city-wide festival for communities to experience and learn about their waterfronts. *Photo: Kate Boicourt*



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## WEDG is not ...

- > **Building code or comprehensive building standard:** The primary use for WEDG is projects on waterfront parcels, emphasizing resilience, ecology, and access. It does not provide guidance on building design except for measures to improve building resilience and exterior/neighborhood character, and was designed to be complementary to other systems such as LEED®, SITES®, WELL®, Envision, and others.
- > **Land use law or policy:** WEDG is intended to complement and exceed, but not supplant local zoning and code. For guidance as to appropriate siting of the project for the intended use, WEDG should be used in concert with a review of priorities established by zoning and building code. Like other rating and certification programs, WEDG is a voluntary tool to encourage waterfront innovation and best practices.
- > **Fully applicable beyond the water's edge:** the applicability of WEDG to any project ultimately will depend on the project type or scope. While not a target for certification, projects within the floodplain but not on a waterfront lot may find the flood resilience guidelines useful, but the community access and connections or edge resilience sections to be not applicable.
- > **For single-family homeowners:** While elements of WEDG related to risk reduction and sustainability may be useful for single-family homes, the Fortified HOME™ Hurricane Standard, Enterprise Green Communities, and Green Shores for Homes (and other living shorelines design programs) share similar principles with WEDG and are designed for single-family homes.
  - Fortified HOME: Created by the Insurance Institute for Business Home & Safety, Fortified HOME complements WEDG's site-wide guidance for coastal risk reduction by providing building-level construction standards and durability to withstand hurricanes and other extreme weather events.
  - Enterprise Green Communities: Designed for the affordable housing sector, Enterprise Community Partners' Green Communities program aligns affordable housing investment strategies with environmentally responsive building practices to improve the health and wellbeing of low-income people nationwide.
  - Green Shores for Homes: Designed for waterfront homeowners and contractors, this tool and certification program shares WEDG's focus on natural shoreline preservation and restoration in Washington State and British Columbia. Similar living shorelines certification systems exist in other states and may be available locally.

There are also important considerations that extend beyond the scope of WEDG. For example, affordability remains a challenge in rapidly developing coastal centers, impacting who is served by accessible waterfront spaces and programs. WEDG encourages projects to take into account community needs such as affordability when designing projects, but the program is not equipped to evaluate or assign credits at this time for these measures beyond their consistency with community needs. WEDG was, however, developed in partnership with both public and private affordable housing developers, and aims to be a supportive, useful tool for retrofits and new construction alike. Similarly, building height may have implications for views of the waterfront and upland areas depending on the context, as well as neighborhood character. WEDG does not provide guidance for building height at this time, but design teams are encouraged to consider potential impacts when

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# Scope and components

developing larger-scale buildings on waterfront lots.

As a set of guidelines, WEDG provides a diverse and extensive suite of design options for a wide variety of projects. As a credit-based rating system, WEDG establishes a process and threshold for certification to review a project's performance relative to resilience, access, and ecology. A project should not aim to achieve points under all credits, as not all credits apply to all projects. In some cases, credits may even be contradictory. For example, depending on local conditions, site context, and government policies, a project that provides both commercial ferry use and recreational paddling or rowing uses within a small site may create unintentional conflict and safety hazards. While suggestions are made about appropriate solutions, determining which credits are appropriate for each project must be done in conjunction with a review of the project's context within the region's larger waterfront goals, plans, and policies. The credits help guide the design process, from conceptual design through operations, and provide design performance goals for resilience, ecology, and access in the following six categories:

- > **Category 0: Site Assessment & Planning**
- > **Category 1: Responsible Siting & Coastal Risk Reduction**
- > **Category 2: Community Access & Connections**
- > **Category 3: Edge Resilience**
- > **Category 4: Natural Resources**
- > **Category 5: Innovation**

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Diverse maritime activity, educational programming, resilient design, and environmental stewardship all contribute to the vibrant waterfront public space along the Delaware River in Philadelphia. *Photo: Kate Boicourt*



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# Project scoring and certification





Credits in the WEDG rating system are assigned a range of possible points. Each credit may have several options for achieving points, some of which may be cumulative and universally applicable, separated by an “AND”. Other possible points may be applicable only to certain project use types or site contexts. These are delineated as different “Cases” and separated by an “OR.” And still other possible points may be “tiered”, where meeting a lower threshold earns a project a lower point value, and meeting a higher threshold earns a higher point value. These “tiered” points are not cumulative, and projects may achieve only one level.

All projects must meet the same scoring threshold of **115** out of **215** possible points in order to achieve WEDG Certification.

The point values have been assigned based on preliminary case study testing variations in project size, capacity, and use. As waterfront design advances and WEDG evolves, the minimum points to achieve certification may change.

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## Connect With Us

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WEDG is a living tool continually moving forward to recognize and raise standards for the best in waterfront edge design. The Waterfront Alliance invites you to reach out to us or send feedback and suggestions by contacting or visiting us at <http://wedg.waterfrontalliance.org>





The ideal waterfront contains a balance of resilience, access, and ecology.  
*Photo: Etienne Frossard*



# Site Assessment & Planning



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## CATEGORY 0

TOTAL POSSIBLE POINTS 28 PTS

**Credit**

- 0.1 Develop a multidisciplinary design team** PG15
- 0.2 Assess site-wide social and ecological context and vulnerabilities** PG15
- 0.3 Develop and implement an equitable plan for community engagement** PG16
- 0.4 Create a maintenance and adaptive management plan** PG18

TOTAL POSSIBLE POINTS 28 PTS





## Category 0: Site Assessment & Planning

Use sound assessment and community input to establish processes that support design, construction, and management of the site that can increase performance over time

28 POSSIBLE PTS

### CREDIT 0.1

Develop a multi-disciplinary design team

6 PTS

**Intent:** Project is informed by a comprehensive group of experts.

**Description:** Use a multi-disciplinary team of professionals experienced in waterfront development to collaborate on the design, construction, and maintenance of the site. This should include, at a minimum, a biologist or environmental professional, coastal or geotechnical engineer, and a landscape architect or architect. Additionally, for retrofits, include one or more individuals operationally familiar with the site, or for new construction, someone who will be involved in site operations upon project completion. Employ an integrated design process that includes a pre-design site visit, a workshop, and multi-disciplinary collaboration. Use WEDG principles to guide discussion and provide a framework for all disciplines to assess and contribute to the design from the beginning of the project. Seek collaboration with government and regulatory agencies early in the process to obtain the best outcome. Meet with insurers early in the process to reduce costs and overall risk.

**Scoring:** Narrative and contracts list the required project team members as well as their disciplines and qualifications.<sup>1</sup> Narrative and contracts also illustrate the extent to which multi-disciplinary collaboration employed throughout the design and development process, including any pre-design site visit and meetings **(6 points)**.<sup>2</sup>

**Materials needed to measure:** Narrative, contracts.

### CREDIT 0.2

Assess site-wide social and ecological context and vulnerabilities

10 PTS

**Intent:** Provide an analysis of the project site to inform a design approach in line with site conditions and a baseline from which to measure performance over time.

**Description:** Waterfront projects have many unique site characteristics that may affect the range and optimization of design strategies. Waterfront lands are inherently exposed to the effects of climate change and an increasingly changing environment, and are also important ecological and social transition areas from land to water. Before designing a project, a multidisciplinary team should conduct an initial site assessment. The outcome of these analyses will inform the design strategies for shoreline stabilization, adaptation and mitigation of flood risk, and ecological protection and restoration. Projects must also be sited appropriately for the intended use and context, as defined by local and state zoning and code.

**Design strategies:** Use the methods detailed in *Appendix A: Assessment and Ongoing Performance* (or comparable) to develop an initial assessment of site conditions. Assessments are prerequisites for achieving many credits to ensure that designs are appropriate to the site context and intended use. *Appendix A* provides a worksheet and summary of how each parameter relates to each credit and ongoing performance and adaptive management.

<sup>1</sup> Contract fees may be redacted for WEDG review purposes.

<sup>2</sup> Alternatively, narrative and contracts should meet the requirements for [LEED v4 BD+C Prerequisite: Integrative Project Planning and Design](#) or [SITES V2 Prerequisite 2.1: Use an integrative design process](#).

**Scoring:** Site assessments are completed and noted in the *Appendix A* worksheet. The project's scope and size will be taken into consideration for the extent to which assessments are completed. Only projects which provide adequate assessments which achieve points. **(10 points).**

**Materials needed to measure:** Site assessments. Project teams may provide a filled-out version of *Appendix A* as a summary of all data collected in pre-design, post-construction, and on an ongoing basis, but must elaborate on the analysis conducted and results found in short narrative form.

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### CREDIT 0.3

Develop and implement an equitable plan for community engagement

**6 PTS**

**Intent:** Engage community stakeholders in the vision, design, and implementation of the project to create a welcoming and equitable waterfront for all.

**Description:** Waterfront projects should embody the diverse needs and desires of community stakeholders by building from existing goals and networks, and establishing a process for ongoing engagement. Design teams must take responsibility to ensure an equitable process and balance project goals with complex public needs such as access to nature, recreation, housing, affordability, commerce, education, open space, views, transportation, and jobs. A process informed by these goals helps achieve outcomes responsive to community needs and to broader goals for the neighborhood and city.

**Design strategies:** Use the information collected during the initial assessment for community and historical context (**credit 0.2**), and develop a plan for broad community engagement of diverse stakeholders.<sup>3</sup> The definition of "community" will differ for each project, but should take into account social context, with a particular focus on engaging and serving the needs of under-served groups.<sup>4</sup> For projects located in industrial areas, consider how zoning and the physical landscape may pose obstacles for successfully engaging community members. Develop and implement a plan for robust community participation in the design process, to determine needs and priorities. Iterative adjustments to outreach strategies and design can help to build trust throughout the process. In addition to fulfilling planning requirements for public review:

- › Plan for community participation over time through the life of the project (incorporate plans for engagement beyond construction in **credit 0.4**).
- › Coordinate with government agencies to ensure that project goals and the participatory plan are compatible with existing efforts and policies.
- › Set goals for participation, such as number of workshops, attendees, and demographic representation.
- › Engage the public and key stakeholders using direct outreach by calling individuals and organizations, making announcements at community meetings, and indirect outreach using hard copy flyers or online forums.
- › Assess and manage barriers to participation, including language, technical facility, child-care needs, work schedules, to ensure maximum participation. Particularly in transit poor, low-income and under-served communities, meet people where they are to solicit their input (e.g. community spaces, parks, places of worship);<sup>5</sup>
- › Create fun, interesting, and accessible activities (e.g. videos, tours, hands-on activities or sketching).<sup>6</sup>

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<sup>3</sup> For reference, see the New York City Department of Housing Preservation & Development. (2015). *NYC Neighborhood Planning Playbook*.

<sup>4</sup> Definition adapted from **LEED v4 BD+C: New Construction: Social equity within the community**.

<sup>5</sup> Rebuild by Design. (2016). [Elements of Effective Engagement](#).

<sup>6</sup> Ibid.

For exceptional performance on this credit:

- › Conduct a human health and wellbeing impacts assessment following the conceptual design phase, including impacts related to affordability, a key concern in historically under-served communities. Local environmental agencies often require an analysis of potential impacts to human health for larger projects. Health impact assessments are policy and planning tools to integrate human health and wellbeing into non-health policies and planning.<sup>7</sup>
- › Develop a plan to receive and respond to public input over time (e.g. an online platform or regular “town-hall” style meetings).

**Scoring:** All projects must demonstrate successful community engagement, exceeding what is required by regulatory agencies. Projects may achieve points by:

- › Meeting applicable requirements below and provides evidence of an excellent two-way communications strategy to regularly engage the public over time<sup>8</sup> **(1 point)**; and
- › Meeting the applicable requirements below, a human health and wellbeing impacts assessment is provided, and narrative or annotated construction documents indicate adjustments to the design based on the process **(1 point)**.

AND EITHER

*Case A: Residential, commercial, mixed-use, park*

Narrative describes how assessments informed outreach strategies, and how a plan for reviewing, responding to, and incorporating community priorities was implemented. Narrative addresses how strategies addressed the needs of underserved communities and how diverse participation was achieved. Public events are defined as in-person public engagement activities such as canvassing, charrettes, or interactive presentations, held at least at the beginning (~10 percent design), and end (~75 percent design) of the design process. Meets the below standards or exceeds local requirements for public review, whichever is more stringent:

- › At least two public events were conducted **(2 points)**
- › At least four or more public events were conducted **(4 points)**<sup>9</sup>

OR

*Case B: Industrial*

Narrative and evidence of outreach describe how a plan for reviewing, responding to, and incorporating existing community priorities was implemented. At least one public event with individuals and groups that represent the full range of diverse public stakeholders identified in the initial assessment has been held and exceeds local requirements for public review, whichever is more stringent.

- › At least one public event was conducted **(2 points)**
- › At least two or more public events were conducted **(4 points)**<sup>10</sup>

**Materials needed to measure:** Narrative, annotated construction documents showing features influenced by engagement process, outreach documentation (e.g. testimonials, health impact assessments, attendance lists, workshop activities).

<sup>7</sup> Korfmacher, K., Aviles, K., Cummings, B., Daniell, W., Erdmann, J., & Garrison, V. (2015). [Health Impact Assessment of Urban Waterway Decisions](#). *International Journal of Environmental Health*, 12(1), 300–321. doi: 10.3390/ijerph120100300.

<sup>8</sup> Or meet the requirements of [LEED v4 BD+C: Innovation: Community outreach and involvement Option 1 “Ongoing Communication”](#)

<sup>9</sup> Or meet the requirements of [LEED v4 BD+C: New Construction pilot credit: Social equity within the community Options 1 or 2](#), or [Envision V3 QL 1.1: Improve the Quality of Life \(Superior Level\)](#).

<sup>10</sup> Or meet the requirements of [LEED v4 BD+C: New Construction pilot credit: Social equity within the community Options 1 or 2](#), or [Envision V3 QL 1.1: Improve the Quality of Life \(Superior Level\)](#).

**TABLE 1: CREDITS REQUIRING COMMUNITY STAKEHOLDER INVOLVEMENT**

CREDIT	CREDIT TITLE
2.1	Provide quality public access areas on the waterfront
2.2	Reduce industrial impacts to human health and wellbeing
2.3	Provide diverse programming and passive educational features
2.5	Create maritime-related employment opportunities
2.6	Increase waterfront pathway and greenway connectivity
2.7	Provide direct connections to the water for people and boats
2.8	Support diverse and sustainable maritime activity

The plan must provide site-specific detail for each of the following components, addressing specific instructions listed in *Appendix A* or in the credits above

**CREDIT 0.4**  
Create a maintenance and adaptive management plan  
**6 PTS**

**Intent:** Ensure the maintenance, ongoing performance, and adaptive management of waterfront projects in support of access, ecological health, and resiliency.

**Description:** The long-term success of waterfront projects requires innovative, multidisciplinary planning to ensure ongoing performance and adaptive management. Landowners should also establish funding and plans for maintenance and adaptive management over time. Lastly, strategic partnerships with scientific and research institutions can strengthen the team’s ability to track, monitor, and learn from changes and extreme events over time by building capacity and supporting better-informed waterfront best practices, policy, and education.

**Design strategies:** Use the table in *Appendix A* as a reference to develop a plan for maintenance and adaptive management. The plan must address any credits sought. *Appendix A* provides specific instructions for maintenance and adaptive management. This must include plans for all critical ongoing components and the credits sought. The credits in **Table 2** require ongoing maintenance plans in order to receive credit:

**TABLE 2: CREDITS REQUIRING ONGOING MAINTENANCE, MONITORING, AND ADAPTATION**

CREDIT	CREDIT TITLE
1.1	Avoid or reduce risk from coastal hazards
1.5	Provide an emergency preparedness and response plan
2.3	Provide diverse programming and passive educational features
2.4	Increase transportation access to the waterfront
2.6	Increase waterfront pathway and greenway connectivity
2.7	Provide direct connections to the water for people and boats

<b>2.8</b>	Support diverse and sustainable maritime activity
<b>3.1</b>	Choose an appropriate edge strategy for the context and intended use
<b>3.4</b>	Ecologically enhance structural components
<b>4.1</b>	Maintain and restore biodiversity and ecosystem services
<b>4.3</b>	Support native habitat complexity and biodiversity
<b>4.4</b>	Avoid human disturbance to natural resources
<b>4.9</b>	Reduce and manage stormwater quantity
<b>4.10</b>	Improve stormwater discharge quality
<b>4.11</b>	Reduce water use

The plan must provide site-specific detail for each of the following components, addressing specific instructions listed in *Appendix A* or in the credits above:

- > Operations and maintenance tasks
- > Plans to monitor performance and adapt over time and associated interval;
- > Potential adaptive management strategies
- > Permission to release data (see **credit 4.13**)<sup>11</sup>

For monitoring, provide a brief summary statement (50-200 words) for each applicable credit, including monitoring protocol used, monitoring interval, responsible party, and sources of long-term funding. Indicate whether the team is willing to share data collected with the Waterfront Alliance and academic partners. Include any plans or options for adaptively managing the site over time in response to shifting climatic, environmental, and social conditions, anticipating any factors that could negatively or positively impact each ongoing performance measure.

**Scoring:** Plan for operations and maintenance, for monitoring performance over time, including monitoring interval, responsible parties, and sources of long-term funding, and for adaptive management is provided for each credit sought using *Appendix A*. Credits which state specific maintenance and adaptive management elements must be addressed to receive credit **(6 points)**.<sup>12</sup>

**Materials needed to measure:** Plan for maintenance, ongoing performance, and adaptive management.

<sup>11</sup> Reporting data may be used for purposes internal to the Waterfront Alliance, or shared with academic and scientific institutions or agencies, to provide valuable insight and inform best practices for waterfronts.

<sup>12</sup> Projects may also meet **Envision V3 LD 2.3 Plan for Long-term Monitoring and Maintenance (Enhanced level)** requirements. While the WEDG program may eventually evaluate monitoring and performance over time, the program does not currently have this capacity. Plans for monitoring and adaptive management will be scored based on completeness, applicability, and intent at the time of submittal, and reporting over time is voluntary.



# Responsible Siting & Coastal Risk Reduction



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## CATEGORY 1

TOTAL POSSIBLE POINTS 40 PTS

**Credit**

- 1.1 Avoid or reduce risk from coastal hazards** PG23
- 1.2 Site with ecological sensitivity** PG30
- 1.3 Site or design structures to improve visual and other sensory connections to the water** PG31
- 1.4 Support industrial water-dependent uses** PG33
- 1.5 Provide an emergency preparedness and response plan** PG35

TOTAL POSSIBLE POINTS 40 PTS





## Category 1: Responsible Siting & Coastal Risk Reduction

Use responsible development strategies for project siting and resilience that account for climate change and flood risks

40 POSSIBLE PTS

### CREDIT 1.1

Avoid or reduce risk from coastal hazards

12 PTS

**Intent:** Reduce human health and safety risks and potential damage to site features.

**Description:** Sea levels are rising across the globe, at a pace that is determined by past, current, and future fossil fuel emissions,<sup>13</sup> as well as climatological factors and local coastal characteristics. This rise occurs unequally, with varying degrees of regional rise due to land subsidence, glacial rebound, and other factors.<sup>14</sup> Further, there are regional variations in vulnerability to surge from coastal storms and tsunamis.

As sea levels rise, the extent, frequency, and duration of coastal flooding will increase, adding to the risks and forces already affecting waterfront projects, such as wind and waves; shoreline erosion; and regular flooding associated with tides, on-shore winds, and rain. Projects should be designed to reduce these risks using an adaptive approach, taking into account these vulnerabilities and potential impacts on the environment, neighborhood character, and human experience at the street level.

**Design strategies:** The following guidance should be used in conjunction with initial assessments of risks and vulnerabilities (**credit 0.2**). Design teams can achieve risk reduction through siting, structural modification, and nature-based or integrated flood protection strategies. Any of these approaches should be tailored to the site's characteristics and operational needs, and employs plans for adaptive management over time. Engage insurers early in the design process to support a risk-avoidant decision-making process that can lead to lower premiums.

#### *Minimize exposure to coastal erosion risk*

Based on initial assessment and on the presence of natural or constructed protective features, determine an approach that avoids building in highly erodible or coastal erosion hazard areas. If structures must be placed in erodible areas, components should comply with ASCE 7 to support stability. It provides structural design guidance to accommodate soil, flood, tsunami, snow, rain, atmospheric ice, earthquake, and wind loads.<sup>15</sup> Assume rising water tables and increased inundation of edges over time. Evaluate opportunities to prioritize natural and nature-based features over conventional hard structures when additional stabilization is needed (**credit 3.1**).

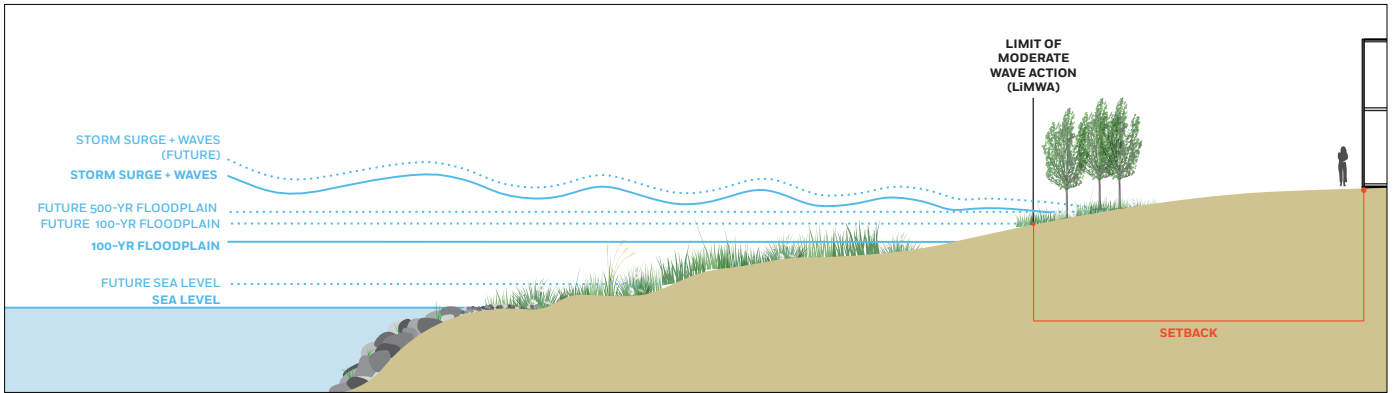
#### *Minimize flood risk*

Flood risk reduction strategy will vary depending on context, intended use or project type, and whether the use needs to remain uninterrupted during a storm. Design teams should consider the following strategies, taking a precautionary approach to reducing flood risk over time.

<sup>13</sup> In general, the "low" greenhouse gas emissions scenario refers to the [Intergovernmental Panel on Climate Change's Representative Concentration Pathway \(RCP\) 2.5](#), whereas "moderate" refers to two intermediate RCP scenarios (4.5 and 6.0), and "high" refers to RCP scenario 8.5.

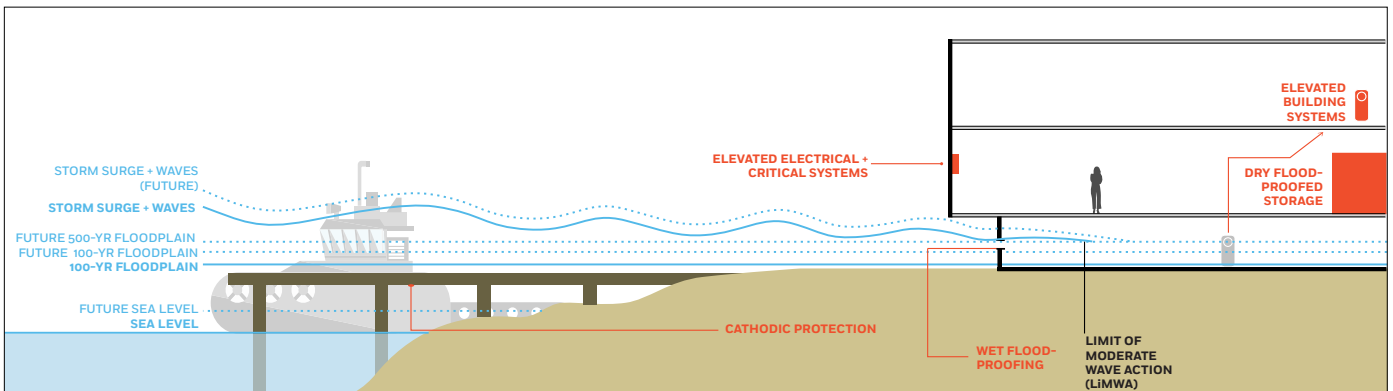
<sup>14</sup> See Appendix A "Risk and vulnerability to sea level rise and storm surge" for guidance on finding peer-reviewed, regional and local sea level rise data.

<sup>15</sup> American Society of Civil Engineers. (2017). *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE/SEI 7-16).



*Case A: Setbacks*

Setbacks offer the highest levels of structural protection, risk reduction, premium reduction, and environmental benefits. Setting back structures from hazard areas to keep them out of the sea level rise-adjusted future floodplain, floodway, wave zone, or regularly inundated area is the preferred option in less dense areas, particularly when building on previously undeveloped land, and for structures not critical to water-dependent uses (e.g. docks and piers). Employing site-wide elevation or grading changes to meet target elevation as an additional strategy may be used, provided that impacts on habitats, and overall neighborhood character, and resilience are addressed. In these areas, the costs—including environmental impacts and long-term costs such as higher maintenance and insurance—may outweigh the benefits. Set structures outside of the sea level rise-adjusted 100-year and/or 500-year floodplains, with the latter offering significantly higher level of risk reduction. If a setback is not feasible due to limited spatial area or water-dependent use structures, a partial setback from higher-frequency flood zone combined with flood risk reduction strategies listed below is advisable, provided that risk is reduced adequately through other means. For parks, grade the site using a sea level rise adjustment to ensure that public access structures and amenities that cannot be inundated regularly (i.e. sunny day flooding/permanent inundation) are sited outside of future sea level rise areas. Design for floodability under storm conditions (e.g. use heavier infill for sports fields), using a freeboard adjustment only where necessary for structural components (base flood elevation and freeboard still apply to structures) unless the park is also serving as part of an integrated flood protection strategy (e.g. berm). Maintain a gradual slope to facilitate inland migration of wetland areas/intertidal habitat and plant water/salt-tolerant species, designing to “let water in” under storm conditions where feasible.



Case B: Structural and site-scale flood protection

Where future regular tidal flooding is expected to cover a significant portion of the site and surrounding infrastructure, new construction that increases density or introduces a vulnerable population or facility that requires uninterrupted operation (e.g. a new hospital, new construction of public housing), is not recommended. For some intended uses and contexts, the benefits of siting structures near water may outweigh the potential risks and costs. This may be the case for piers, retrofits or urban infill, historic buildings, or maritime facilities. For these cases, employ strategies from the guidance below, considering adaptation and maintenance over time (**credit 0.4**).

Use the calculation below in consultation with code requirements to determine design flood elevation. If a structure must maintain uninterrupted operations throughout an extreme event, has high-value inventory or machinery, or includes storage of hazardous substances, use the “high” sea level rise scenario, and include additional protective measures, particularly for projects currently within or near the current Limit of Moderate Wave Action (LiMWA).<sup>16</sup>

**CALCULATING DESIGN FLOOD ELEVATION**<sup>17, 18</sup>

BASE FLOOD ELEVATION		FREEBOARD		SEA LEVEL RISE ADJUSTMENT	DESIGN FLOOD ELEVATION
Use the FEMA 100-year floodplain base flood elevation. Or, if seeking a elevation above the 500-year floodplain, use the methods in <i>Appendix A</i> to identify the 500-year floodplain baseline elevation.	+	12” (30.5cm); 24” (61cm) for critical structures	+	Determine the regionally-adjusted sea level rise expected for the design life of the project using methods in <i>Appendix A</i> . Use at least the moderate sea level rise scenario or higher.	=

Meet target elevation and durability using the following strategies (in descending order of risk reduction value), for all buildings and equipment in the future floodplain:<sup>19</sup>

- *Elevation and wet floodproofing*: this strategy provides the second highest level of risk reduction (for non-residential structures) after setbacks. Elevate structures so that lowest occupiable floors and critical systems are above design flood elevation, minimizing damage while allowing floodwaters to enter lower levels.<sup>20</sup>

<sup>16</sup> The LiMWA is the inland limit of the area expected to receive 1.5-foot or greater breaking waves during the one percent annual chance flood. See [FEMA. 2015. Fact Sheet: Importance of the Limit of Moderate Wave Action.](#)

<sup>17</sup> Adapted from New York City Mayor’s Office of Recovery & Resiliency. (2018). [Climate Resiliency Design Guidelines](#). By the insurance industry, a design flood elevation of the 500-year floodplain plus two feet of freeboard is commonly recommended. In some cases, this has been found to roughly correspond to the 2080s sea level rise adjustment using the moderate scenario. The methods described in *Appendix A* and **Table 2** offer methods for more tailored adjustment based on the site context. State and local laws primarily administer regulations related to siting and design in coastal hazard areas, and municipal codes generally regulate structural modifications such as elevations. The Federal Emergency Management Agency (FEMA) determines base flood elevation, the computed elevation to which floodwater is anticipated to rise during a 100-year flood, measured relative to the North American Vertical Datum of 1988 for the current 100-year floodplain, and does not take into account sea level rise.

<sup>18</sup> Examples of critical structures include, but are not limited to: hospitals and health care facilities, emergency response facilities, major food distribution centers, wastewater treatment plants, facilities that store or process toxic or hazardous substances, and those where residents have limited mobility or ability such as nursing homes. Local definitions of critical structures and facilities may vary. If available, see local guidance.

<sup>19</sup> For elements not vulnerable to negative impacts upon inundation, such as salt-tolerant planted areas or durable structures without utilities, designing to allow for occasional inundation is a resilient option.

<sup>20</sup> See also: FEMA. (2005). [Design and Construction in Coastal A Zones.](#); New York City Department of City Planning (2013). [Coastal climate resilience: Designing for flood risk](#); FEMA. (2015). [Highlights of ASCE 24-14 Flood Resistant Design and Construction](#); FEMA. (2013). [Floodproofing Non-Residential Buildings](#) (P-936).

- Elevate all mechanical and electrical systems, and equipment storage areas (especially hazardous materials) above Design Flood Elevation (DFE), with critical systems preferably on upper floors. Provide protection (e.g. waterproof vaults, water- and salt-resistant materials, non-corrosive casings) for all utilities and lines that must be located in the flood zone.
- Remove obstructions to wave attack, minimizing hydrostatic forces.<sup>21</sup>
- Integrate elements from FEMA references associated with this credit.
- Provide cathodic protection for marine infrastructure to minimize corrosion to metals caused by exposure to harsh environmental conditions and maritime activity.
- For non-industrial uses, reduce the impact of any elevation changes to neighborhood character and the human experience, especially for users with disabilities or limited mobility.
  - For larger buildings, create a spacious, wet-floodproofed building lobby or exhibition space at grade, with interior access to floors above DFE, rather than exterior stairs and ramps that may create a visual and spatial disconnect.
  - For buildings near or close to the property line, façade articulation at the base of the building, combined with plantings and screenings, can help break up the monotony of an elevated façade.
  - For buildings that are set further back from the street, elements such as plantings, stairs, porches, temporary seating areas for outdoor cafes, public art, and changes in grade can contribute to a more dynamic streetscape.
- › *Dry floodproofing:* While generally associated with less risk reduction than wet-floodproofing and elevating structures or critical infrastructure, dry floodproofing can help maintain neighborhood character by keeping windows, crawlspaces, entrances, and retail floor space at the pedestrian level. Dry floodproofing is not permitted by federal and local code for residential spaces and egress points in residential buildings. However commercial uses, storage, or community facilities within residential buildings may be dry floodproofed.<sup>22</sup> Passive dry floodproofing, in which all components are sealed without human intervention, is associated with greater risk reduction than active dry floodproofing, which requires human intervention through flood gates, water-filled dams, sandbags, or plywood and hurricane shutters for wind or hurricane damage. For adequate protection:
  - Apply a waterproof coating to exterior walls and seal all wall penetrations, including windows, doors, and locations where utilities enter the building. For industrial maritime operations, install containment walls or enclosures around susceptible materials or equipment. Note that waterproofed walls need regular inspection and maintenance to ensure that waterproofing is not compromised.
  - Seal every utility, including electrical and telecommunications conduits, sanitary sewer and stormwater infrastructure, to prevent infiltration during a storm surge event.

<sup>21</sup> For more detail, see: FEMA. (1993). Technical Bulletin 7-93, Wet floodproofing requirements for structures located in special flood hazard areas in accordance with the National Flood Insurance Program; FEMA. (1993). [Technical Bulletin 6-93, Below-grade parking requirements for buildings located in special flood hazard areas](#); FEMA. (1993). [Technical Bulletin 6-93, Non-residential floodproofing – Requirements and certification for buildings located in special flood hazard areas](#); FEMA. (2008). [Free-of-Obstruction Requirements for Buildings Located in Coastal High Hazard Areas in accordance with the National Flood Insurance Program](#) (Technical Bulletin 5-08).

<sup>22</sup> FEMA. (2008). [Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas in accordance with the National Flood Insurance Program](#) (Technical Bulletin).

Variety in stoops, windows, and landscaping along the residential building façades can help to reduce the impact of building elevation changes. *Photo: NYC Department of City Planning*



- Consider the need to install backflow prevention devices, duckbills, or tidal check valves in stormwater infrastructure to prevent tidal and surge flooding of stormwater infrastructure. This strategy should be paired with a high on-site precipitation capture given the potential for backup or overflow during high precipitation events.
- Use deployable flood protection strategies only in the absence of other options. Regular drills as preparation for deployment are needed, and must be included in the maintenance and operations plan if this strategy is employed (**credit 0.4**). These are not appropriate as standalone measures for new construction. Deployable flood protection products should be tested and approved by a Nationally Recognized Testing Laboratory.
- › *Increase the durability of structures:* Considering the increased exposure to coastal flooding and temperature changes identified in **credit 0.2**, design to a higher standard of durability. Strengthen foundations, floor slabs, and walls to resist hydrostatic and hydrodynamic loads and buoyant forces. And:
  - Use building and structural materials that are resistant to saltwater, flooding, heat, cold, wind, and ultraviolet light but environmentally safe.
  - For areas within or near the current LiMWA, which includes FEMA A and V zones, free the area below the lowest floor of elevated buildings of obstructions or ensure that any enclosed areas constructed of non-supporting breakaway walls, open lattice-work, or screening will not cause building collapse, displacement, or other damage to the building foundation if impacted by or lost due to wave forcing.<sup>23</sup>
  - Minimize exposure to coastal winds and wind-borne debris. To increase a commercial building's durability and resistance against wind pressures and debris, consider using the Insurance Institute for Business & Home Safety FORTIFIED Commercial™ Hurricane Standard. This voluntary construction criteria greatly reduces the risk of property damage and loss of business operations.

<sup>23</sup> FEMA. (2008). [Design and Construction Guidance for Breakaway Walls](#) (Technical Bulletin 9).

- > *Landscape-scale storm-surge and wave damage risk reduction features:* If other options are limited, incorporate upland strategies that reduce the impacts of flooding and waves on vulnerable assets and that consider risk beyond the site. These strategies may include vegetated upland berms connected with high elevation points, floodwalls integrated into the landscape, raising edge elevation, or other landscape features. Landscape-scale features are less recommended for lower-density sites. If a berm, floodwall, or levee is already in place, examine its condition and determine height in relation to future flood elevation to inform whether or for how long the structure should be employed or if other strategies should be pursued. Consider potential impacts to public access, views, stormwater flooding, and habitat connectivity. Designs employing landscape-scale features that significantly impact these considerations, or that do not provide long term maintenance plans, cannot achieve this credit. Projects that involve collaboration with neighboring landowners to develop an integrated flood risk reduction strategy beyond the site are preferred, due to their increased benefits for neighboring communities.<sup>24</sup>
- > *Nature-based features:* Employ nature-based features to reduce wave damage from smaller, more frequent storms. Significant wetland, mangrove, coastal shrubland, and edge forest restoration may qualify for this credit, provided that vulnerable structures are either sited outside of the future floodplain or meet design flood elevation and durability guidance. Nature-based features provide multiple benefits, and can be effective in reducing impacts from smaller, more frequent storms and gradual erosion.<sup>25</sup>
- > *Critical infrastructure redundancy:* For critical operations as applicable, incorporate redundant energy strategies into the design. Emergency and auxiliary systems should provide sufficient power to run critical systems for an extended period of time following an extreme event, using renewables to the extent feasible. Auxiliary systems should be sized to approximately 110 percent of starting design load for the following critical components:<sup>26</sup>
  - Egress and exit lighting
  - Fire alarm system
  - Generator auxiliaries
  - Smoke control systems (if required by code)
  - Fire pump
  - Telephone switch
  - Security systems
  - Mechanical control systems
  - Building Automation System (BAS)
  - Elevators (one per bank)
  - Sump pumps
  - Sewage ejector pumps
  - Exhaust fans removing toxic, explosive or flammable fumes
  - Critical computer systems and databases
  - Power and lighting for areas that need to remain operational (e.g. utility rooms)
  - Air conditioning systems
  - Horizontal sliding doors
  - Other associated equipment designated by code

<sup>24</sup> See also New York City Department of City Planning. (2013). [Coastal Climate Resistance: Urban Waterfront Adaptive Strategies](#).

<sup>25</sup> The Nature Conservancy. (2015). [Urban Coastal Resilience: Valuing Nature's Role, Case Study: Howard Beach, Queens, NY](#). See also [SAGE. \(n.d.\) Systems approach to geomorphic engineering](#).

<sup>26</sup> General Services Administration. (2017). [6.12: Emergency Power Systems](#).



**Scoring:** Risk reduction strategy is consistent with the surrounding context, accounting for density, intended use and environmental conditions. Narrative or annotated site plans and construction documents demonstrate that the site is designed for coastal risks. Structures are not located within or are sufficiently set back from any coastal erosion hazard areas, or meet ASCE 7 engineering standards. For parks, site is graded or elevated (e.g. for esplanades) to prevent permanent or regular inundation of key public access areas/amenities. Structures built without setbacks from vegetated dunes or natural protective features may not qualify for points, with the exception of park boardwalk features or maritime-dependent uses that require such siting **(2 points)**.

AND

Redundant strategies and secondary protective measures that minimize losses to business operations or adverse environmental impacts are incorporated into the design. For facilities that need to maintain uninterrupted operations, redundant strategies are required to qualify for this credit **(1 point)**.

AND EITHER

*Case A: Setbacks*

Buildings are set back from either:

- > Future 100-year floodplain **(4 points)**; or
- > Future 500-year floodplain **(6 points)**

For parks with no buildings, full credit is possible if site is graded to reflect future 100-year sea level rise, incorporating more gradual slopes to enable wetland/intertidal habitat migration. Structures are built for durability. *Exception:* parks that serve as integrated flood protection should be graded to the above floodplain (rather than sea level rise alone) standards to achieve points.

OR

*Case B: Structural and site-scale flood protection*

Narrative justification for proceeding with other flood risk reduction strategies is provided, and structures and utilities are protected or floodable and structurally sound<sup>27</sup> to the following future flood conditions, or meet local code, whichever is more stringent; either to:

- > Future 100-year floodplain **(4 points)**; or
- > Future 500-year floodplain **(6 points)**

For parks with buildings, full credit is awarded if site grade reflects future 100-year sea level rise and gradual slopes enable wetland/intertidal habitat migration. Buildings and integrated flood protection must be built to the above standards.

Impacts of elevation or landscape features to the human experience beyond the site must be minimized. Industrial/hazardous or potentially polluting material storage sites have a plan in place for controlling materials. A National Flood Insurance Program Elevation Certificate is provided. If the project's flood-risk strategy demonstrates measurable risk reduction to adjacent communities, an additional **(3 points)** may be awarded. Maintenance plans are provided for landscape features.<sup>28</sup> Projects that are planned to primarily be placed in an area that will be inundated by regular (nuisance) flooding in 2050 cannot score for this credit, with few exceptions.<sup>29</sup>

<sup>27</sup> Durability must meet at a minimum FEMA requirements for the structures' zonation, ASCE 7; FORTIFIED Commercial™ Hurricane Standard is also a higher-level durability standard.

<sup>28</sup> Provided that projects have met requirements, **RELI's HA Req 1** can qualify for maximum points for this credit.

<sup>29</sup> Applicants may state their case for how this will be managed, but exceptions will be made only for rare use cases (e.g. natural areas park with elevated walkways).

**Materials needed to measure:** Narrative and/or annotated site plans, insurance quote (for structures/high value amenities), operations and maintenance plan, National Flood Insurance Program Elevation Certificate.

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**Credit 1.2**

Site with ecological sensitivity

8 PTS

**Intent:** Prevent adverse ecological impacts caused by structures to important habitat areas, and increase resilience to sea level rise and coastal storms.

**Description:** Coastal habitats provide critical nursery grounds for fish and wildlife, and edge protection and other benefits. They are also more difficult to replace or restore than to protect. Building structures over or directly adjacent to wetlands and water bodies not only affects habitat health, but also places those structures at greater risk. Sea level rise and climate change place additional pressures on habitats, and when combined with structural barriers, habitat can be compromised or lost. Setting back structures and operations from these areas allows them the best opportunity to thrive and adapt over time.

**Design strategies:** Using assessment of habitat extent (**credit 0.2**), site structures away from or include a buffer (**Table 3**) between critical habitats and areas of high human activity. If rare, threatened, endangered, wetland, or protected habitat is found, work with a qualified biologist or environmental professional at the onset of design to delineate and develop an appropriate buffer (e.g. state Natural Heritage Program, fish and wildlife agency or local equivalent, state or federal wetlands offices). Consider protection through conservation easement, transfer of development rights, or other preservation method. For projects on undeveloped lands, site structures and modifications away from intact habitats (see **credit 4.1** and “habitat quality” in *Appendix A*), even if not rare or threatened. See also *Category 4: Natural Resources* for other environmentally-sensitive considerations.

**Scoring:** Site plans indicate that permanent structures are not over water (excepting water-dependent uses), wetlands, or other ecologically-sensitive areas, and there is a buffer between sensitive habitats as described above or local regulations, whichever are more stringent. For water-dependent structures, sensitive habitats are avoided.<sup>30</sup> Natural protective features and those vulnerable to erosion are avoided, as they contain vulnerable habitats and provide protection for communities. Responsible siting for these habitats includes a 50-foot setback for buildings and significant structures, away from the edge of any vulnerable physical features (e.g. dunes, bluffs). For beaches, this is 100 feet from the vegetated edge, plus an additional amount determined by multiplying the annual erosion rate by the expected design life of the structure, but not less than 40 years. Urban infill sites with no existing habitat achieve full points for this credit. **(6 points).**

AND

Environmental setbacks enable habitat migration due to sea level rise. Along at least 25 percent of the shoreline, at least 20 horizontal feet (additional to any buffers) of upland space is designated for habitat migration for marsh, mangroves, shrubland, or maritime forest where it exists or has been created. For coastal dune systems, 75 feet are provided and 125 feet for beaches. The migration area must not be at a steep grade or include any physical barriers to migration (e.g. seawall, road, slope greater than 1:5 for a tidal marsh). For retrofits, projects achieve points if existing condition or new design meets this standard. Urban infill sites with no existing habitat and no feasible means of incorporating/restoring natural edge habitat can achieve full points. **(2 points).**

**Materials needed to measure:** Site plans indicating setback from critical areas.

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<sup>30</sup> For retrofits, projects meeting [LEED BD+C V4 LT: Sensitive land protection](#), or [SITES Site Context Prerequisite 1.3: Conserve aquatic ecosystems and Prerequisite 1.4 Conserve habitats for threatened and endangered species](#) achieve at least the first part of this credit



**TABLE 3: GUIDANCE FOR DESIGNATION OF BUFFERS (FROM SITES V2 P1.3)<sup>31</sup>**

<b>Classification</b>	Aquatic ecosystem habitat buffer designation
<b>Marine</b>	200 feet (60.96 meters) landward from normal high tide line
<b>Estuarine</b>	100 feet (30.48 meters) landward from the normal high tide line
<b>Riverine</b>	Tidal: 100 feet (30.48 meters) landward from the normal high tide line  Lower and upper perennial: 100 feet (30.48 meters) from the ordinary high water mark or the 100-year floodplain, whichever is greater  Intermittent and unknown perennial: 50 feet (15.24 meters) from the ordinary high water mark or the 100-year floodplain, whichever is greater
<b>Lacustrine</b>	Water body greater than 50 contiguous acres (20.23 hectares): 100 feet (30.48 meters) landward from the normal water edge  Water body less than 50 contiguous acres (20.23 hectares): 50 feet (15.24 meters) landward from the normal water edge
<b>Palustrine</b>	100 feet (30.48 meters) landward from the delineated edge of the delineated wetland

**CREDIT 1.3**

Site or design structures to improve visual and other sensory connections to the water

**6 PTS**

**Intent:** Enhance and maximize light, air, and visual and psychological access to the water from upland areas.

**Description:** Visual corridors provide unobstructed views from upland streets to the waterfront, and help enhance community connections to the water. View corridors also promote sensory connections to water, such the ability to see, touch, or hear water, which can improve physical and mental health. Researchers have found that the presence of clean water on site reduces stress, increases feelings of tranquility, improves concentration and memory, and lowers heart rate and blood pressure.<sup>32</sup> Research also suggests that connections to the water through marine-based citizen science can improve health and wellbeing, and facilitate a culture of waterfront stewardship.<sup>33</sup> It is important to preserve and enhance waterfront view corridors to promote these benefits and inspire people to safely interact with water on site.

**Design strategies:**

- > Improve view corridors: Site and orient buildings at an appropriate angle to the shoreline to maximize light, air, and visual access to water:
  - Extend views to the water by aligning visual corridors with the street grid, or at intervals determined by local zoning. Corridors can provide connections for the upland community, and should be spaced within a short walking distance (1,300 feet or 400 meters or less).

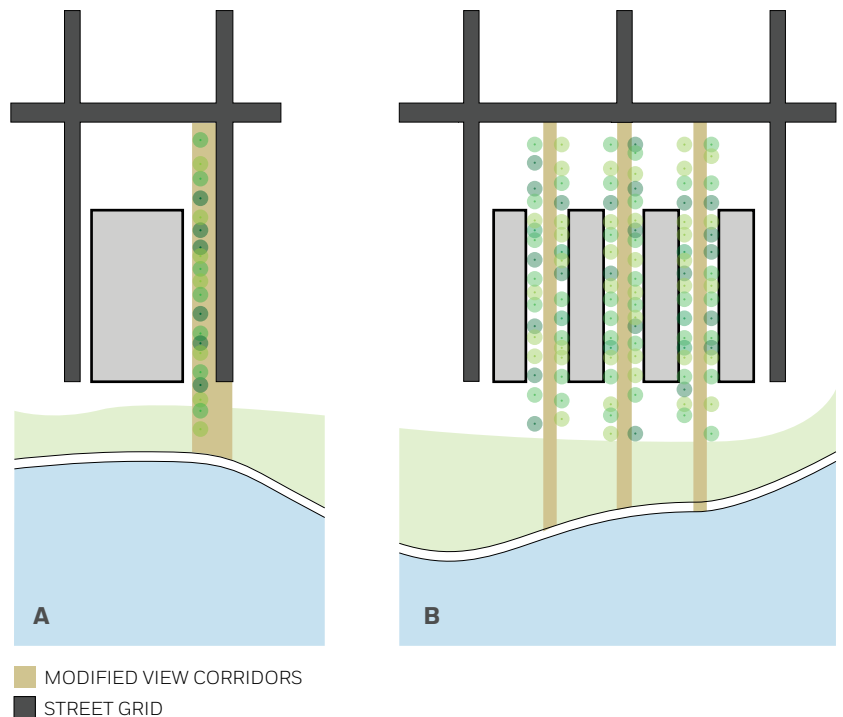
<sup>31</sup> This is a general overview, and the level of buffer will depend on the exact habitat type found on site. For retrofits and urban infill areas with no significant or sensitive habitat areas found onsite, setbacks/buffers are still recommended, but not always feasible, and not required for this credit if no such habitats exist.

<sup>32</sup> Nutsford, D., Pearson, A. L., Kingham, S., & Reitsma, F. (2016). Residential exposure to visible blue space (but not green space) associated with lower psychological distress in a capital city. *Health and Place*, 39, 70-78. DOI: 10.1016/j.healthplace.2016.03.002; Browning, W., Ryan, C., & Clancy, J. (2014). **14 patterns of biophilic design**. New York: Terrapin Bright Green LLC.; Völker, S. & Kistemann, T. (2011). The impact of blue space on human health and well-being—Salutogenetic health effects of inland surface waters: A review. *International Journal of Hygiene and Environmental Health* 214, 449–460. doi:10.1016/j.ijheh.2011.05.001.

<sup>33</sup> Beatley, T. (2014). Chapter 7. In *Blue Urbanism: Exploring Connections between Cities and Oceans*. Washington, DC: Island Press.

- Based on the site context considering surrounding density, uses, and orientation of upland streets, determine whether widening one or more existing view corridors, or creating an additional view corridor where there is no street grid transecting the upland property line, is appropriate. For example, widening visual corridors in some contexts may cause floor area to be re-distributed in a way that creates taller buildings and burdensome maintenance costs for the public space. A narrative justifying a widened or additional visual corridor and a description of designs implemented to strongly enhance the quality of the public access area must be provided to achieve this credit (see **credit 2.1**).

In addition to alignment with the street grid, view corridors can be expanded or enhanced, depending on the site context, to improve connections to the water.



- > *Prospect*: Create unimpeded views over landscapes, especially of natural features such as mountains or wetlands. Researchers have shown that the biophilic principle of “prospect” creates a balance of freeing openness with safety and control, which can reduce stress, boredom, irritation, fatigue and perceived vulnerability, and also provide comfort.<sup>34</sup>
- > *Refuge*: Balance expansive views with more enclosed places of refuge through taller, vertical elements such as shade trees, landscaped walls, or seating. Refuge has been shown to promote concentration, attention and perceptions of safety. While the health benefits of creating refuge are reportedly stronger than the response to prospect, the benefits are compounded when both principles converge.<sup>35</sup>

<sup>34</sup> Browning, W., Ryan, C., & Clancy, J. (2014). *14 patterns of biophilic design*. New York: Terrapin Bright Green LLC.

<sup>35</sup> Ibid.

- *Activate ground floor usages:* Provide community facilities and/or retail spaces. Providing multiple entries along upland connections offers refuge from outdoor areas.
- *Avoid blank walls:* For sites with residential uses, avoid blank walls and large, homogeneous ground floor uses. Instead, provide entryways or “stoops” along the ground floor to add rhythm and variety to the users’ experience, and promote a sense of comfort and safety.
- *Create temporal connections to views and lighting at different times of day.* Reduce nighttime light pollution.

Balancing more expansive view corridors to the waterfront with those that are planted and have more of a sense of enclosure can improve design for the human scale. *Photo: Mary Kimball/New York City Department of City Planning*



**Scoring:** Site plans show that all existing view corridors (sight lines continuing the street grid to the waterfront) have been maintained. If the upland adjacent lot is a greenfield, or otherwise not developed, and streets do not continue to the site, use the closest mapped streets transecting the shoreline.

*Case A: Residential, commercial, mixed-use, industrial*

Site plans and narrative demonstrate a design in which existing, additional or widened view corridors follow the strategies provided here, or in credit 2.1, to enhance the quality of the public space and sensory connections to the waterfront. **(6 points)**

*Case B: Parks*

Site plan and narrative demonstrate satisfactory incorporation of a variety of views through landscaping, elevation, seating, or other referenced strategies **(6 points)**

**Materials needed to measure:** Narrative and site plans showing existing, preserved, enhanced, widened, and/or added view corridors.

**CREDIT 1.4**

Support industrial water-dependent uses

**10 PTS**

**Intent:** Support and preserve water-dependent uses related to maritime industry and commercial shipping and promote associated economic, environmental, and public health benefits.

**Description:** Water-dependent industrial uses can revitalize waterways and provide ecological, economic, and social benefits. Concentrating industrial waterfront sites can reduce environmental impacts and greenhouse gas emissions by preserving the use of the waterways for transporting materials and goods by barge, which is more efficient than moving freight by truck. Supporting water-dependent industries can also provide jobs to the region, and reduce transportation costs, and preserve mixed uses in waterfront neighborhoods. Maritime shipping also reduces truck traffic, supporting safer, healthier, more pedestrian-friendly neighborhoods.

Siting and supporting maritime uses, where appropriate, provides multiple public benefits.  
 Photo: Kate Boicourt



**Design strategies:** A water-dependent use is an activity that can only be conducted on, in, over, or adjacent to a water body because it requires direct water access and the use of water or waterways.<sup>36</sup> This credit is intended for water-dependent uses related to the maritime industry. Examples include loading and shipping raw materials that are difficult to transfer on land, such as cement; uses requiring large amounts of water for processing and cooling, such as hydroelectric power plants; and time-sensitive shipping operations for products such as perishable goods.<sup>37</sup>

- Based on the initial site assessments, zoning and planning initiatives, community priorities, and long-term operational and adaptive management needs (**credits 0.2, 0.3, and 0.4**), determine whether industrial water-dependent uses are appropriate.

<sup>36</sup> New York Department of State. (2017). [State Coastal Policies, Policy 2](#). Albany, NY: New York State Department of State Coastal Management Program.

<sup>37</sup> Ibid.

- If appropriate, adapt or develop marine transportation networks on or adjacent to the site. Site consistent with the aims of **credits 1.2, 4.1, and 4.2.**
- Assess locations of existing local or regional berthing sites for historic boats and site in an area that enhances the site’s maritime history if applicable, or reflects a broader narrative of the area’s historical maritime uses.
- Site working edge in area where dredging will be minimal or is not needed.

**Scoring:** Narrative describes any existing policies or requirements for water-dependent uses and maritime industrial zoning, and the measures taken to support and maintain these uses in the context and enhance existing clustering of maritime businesses. Designs must be appropriate for the site’s ecological conditions determined in **credit 0.2, 1.2, and 4.4. (6 points).**

AND

Documentation shows marine transportation accounts for 25 percent or more inbound/outbound transportation of materials **(2 points).**

AND

For industrial maritime facilities, annotated site plans show working edge is condensed to less than 75 percent of the total shoreline length **(2 points).**

**Materials needed to measure:** Narrative and site plan indicating measures to support industrial or transportation water-dependent uses, required transportation documentation, condensed working edge (75 percent or less of total shoreline).

**CREDIT 1.5**

Establish an emergency preparedness and response plan  
**4 PTS**

**Intent:** Protect human safety by planning for emergency conditions, which includes effective communications and operations both prior to and following extreme events.

**Description:** Clear communication and outreach about coastal hazard risks can increase human safety during and after emergencies. Create an emergency preparedness plan for human safety prior to an extreme weather event, particularly considering the most vulnerable communities, such as those with impaired mobility. Plans should address emergency preparedness before, during, and after a disaster. Collect pre- and post-event data to evaluate vulnerabilities including site photographs to expedite insurance claims after a storm.

The key components for emergency preparedness include:

- A defined mission and goals; and
- A strategy for communicating the plan before, during, and after an event

**Design strategies:** Landowners should adapt emergency preparedness plans if available. If unavailable, consider the following strategies to create a plan specific to the site’s needs:<sup>38</sup>

- Define goals for safety and recovery after an extreme event.
- Establish an emergency network of on-site team leaders, as well as applicable local, city, state, and federal entities.
- Create an education and outreach strategy about the risks before, during, and after an extreme event. Identify and communicate about your hurricane

<sup>38</sup> See also <https://www.ready.gov/> and state references for more information and templates.



evacuation zone, nearby shelters and resources, and process for monitoring evacuation order.

- › Develop a plan for managing operations during an event to protect human safety and reduce damage. If deployable flood protection is part of the building's risk reduction strategy, identify when (prior to an event), they must be deployed, and plan to ensure all civilians are out of the building or provide alternative ingress/egress paths to avoid inhibiting escape.
- › Establish a pre- and post-emergency communication network consisting of on-site team and relevant local, state, and federal entities including local emergency management agencies, port authorities, NOAA, or US Coast Guard to gather real-time updates to hazards. Use local agencies, NOAA's StormReady, or TsunamiReady as a reference. Residents should be made aware of local community resources, as state or federal government resources may be strained during times of disaster.
- › Maintain a map of vulnerable assets and hazardous substances within the floodplain and a list of strategies for elevating or securing those assets prior to the storm. Familiarize managers with these strategies.
- › Provide the emergency preparedness plan online and to all key stakeholders.
- › Conduct annual training of employees, managers, and residents to present flood risk avoidance information and provide informational brochures or newsletters.
- › Provide a system for notifying residents and employees using local emergency management notifications (e.g. evacuation orders), or the National Weather Service.

Establishing an emergency preparedness plan, including plans for training staff, is an important way to reduce risk. *Photo: Kate Boicourt*





- › If levee, berm, or upstream dam is located on-site or poses a risk off-site, refer to local levee failure warning and response plan or state dam safety program and local warning and response plan;<sup>39</sup>
- › For industrial sites, ensure that critical infrastructure is protected (see **credit 1.1**).

**Scoring:**

*Landowner has developed or adapted emergency preparedness protocols using the recommended design strategies and provides evidence of plans for operations during coastal storms or other extreme weather-related events* **(2 points)**.

OR

*Landowner has worked with key stakeholders such as employees, management staff, residents, community groups, emergency planning agencies, and neighbors to complete an emergency preparedness plan. Plans to provide annual public information sessions before hurricane season to prepare on-site residents, workers, and managers. For projects in a community participating in the National Flood Insurance Program, work with local floodplain manager to provide stakeholders with up-to-date brochures, newsletters, and relevant information about the site's natural hazards and risks* **(4 points)**.<sup>40</sup>

**Materials needed to measure:** Maintenance plan and emergency preparedness plan and narrative describing training and outreach plans as well as means of reaching site-users.

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<sup>39</sup> See also Mileti, D. & Sorensen, J. (2015). *A Guide to Public Alerts and Warnings for Dam and Levee Emergencies*. United States Army Corps of Engineers Risk Management Center.

<sup>40</sup> Projects that meet **RELi HP Req 1, 2, 1.1**, and **credit 4** can qualify for this credit.



# Community Access & Connections



## CATEGORY 2

TOTAL POSSIBLE POINTS 52 PTS

**Credit**

- 2.1 Provide quality public access areas on the waterfront** PG41
- 2.2 Reduce industrial impacts to human health and wellbeing** PG45
- 2.3 Provide diverse programming and passive educational features** PG45
- 2.4 Increase transportation access to the waterfront** PG48
- 2.5 Create maritime-related employment opportunities** PG50
- 2.6 Increase waterfront pathway and greenway connectivity** PG51
- 2.7 Provide direct connections to the water for people and boats** PG53
- 2.8 Support diverse and sustainable maritime activity** PG55

**TOTAL POSSIBLE POINTS 52 PTS**



## Category 2: Community Access & Connections

Make waterfronts more accessible, inspiring, and welcoming to all by engaging diverse community stakeholders in the design of waterfront projects.

52 POSSIBLE PTS

### CREDIT 2.1

Provide quality public access areas on the waterfront

12 PTS

**Intent:** Create or improve high quality public access areas on the waterfront that maximize interaction with the water and are shaped by community priorities, to promote equitable, engaging, and healthy waterfronts.

**Description:** Waterfronts are desirable places to develop and provide public space, are critical to fostering environmental stewardship and community identity, and the only places where water-dependent activities like fishing and boating can take place.<sup>41</sup> However, the design of waterfront spaces often fails to maximize potential aesthetic, programmatic, and health benefits to the public. By designing based on robust community engagement, the complex balance between needs and uses of the site can be better served, resulting in a more successful waterfront design.

**Design strategies:** Design teams should use the community research and input resulting from initial assessments and outreach to develop or improve publicly-accessible spaces (see **credits 0.2** and **0.3**). Additionally, as public uses and natural resource goals can conflict, design teams should take particular care to identify and avoid sensitive natural areas, evaluate tradeoffs and potential disturbance when developing public access, and develop direct access where feasible (see **credits 1.2** and **4.1**). Projects must develop or improve public access, or provide monitored public access, for some industrial sites, focused at the water's edge to meet this credit. Additional design recommendations include:

#### *Design to increase accessibility*

- › Incorporate “passive” or landscaped features (e.g. lawns or picnic areas) and “active” recreational features (e.g. sports facilities) to accommodate diverse needs for people of all ages, physical capabilities, preferences, and interests.
- › Reduce physical barriers to accessing the site, such as fences or visual obstructions in view corridors, and provide wayfinding to direct people to the site.
- › Create or enhance public access in an area under-served by open space (2.5 acres or less per 1,000 residents).
- › Provide amenities like restrooms, rest areas, lockers, bike pumping stations, food vendors, and community gardens.
- › Include wayfinding features to draw visitors to the waterfront and throughout the site. Signs should include information on direction, walk time, amenities, and wheelchair accessibility.
- › Consider public priority phasing for public access components of the project before the full project is complete and create channels for user input over time.
- › Consider how affordability of amenities, concessions, and activities affects the ability for lower-income visitors to access and fully experience the site.
- › Create welcoming public spaces that accommodate diverse interests and needs, and comply with ADA Standards. Strategies can include:

<sup>41</sup> Stedman, R. (2003). Is it really just a social construction? The Contribution of the Physical Environment to Sense of Place. *Society & Natural Resources: An International Journal*, 16(8), 671-685. <https://doi.org/10.1080/08941920309189>.

- Incorporate a variety of seating options;
- Design spatial layouts and seating so that visual connections to the water are upheld when people are seated;<sup>42</sup>
- Consider how materials for objects such as seating and railings conduct temperatures and light, and avoid designs which may produce glare or overheat;<sup>43</sup>
- Design features which reduce undesirable wind conditions to make the waterfront edge more accessible year-round;
- Avoid creating spaces for programming designed for direct attention activities in areas exposed to direct sunlight;<sup>44</sup>
- Provide shade or sheltering structures to expand use in times of hot sun or light rain. When possible, include a covered area large enough to seat 40 people to accommodate local school groups under a variety of conditions.

Integrative native plantings, historical elements, and a mixture of shade and open space support positive experiences for public space users. *Photo: Ian Douglas*



*Design to improve health and wellbeing*

Public spaces should be engaging, aesthetically inspiring places that promote human health and wellbeing by designing for the human scale. These spaces should integrate natural elements from green and blue spaces. Implementation of such “biophilic” design features has been shown to reduce stress, improve concentration, promote mental clarity and creativity, and expedite healing.<sup>45</sup> In particular, research suggests that the presence of water has a greater impact on improving self-esteem

<sup>42</sup> Browning, W., Ryan, C., & Clancy, J. (2014). [14 patterns of biophilic design](#). New York: Terrapin Bright Green LLC.

<sup>43</sup> Ibid.

<sup>44</sup> Ibid.

<sup>45</sup> Ibid.



and mood than greenspace alone.<sup>46</sup> Elevating the presence of water through designs that promote seeing, hearing, touching, and interacting with water is particularly important.<sup>47</sup> Design strategies to improve health and wellbeing include:<sup>48</sup>

- › Employ strategies which convey complexity and order, mimicking patterns found in nature, conveyed through plant selection variety and placement, building facade design, variety in pathways, and furnishings;
- › Enhance connections to nature, biodiverse living systems, and natural processes. Examples include integrating natural/green infrastructure rainwater capture and treatment systems, as well as using materials that change form with exposure to heat, wind, rain, or shading to heighten awareness of design connections to natural systems;
- › Design structures at the human scale, so that building proportions and features are engaging for pedestrians at the ground level;
- › Integrate multi-sensory connections such as flowing water, fragrant herbs or flowers, sun patches, and warm or cool surfaces;
- › Strive to balance dynamic and diffused lighting conditions, particularly when designing transitions between indoor and outdoor spaces.

Vegetated walls promote sensory connections to nature within the built environment and promote ecological biodiversity. *Photo: Deryck Chan*



<sup>46</sup> Barton, J. & Pretty, J. (2010). What Is the Best Dose of Nature and Green Exercise for Improving Mental Health. *Environmental Science & Technology*, 44, 3947–3955.

<sup>47</sup> Völker, S. & Kistemann, T. (2011). The impact of blue space on human health and well-being—Salutogenetic health effects of inland surface waters: A review.

<sup>48</sup> Adapted from Active Design Guidelines and Browning et al. (2014).

**Scoring:** All project designs must align with community needs and priorities identified in **credits 0.2** and **0.3**. Further, enhancement of public access features should avoid sensitive, important natural habitats as described in **credits 1.2** and **4.4**.<sup>49</sup> Projects can achieve points depending on their intended use as either:

*Case A: Residential, commercial, mixed use, parks*

Site plan demonstrates that new waterfront public space comprises at least 30 percent of the total site area, or 90 percent of the site area for parks.<sup>50</sup> In urban areas with limited site width, in-cuts from the bulkhead line to accommodate habitat features or direct pedestrian access to the water can contribute to the total public access area, provided that American Association of State Highway and Transportation Officials (AASHTO) and local requirements are met. Narrative illustrates or expands upon the extent to which the design incorporates accessibility and health and wellbeing elements (as described above), and is reflective of the community assessment. Include quotes from participants, demographic or public health data, or references to specific planning initiatives, where applicable. If public access provision is not required by local regulations, projects providing public access according to the guidelines can receive full credit without conducting the full community assessment to inform design **(12 points)**.<sup>48</sup>

OR

*Case B: Industrial*

- Option 1: Site plan demonstrates that new waterfront public space comprises at least 10 percent of the total site area (total area of public and private space must be annotated). Narrative illustrates the extent to which the design incorporates or expands upon accessibility and health and wellbeing elements described above, and is reflective of the community assessment. Include quotes from participants, demographic or public health data, or references to specific planning initiatives, where applicable. If public access provision is not required by local regulations, projects providing public access according to the guidelines can receive full credit without conducting the full community assessment to inform design<sup>51</sup> **(12 points)**.
- Option 2: If there are no means of avoiding safety hazards to public access, narrative justifies this decision and site design either provides a safe public access point on site or within one half mile of the site (e.g. creating an overlook, or a pocket park by extending an adjacent shoreline street end) or regular, monitored public access (e.g. tours). For descriptions of monitored activities/ tours, a description of content as it relates to the site's integration of access, resilience, or sustainability features must be included. Sites must offer additional programming unrelated to activities in this credit to achieve both this and **credit 2.3. (6 points)**.

**Materials needed to measure:** Site plans indicating percent and total new, preserved, or enhanced public access area and private space. Provide a narrative describing how the community and historical context and connectivity, health, and wellbeing assessments influenced the designs.

<sup>49</sup> Projects achieving **LEED V4 BD+C SS Credit Open Space**, **Envision QL 1.1: Improve Community Quality of Life (Superior Level or greater)**, and **Enterprise Green Communities Criteria Checklist Credit 2.7: Preservation of and Access to Open Space** and for which space requirements for this credit are met receive full points for this credit, provided that community input shaped the design. **Credit 0.3. SITES v2 6.4: Support mental restoration** satisfies the requirements for health and wellbeing elements in this credit.

<sup>50</sup> Adapted from **LEED v4 BD+C SS: Open Space** credit requirement.

<sup>51</sup> Adapted from **LEED v4 BD+C: Open Space** credit requirement.

**CREDIT 2.2**

Reduce industrial impacts to human health and wellbeing

**4 PTS**

**Intent:** Minimize the adverse impacts of on-site industrial operations on the surrounding community.

**Description:** Industrial activities on waterfront sites are often accompanied by dust, airborne debris, pollution, and odor due to engine exhaust, fumes, on-site activities, and wind carrying fine material particles. Industrial infrastructure might also obstruct views and connections to the waterfront. Additionally, operations may produce noise levels that can negatively affect nearby sensitive sites like residences and public areas.

**Design strategies:**

- › Suppress dust and odor by relocating their sources away from sensitive sites, enclosing and properly ventilating these sources, switching from fuel to electric power sources, or providing vegetated buffers;
- › Dampen intrusive noises by relocating their sources away from sensitive sites, enclosing these sources, or providing sound buffers to reduce noise;
- › Provide wayfinding signage to safely guide visitors through public spaces;
- › Use landscaping such as berms, vegetated screens, or shade trees.

**Scoring:** Narrative and annotated site plans or construction documents demonstrate alignment with community needs and priorities as defined by the community assessment and engagement process described in **credits 0.2** and **0.3**. Annotated site plans, construction documents, or narrative identify visual impacts, wayfinding barriers, dust, odor, and noise sources, and plans to ameliorate those impacts beyond what is required by code (**4 points**).

**Materials needed to measure:** Annotated site plans, construction documents and narrative.

**CREDIT 2.3**

Provide diverse programming and passive educational features

**6 PTS**

**Intent:** Provide robust programming opportunities to enhance the historical, cultural, and environmental context, promote stewardship and build diverse community ownership.

**Description:** Improve the visitor experience by embedding historical, cultural, and environmental elements within public areas, and provide free or low cost programming expressing the historical, cultural, and environmental context.

**Design strategies:** Using information and priorities gathered through research and the public engagement process (see **credits 0.2** and **0.3**), work with partners to strengthen local historical, cultural, and environmental connections to the water through design and programming. Priority consideration should be given to historically disadvantaged groups.

- › Preserve and enhance existing historical and cultural resources by partnering with local groups to inform design and management.
- › Preserve waterfront docking infrastructure to maintain possibilities for maritime-dependent programming and provide possibilities for emergency use. Maintained bollards (attachment points for dock lines) can be incorporated into the design (see **credit 2.8** for further technical guidance).
- › Incorporate passive and self-guided features referencing the historical, environmental and cultural context of the site, such as a visitor center, kiosks, historic artifacts, lighting, informational panels, photographs, local artwork, spotting scopes and maps.

- › Solicit local artists to design aspects of public areas or to exhibit work on-site.
- › Provide programming that supports the cultural or maritime history of the site (e.g. historic ships), or opportunities for citizen science and environmental stewardship.
- › Provide facilities or host stewardship and educational organizations for free or at low cost. Storage and bathroom facilities are critical for supporting public programs.
- › Provide a community boathouse with space for creating an environmental or boating education. Boathouses should also be designed for accessibility and low environmental impact. This might include providing human-powered boat launch aids (e.g. floating launches, davit, craft dollies), drainage and moisture controls, leasable storage for personal craft, watercraft retail and maintenance facilities, restrooms with showers, drinking water, power and internet, and rescue and first aid facilities.
- › Include temporary vehicle access and parking for program providers to enable deliveries and event staging.

Incorporation of environmental programs can enrich public spaces.  
*Photo: Kate Boicourt*





Artist Stacy Levy's *Water Map* demonstrates passive educational features; when it rains, the map carries water through the carved tributaries, mimicking the Delaware River watershed. *Photo: Stacy Levy*



The WEDG Certified Sunset Park Materials Recovery Facility in Brooklyn, New York provides public access to observe industrial activities. *Photo: Anahita Rouzbeh*



**Scoring:** Annotated construction documents and narrative must demonstrate how options for designs and/or programming align with community priorities, as defined in **credit 0.3**. Options for scoring include one or more of the following:

- Agreement or plan is in place to provide regular environmental, historical, or cultural programming during active seasons on site. Documentation should name specific program partners, describe how the site features will be used, how partners were solicited during the community engagement process, and explain the need for charging use fees to program providers, if any. Plans for monitoring and evaluating these programs over time are not required but highly encouraged (see **credit 0.4**) **(3 points)**.
- At least three different types of passive educational features relating to the environment, historical, or cultural site context are implemented **(1 point)**.<sup>52</sup>
- Development entity or landowner subsidizes at least two percent of the operating budget towards public programming at the site, or provides low-impact facilities to house educational programming partners (such as a community boat house) at no cost **(2 points)**.

**Materials needed to measure:** Partnership agreement, narratives, maintenance plan, documentation and/or annotated construction documents.

**CREDIT 2.4**  
 Increase transportation access to the waterfront  
**5 PTS**

**Intent:** Improve public access to the site by expanding and encouraging sustainable transportation options, especially waterborne transportation.

**Description:** Increased transportation options provide multiple benefits for community access. Beyond siting a project within a walkable distance of land-based public transportation (one half mile or less), projects can help increase access by supplementing available modes. For waterfront sites, ferries are a fast, comfortable, efficient, and low-impact means of transportation. Ferries can also be a catalyst for waterfront redevelopment and help reduce congestion in other modes of transport.<sup>53</sup>

**Design strategies:** Improve transit access by supplementing land-based options or providing waterborne modes, by building or renovating a ferry terminal or landing if the site context is appropriate (**credit 0.2**). If project is sited further than one half mile from public transportation, consider obtaining a shuttle service or agreement with transit authorities to extend service to the site.

*Land-based transportation*

- Incorporate available modes of public transport such as bus, rail, subway, or streetcars by working with local transportation authorities to ensure stations provide adequate shade, shelter, and safety for all users.
- Work with local transportation authorities to ensure adequate wayfinding signs are in place to direct people from transportation nodes to the site.
- If the site is not well-served by public transportation, provide shuttle service or work agreement with transit authorities to extend service to the site. Service agreements should show route service available at least during morning and evening peak hours and available to the surrounding community.

*Waterborne transportation*

- Optimize docking orientation and platform layout for maximum volume of marine traffic, and minimize impact on any nearby boating or public access.

<sup>52</sup> Successfully achieving **SITES v2 Credit 9.1: Promote sustainability awareness and education** satisfies programming and partnership requirements. **Envision V3 QL 3.2: Preserve historic and cultural resources (Superior Level)** satisfies cultural/historical requirements.

<sup>53</sup> New York City Economic Development Corporation. (2013). **Comprehensive Citywide Ferry Study**.



- › Provide wave attenuation to expedite docking in areas where this is a challenge.
- › Design gangways to accommodate quick loading and unloading.
- › Use non-slip surfaces and materials on all walkways.
- › Design the gangway connection to lift off its support during high water events.
- › Provide shelter from the elements for passengers.
- › Provide security and manage access.
- › Provide pedestrian and bicycle wayfinding to and from upland connections.
- › Provide bike access and parking or short-term bike rental.
- › Design, orient, and place docks, passenger loading, and accompanying plantings and buildings to create sound barriers to vessel noise.
- › If providing ferry service, use low emission boats (US Environmental Protection Agency Tier 3 or Tier 4) and those that produce less noise.

Adequate public transportation helps support and expand the possibilities and benefits of waterfront projects and supports the communities that surround them. *Photo: Ian Douglas*



**Scoring:** Narrative and/or documentation demonstrate how recommended strategies for accessibility (including wayfinding/upland connections) have been implemented in the provision of an on-site ferry dock. Designs avoid sensitive, natural habitats as described in **credits 1.2 and 4.4**. A plan for ongoing maintenance and costs over time is provided. If a ferry dock already exists on site, provide documentation to demonstrate that it meets the requirements in this credit. **(2 points)**

AND

Project is sited within walking distance (one half mile) of public transit. **(1 point)**

AND

Development entity has provided funds for a water or land-based transportation service or agreement to extend public transit. **(2 points)**

**Materials needed to measure:** Construction documents indicating new or renovated ferry and public transit infrastructure, transit service agreements, operating funding documentation, maintenance plan.

**CREDIT 2.5**

Create maritime-related employment opportunities

**8 PTS**

**Intent:** Provide employment opportunities and vocational training in maritime fields to support the local economy and water-related industries.

**Description:** Compared to other sectors, jobs in the industrial maritime sector can often have fewer barriers to entry; in the New York region, 79 percent of jobs are available to those without a bachelor’s degree. Employment in this sector can be of comparably high quality as well, with median wages in the water transportation sector at higher than the national average.<sup>54</sup> Hands-on skills training and working class maritime industrial job opportunities help to build social and economic resilience.

**Design strategies:** Supporting maritime jobs as well as education and skills development can be important aspects of a vibrant waterfront community. Job and applicant quality can be strengthened through partnerships with local workforce development organizations, high schools, technical or vocational schools, colleges, and other educational providers. Additionally, partnerships with local work placement programs can help employers reduce costs, seek quality candidates, and preferentially direct outreach and job provision to local residents, low-income applicants, and historically under-served communities (see **credit 0.3**).

**Scoring:** Documentation and narrative show one or more of the following:

- At least 75 percent of jobs provided on site are quality full-time positions associated with a maritime industrial field. Positions must provide multiple employee benefits, including health insurance, transportation benefits, and workers compensation, and pay above minimum wage **(4 points)**.
- Provision of or partnership with a local workforce development corporation to support on-site vocational training in industrial maritime careers **(2 points)**.
- If within a community with low-income or historically under-served residents, at least 25 percent of new positions are filled by these residents **(2 points)**.

**Materials needed to measure:** Narrative and documentation of job, partnership, and demographic employment requirements. For local hiring, if located within a low-income area, describe efforts to hire locally and estimate percent local hires based on employee zip code or other means.

Vocational training, workforce development, and efforts to hire locally for maritime-related industries helps to preserve a mixture of job opportunities and water-dependent uses where appropriately sited.  
Photo: Ian Barbour



<sup>54</sup> The City of New York. (2017). New York Works. Office of the Mayor.

**CREDIT 2.6**

Increase waterfront pathway and greenway connectivity

**5 PTS**

**Intent:** Increase connectivity of green and blue spaces along the waterfront to promote physical activity, health and wellbeing, and encourage non-motorized transportation options.

**Description:** Create well-connected pathways and greenways throughout the site that are safe, comfortable, and inviting to both bicyclists and pedestrians. Walking and biking help encourage exercise, reduce emissions, and are highly efficient for short trips of less than two miles.<sup>55</sup> Well-designed pathways and greenways can expand the use and richness of experience in waterfront spaces.

**Design strategies:** All designs must be consistent with ADA accessibility and AASHTO standards.

*Pedestrian pathways*<sup>56</sup>

- › Increase the width of a public access area on the water's edge to facilitate diverse uses and programming. Width can be accomplished through natural or landscaped areas, as well as paved or constructed areas, provided that AASHTO, ADA, and other local requirements are met.
- › Avoid monotony of long linear paths with uniform width and create engaging pathways through tiering, using varying surfaces, and landscaping;
- › Design pathways for the human-scale by creating shorter blocks, cut-throughs on long blocks, or reduced parking area.
- › Provide streetscaping such as well-marked crosswalks, curb extensions, and pavers to slow traffic and protect pedestrians.
- › Ensure pathways are well lit to keep areas safe and assist wayfinding.
- › Create suitable play spaces for children. As much as possible, preserve and incorporate natural features and landscaping (e.g. trees, stumps, hills). Make play areas visible from pathways or streets through siting, colorful markings, art, or materials to encourage use.
- › Connect with regional water trails and upland destinations that draw people to and from the waterfront using wayfinding.

*Biking and pedestrian greenways*<sup>57</sup>

- › Provide amenities for cyclists and pedestrians such as restrooms, bike racks, tire pumping stations, water fountains, benches and indoor or outdoor storage, retail and rental opportunities, and bike-shares.
- › Provide maps and signs for pedestrians with mileage, walking and biking time, and destinations.
- › Minimize or improve existing unsafe intersections.
- › Mimic aesthetic of adjacent greenway or develop an appropriate transition
- › Convey transitions between public and private space through grading and materials.

*Elevated paths and boardwalks*

- › Accessibility:
  - Install railings on sections that are 18 inches or more above ground.
  - Avoid long stretches of straight boardwalk.
  - Elevate sections of boardwalk and platforms to provide views over high or dense vegetation.

<sup>55</sup> Adapted from Urban Land Institute. (2015). [Building Healthy Places Toolkit: Strategies for Enhancing Health in the Built Environment](#). Washington, DC: Urban Land Institute.

<sup>56</sup> Ibid.

<sup>57</sup> Ibid.

Providing connected paths from the upland to the waterfront can help to promote safe waterfront access. *Photo: Mary Kimball/New York City Department of City Planning*



- › Stabilization and adaptability:

  - Elevate above future mean higher high water using the relevant sea level rise adjustment in **credit 1.1**.
  - Design to withstand uplift from flooding and lateral forces from wave action and ice if applicable and allow for adaptability in design. For example, floatable boardwalk sections can adjust to surge and wide tidal range, though should be positioned away from sensitive habitat.
  - Use materials resistant to rot, corrosion, or fracturing.
  - Avoid or limit construction and founding structures in unconsolidated soils or in areas of high erodibility and vulnerability to storm surge.
  - Piles should be built to withstand floating debris collision, storm surge, ice, and regular wave action and prevailing current forces.
- › Minimize impacts:

  - Limit structures over water and wetlands or other vulnerable habitats.
  - Restrict access to sensitive habitat and ecosystems with placement of railings on adjacent sections of boardwalk.
  - Avoid removing large trees or fragmenting habitat.
  - Increase light transmission through decks to reduce shading of habitat.
  - Minimize use of potentially-polluting materials such as plastics, containing potentially leachable chemicals.

**Scoring:** For all site types, greenway design features are ADA compliant and aligned with community priorities as defined in **credit 0.3**. Additionally, annotated site plan and narrative show that a continuous waterfront pathway has been created or renovated throughout the site and along the waterfront (unless siting conflicts with sensitive habitats determined in **credit 0.2** and **1.2**). Narrative describes how the recommended strategies above have been implemented into final design, including measures taken to increase accessibility, visual interest, and safety for the expected number of users. Operations and maintenance plan must be provided for any in-water features (**credit 0.4**) to receive credit (**4 points**).<sup>58</sup>

AND

<sup>58</sup> LEED v4 BD+C Innovation: Walkable project site satisfies pedestrian pathways and greenways requirements.



Narrative shows greenway contributes to regional greenway plans and priorities (cite specific plan and priorities to receive credit) **(1 point)**.

**Materials needed to measure:** Annotated site plans and/or narrative identifying required features, maintenance plan.

**CREDIT 2.7**

Provide direct connections to the water for people and boats

**5 PTS**

**Intent:** Enable people to safely and directly access and interact with the water to enhance human wellbeing and promote stewardship of the waterways.

**Description:** Public beaches, waterside get-downs, human-powered boat launches, and public fishing and recreational amenities encourage direct contact with the water. The ability to touch and enter the water provides psychological benefits and helps to foster a sense of pride and stewardship of natural resources, and expands the diversity of recreational and educational opportunities at a waterfront space.<sup>59</sup> Waterfront development should prioritize these water dependent uses, as they are not available for inland development sites.

Brooklyn Bridge Park, a WEDG Certified project in New York City provides a beach allowing visitors to directly interact with the water. *Photo: Mary Kimball/NYCDCP*



**Design strategies:** For all of the below strategies, use **credits 0.2, 0.3** and **0.4** to inform design and maintenance strategies that ensure the safety and longevity of these features. Site according to considerations of current, available draft, and sub-surface features. Consider strategies to accommodate users with mobility challenges, children, and elderly groups. Include limited nearby vehicle access lanes and temporary parking for program providers to enable deliveries and event staging. For all sites, avoid creating direct access features in ecologically-sensitive areas (see **credit 1.2**) and avoid sewer or stormwater outfalls. In the presence of combined sewer outfalls, heavy boat traffic, or other human health concerns, work with local programming partners to adjust designs and develop public education aimed at increasing public safety. The appropriate means of developing direct access will depend on the site context, but in general, natural and gradually sloping shorelines are the best for human use and for natural habitats. Choose from or incorporate multiple means of direct connection:

<sup>59</sup> Beatley, Tim. (2014). *Blue Urbanism: Exploring Connections between Cities and Oceans*.

*Beaches and get-downs*

These features allow users to directly access and get into the water. Beaches are the natural shoreline area that extend landward from the low water line to where there is a marked change in the landform and vegetation. Get-downs are structures provide direct access to the water's edge. Designs should incorporate the following strategies:

- › Locate in areas of reduced stream velocity and wave action.
- › Avoid flotsam accumulation areas.
- › Slopes (a ratio of the shoreline's width to height) should be ideally less than one foot high to two feet wide.<sup>60</sup>
- › Design for water access at all tidal ranges.
- › Prevent slippery conditions on built surfaces (install handrails, fouling-resistant material, and textured surfaces).
- › Provide safe access by incorporating padded surfaces, rounded edges and corners, and avoiding steep drops.
- › Ensure accessibility for wheelchair users: provide ADA compliant ramps leading from streets, to boardwalks, or directly onto the beach. Provide beach mats leading from ramps to allow wheelchair access on sand.

Facilities for fishing enable broader educational and recreational programs.  
Photo: Margaret Flanagan

*Natural shoreline launches (for human powered boats)*

- › Avoid using hardscapes, as they can damage boats and become slip hazards.
- › Locate in areas that support safe entry and egress for a variety of users.
- › Design for low- and high-tide use.
- › Provide angle launch to protect users from strong currents or wave action.
- › Direct stormwater away from launch.
- › Minimize the distance between launch and storage and parking.
- › Where applicable, modify existing structures to increase accessibility.
- › Provide storage and washing facilities with sanitizing products.
- › Accommodate watercraft up to 20 feet long.

<sup>60</sup> A get-down that still enables people to touch the water in more urban sites, where predominant slopes are greater than 1:2 and there is minimal width available, can still qualify.



*Public fishing*

- > Provide designated fishing areas with kiosks for fish permit and regulatory information, including advisory about consumption, where appropriate.
- > Provide washing, scaling, and cutting tables.
- > Provide rod holders and fishing line recycling receptacles.

**Scoring:** Annotated construction documents and narrative demonstrate how the recommended strategies have been adequately incorporated in at least one existing, newly created or restored beach, get-down, or human powered shoreline boat launch. The narrative must also address how designs align with community priorities as defined in **credit 0.3**. The results of initial assessments (**credit 0.2**) should also be used to ensure designs are adapted to the site’s hydrodynamic conditions and provide safe access. Plans for maintenance of any features should be included in the operations and maintenance plan (**credit 0.4**) **(4 points)**.

AND

At least two of any combination of the following features is implemented: a beach, get-down, a shoreline boat launch, or public fishing area and amenities **(1 point)**.

**Materials needed to measure:** Annotated construction documents, maintenance plan, and narrative.

**CREDIT 2.8**  
Support diverse and sustainable maritime activity  
**7 PTS**

**Intent:** Promote low-impact, safe design that accommodates a diverse range of vessels and facilitates educational programming.

**Description:** Build or preserve a pier, mooring field, floating dock, or Clean Marina that can accommodate a variety of vessels, such as tall ships and historic and educational boats, to encourage public maritime activities and recreation.

**Design strategies:** Use **credits 0.2, 0.3, and 0.4** to inform design and maintenance strategies which ensure the safety and longevity of these features. Planning these features should begin with an analysis of in-water conditions; they should be sited primarily according to considerations of current, available draft, sub-surface features in the water. These features may be ultimately unusable if sited only according to land-focused considerations such as view or commercial value. For all sites, avoid ecologically-sensitive areas (see **credit 1.2**).

*Floating docks*

These are floating structures on the water which are typically attached to piers, and provide direct access to the water. Typical users are human powered boats, public boating programs. Designs should incorporate the following strategies:

- > Accessibility:
  - Depending on the use, design with the following dimensions in mind:
    - Water trail (for individual small boats): 8 feet wide by 10 feet long to accommodate two boats side-by-side with room to stand and maneuver around them, freeboard of 4-8 inches, cleats at the inland corners only, prioritize open edges for sliding boats in and out of the water.
    - Communal launches (for public boating programs): 10 feet wide by 24 feet long to allow multiple boats to load, launch, and disembark simultaneously and safely from both sides, freeboard of 4-8 inches, cleats at the inland corners only, prioritize open edges for sliding

Provision of resources to support a diversity of boats can provide economic and educational opportunities. *Photo: Jose Soegaard*



boats in and out of the water.

- Large craft (for outrigger canoes, rowboats): 10 feet wide by 20 feet long, freeboard of 4-12 inches, cleats at the corners for securing boats, but not in the middle. Site launch to ensure access from the land and to navigable waters at both low and high tides.
- Site launch to ensure access from the land and to navigable waters at both low and high tides.
- Use breakwaters, wave attenuators, or dock orientation to protect boaters from current and wave action while entering and existing the boats.
- Boat launches designed for public programs should have sufficient setbacks on the adjacent shoreline to allow for staging of participants and maneuvering room for boats to and from storage.
- Boat launches designed as water trail links should have an adjacent upland area for temporary kayak storage.
- Design gangways or approach ramps without turns, or factor in a wide turning radius to accommodate carrying boats back and forth.
- Design docks with a flat surface and traction that can withstand heat and salt exposure, and with vertical sides.
- Limit the use of handrails, and do not install railings on docks to prevent slippage.
- Dock fendering should reach all the way to the water line, to allow access for boats of varying freeboard, or height off the water.
- Provide washing facilities or sanitizing products.
- > Sustainability and adaptability<sup>61</sup>
  - Site launches in areas protected from large wake, waves, and fast currents.
  - Design to accommodate future flood height (see **credit 1.1**) preferably by using rub plates or openable pile guides or by facilitating dock removal during events like flooding, high flow events, ice formation, high wave action, storm surges.
  - Design deck connections to lift off supports during high water events.
  - Use transitional plates (or “toe plates”) for gangways steeper than five

<sup>61</sup> See **Category 4: Natural Resources** for further considerations.

- percent, considering the slope during low and high tides.
- Reduce the use of hardscapes at launch and minimize construction.
- Space pilings so that they do not impede water flow and are tall enough to maintain float anchorage during high water.
- Avoid open-cell expanded polystyrene floats.
- Allow light transmission through the structure.
- Compensate for altered hydrodynamics and sediment discharge.

### *Piers*

These are pile-supported structures at the water's edge which allow for recreational and maritime uses. Designs should incorporate the following strategies:

- > Accessibility:
  - Place recreational areas away from industrial or restricted areas
  - Ensure enough draft and maneuvering room for multiple types of vessels.
  - Provide utility service out on piers, such as water, power, and sewage pump out.
  - Provide adequate pier bracing to resist racking by docked vessels.
  - Provide for maximum deck loads on the pier top to allow services by truck on the pier, such as trash removal, sewage service, or overnight commercial lift.
  - Extend vessel gangways 5-20 feet across the pier top. Plan pedestrian walkways and emergency lanes that accommodate gangway extension across the pier top.
  - Provide frequently spaced bollards and cleats (posts and attachments for securing vessels) for a variety of vessel sizes, and do not obstruct them with railings.
  - Provide fendering (buffers on piers to reduce friction from boats) to the low water line, to allow access for boats of varying freeboard (see **credit 3.3**). Install railings only where they do not obstruct boat operations, and install frequent gates in railings to maximize the variety of possible maritime uses.
  - Provide comfort amenities for the public where feasible, such as shade structures and fishing sinks (see **credit 2.7**), as long as they are set back from pier edges to avoid collision with vessels due to roll caused by wakes and waves.
- > Sustainability and adaptability:<sup>62</sup>
  - Design structures to reduce risk to damage due to wave forces, vertical wave uplift forces, and wave peaking damage (use the assessment from **credit 0.2**), accounting for sea level rise based on design life.
  - Provide wake-reduction measures to protect berthed boats.
  - Design battered piles to stay within the pier envelope in order to allow floating docks and boats to anchor directly against piers.
  - Reduce the impacts of shading on habitat fragmentation by designing to allow light transmission through pier or elevate piers or pier edge.
  - Orient north-south to minimize shadows if in-water conditions allow.

### *Clean Marinas*

The Clean Marinas program provides guidance and best practices for environmentally sustainable marina operations and management. Many states also offer a Clean Marina Certification program.

- > Use the National Parks Service (NPS) Clean Marina Initiative's best practices for marina design and maintenance, stormwater management, vessel

maintenance and repair, petroleum control, sewage handling, waste and chemical containment and disposal, and enforcement and compliance.<sup>63</sup> The ASCE Planning and Designing for Small Craft Harbors also provides strategies for designing and maintaining in-water and land-based support facilities.<sup>64</sup>

- Reserve slips and dock space (10 percent suggested) for use by public programming such as school sailing teams, Sea Scouts groups, or community rowing classes for a discounted or waived fee.

The WEDG Certified Starlight Park in the Bronx, New York provides a floating dock on either side of a weir, allowing boaters to navigate over or around the barrier at high and low tide. Photo: Jim Henderson



### Mooring fields

A mooring field is an area with long term anchors installed so that a boat can simply pick up a mooring instead of using an anchor. Designs should incorporate the following strategies:

- Place mooring field in weather and current protected areas.
- Provide moorings for a variety of boat sizes, and optimize arrangement to accommodate varying ship drafts, placing boats of similar size together to decrease the total footprint. Use low-impact mooring systems.<sup>65</sup>
- Provide floating docks for dinghies or small craft servicing moored boats. Minimize the distance from these service docks to the mooring field.
- Provide for cleaning and maintenance of mooring buoys throughout the boating season, so they remain highly visible to other boaters.

**Scoring:** Annotated construction documents and narratives demonstrate how the recommended strategies above have been incorporated in an existing, newly created or restored mooring field, floating dock, or pier, and how each of these features

<sup>63</sup> National Park Service. (2012). [Clean Marina Guidebook](#). Denver: NPS Commercial Services.

<sup>64</sup> Task Committee on Marinas 2020 of the Ports and Harbors Committee of the Coasts, Oceans, Ports, and Rivers Institute of the American Society of Civil Engineers. (2012). [Planning and Design Guidelines for Small Craft Harbors](#). Baltimore: American Society of Civil Engineers.

<sup>65</sup> Low-impact, rather than conventional mooring systems, can have a significant difference in impact on the environment, particularly in areas with submerged aquatic vegetation. See Urban Harbors Institute, University of Massachusetts Boston. (2013) [Conservation Mooring Study](#). Urban Harbors Institute Publications, 41.

accommodates one or more of the following water-dependent uses for:

- › Recreational uses, including public kayaking and human-powered boating **(2 points)**

AND

- › Historical or cultural uses, including mooring for historic vessels **(2 points)**

AND

- › Industrial or commercial uses, tug boats, fuel lighters, and large shipping vessels (does not include ferries) **(3 points)**

The results of initial assessments (credit 0.2) should also be used to ensure designs are adapted to the site's hydrodynamic conditions and provide safe access. Plans for maintenance of any features should be included in the operations and maintenance plan **(credit 0.4)**.

**Materials needed to measure:** Annotated construction documents, maintenance plan, narrative.





# Edge Resilience



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## CATEGORY 3

TOTAL POSSIBLE POINTS 18 PTS

**Credit**

- 3.1 Choose an appropriate edge strategy for the context and intended use** PG63
- 3.2 Maintain or emulate natural shoreline shape** PG65
- 3.3 Protect the working edge** PG66
- 3.4 Ecologically enhance structural components** PG67

TOTAL POSSIBLE POINTS 18 PTS



## Category 3: Edge Resilience

Design a resilient waterfront edge with a strategy that is appropriate to the site conditions and sensitive to local ecology

18 POSSIBLE PTS

### CREDIT 3.1

Choose an appropriate edge strategy for the context and intended use

8 PTS

**Intent:** Ensure the structural integrity and sustainability of the shoreline and near-shore area using a strategy that has the greatest possible positive impact on the environment and community, given the intended use and context.

**Description:** This credit aims to promote shoreline edge strategies that balance the needs of the intended use with the physical, ecological, and community context of the site, and provide structural integrity and stability of the edge over time, preventing loss of land and function. Shorelines may not require stabilization. Methods that employ hardened shoreline structures, such as bulkheads and seawalls, can have a significant negative impact on ecology, including loss of shallow-water and wetland habitat as well as an overall decline in habitat in the immediate area, and should be minimized wherever possible, except in cases where site conditions prevent their use such as contamination, working waterfront and heavy industrial uses).<sup>66</sup> Use of hardened shorelines should be minimized wherever possible, except in cases where they may be necessary due to site conditions or the use (contamination, working waterfront and heavy industrial sites). Natural and nature-based features (“soft,” “living,” or “ecologically-enhanced” shoreline strategies) can provide comparable stabilization benefits along with enhanced resilience, ecology, and public access.<sup>67</sup>

**Design strategies:** Use Appendix B to determine 1) if edge stabilization is needed and; 2) if so, what an appropriate edge strategy may be for the use and context. If stabilization is not needed and the natural condition will be maintained, develop a plan for maintenance over time, including any buffers to allow for habitat migration with sea level rise, and establish a fixed reference point from which to monitor erosion over time. If stabilization is needed, use the relevant assessments from Appendix A and Appendix B, or other peer-reviewed shoreline stabilization guidance reference that includes “soft” as well as conventional shoreline stabilization methods, to identify the range of possible shoreline strategies. Identify the lowest-impact (“softer”) of those options from an environmental perspective and first consider whether the softer method is feasible and appropriate based on the site context and project goals. The United States Army Corps of Engineers, as well as multiple states, have developed preferred and streamlined permitting processes for living shorelines stabilization methods.<sup>68</sup> If a hardened stabilization strategy is deemed necessary, provide a

<sup>66</sup> Douglass, S.L. & Pickel, B.H. (1999). The Tide Doesn't Go Out Anymore- The Effect of Bulkheads on Urban Bay Shorelines. *Shore and Beach* 67(2-3), 19-25; Coastal Green Infrastructure and Ecosystem Services Task Force. (2015). [Ecosystem-Service Assessment: Research Needs for Coastal Green Infrastructure](#); Patrick, C., Weller, D.E., Li, X. & Ryder, M. (2014). Effects of shoreline alteration and other stressors on submerged aquatic vegetation in subestuaries of Chesapeake Bay and the Mid-Atlantic Coastal Bays. *Estuaries and Coasts* 37, 1516-1531; Seitz, R.D. & Lawless, A. S. (2006). Landscape-level impacts of shoreline development on Chesapeake Bay benthos and their predators. In S. Erdle (Ed.), *Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay. Proceedings of the 2006 Living Shoreline Summit*. CRC Publ. No. 08-164.

<sup>67</sup> National Oceanic and Atmospheric Administration. (2015). [Guidance for Considering the Use of Living Shorelines](#); Knutson, P., Seeling, W. & Inskeep, M. (1982). [Wave Dampening in Spartina Alterniflora Marshes](#). *Wetlands*, 2, 87-104.

<sup>68</sup> United States Army Corps of Engineers Nationwide Permit 54; [New Jersey General Permit 17](#); [Maryland Living Shoreline Waiver](#).

rationale for why. For any stabilization strategy selected:

- Develop design and maintenance and adaptive management plans that address structural integrity, environmental management, and adaptability to sea level rise and other climate change effects over time.
- Consider shifts to structural stability (e.g. shear strength of soils) and shape due to increased inundation frequency over time.
- For soft shoreline strategies such as beaches or marshes, sufficient width and slope are critical for success. Consider width and slope available in light of land elevation and tidal range as well as future high tide level. In most states, there are strict regulations prohibiting the placement of fill below mean high water or tidelands lines due to potential impacts to habitat, indicating a preference for grading in the upland to accommodate appropriate slopes rather than placement of fill material in the water when width is limited.
- For vegetated shorelines, consider sun exposure, soil type, and water quality when evaluating alternatives. Shellfish reefs may need higher water quality conditions to thrive, and vegetated edges require moderate to high levels of sunlight daily.
- Consider storm surge height and any potential impacts on stabilization alternatives

For industrial and maritime sites, also consider the following aspects to create resilient and efficient working edges:

- > Design height must be appropriate for easy loading and unloading facilities in all tidal ranges without overtopping during storm events.
- > Reduce potential for scour behind and below (for edges with toe protection) bulkheads and seawalls, due to overtopping of uncapped structures, dredging, erosion, and navigational traffic).
- > Select materials resistant to marine borer activity and corrosion but that allow settlement of native marine organisms.
- > Design for functionality at multiple water levels. For example, use floating docks that can accommodate a wide range of elevations, integrating a stepped edge or tiered platform that uses a low edge for maritime functionality.

**Scoring:** If stabilization is pursued but deemed unnecessary for supporting the use and prevention of erosion by the reviewer, no points are awarded for this credit, unless stabilization is employed for habitat restoration purposes. Plans for maintenance over time are included, including plans to monitor erosion over time must be included in **credit 0.4**. One of the following approaches is taken:

- > Stabilization is needed and constructed on at least 25 percent of the shoreline length or no less than 50 feet, and the method is consistent with the context (as verified by *Appendix B*) and project goals. Alternatively, an assessment of the existing shoreline has been conducted and the stabilization method is in good condition and maintained in place **(4 points)**.

OR

- > Stabilization is needed and constructed, or the existing natural shoreline is maintained or restored on at least 25 percent of the shoreline length or no less than 50 feet using natural or nature-based features **(6 points)**.

OR

- > Stabilization is needed and constructed or the existing natural shoreline is maintained or restored on at least 50 percent of the shoreline length using natural or nature-based features **(8 points)**.



**Materials needed to measure:** Initial assessment from **credit 0.2**, narrative describing analysis as related to *Appendix B*, maintenance plan, construction documents.

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### CREDIT 3.2

Maintain or emulate natural shoreline shape

2 PTS

**Intent:** Support native biodiversity and reduce the impacts of channelization by maintaining or mimicking local, natural shoreline shape, slope, material, and heterogeneity to the extent possible.

**Description:** Maintaining or mimicking natural shoreline conditions can increase or result in reduced impacts to intertidal habitat, support biodiversity and natural shoreline processes, and potentially reduce stream and river velocity and wave energy. For softer edges, reduced slopes can help support better habitat, and inland migration of habitat as sea level rises. Further, mimicking or using prevailing sediment deposition patterns (e.g. shoaling) can help to reduce intertidal disturbance and management costs over time by minimizing needs for sediment dredging or replenishment in the future.

For industrial areas with a working edge, where harder edges are employed due to use and context constraints, there are still opportunities to mimic the natural shape and heterogeneity of the surrounding context.

On rocky shorelines, the natural slope condition (preferred) may be steeper. Changes to the shoreline configuration should be analyzed by the project team for hydrodynamic and ecological impacts.

**Design strategies:** Identify local natural reference conditions for the site and implement designs that mimic the natural slope and intertidal zone of that reference condition. Changes to the shoreline configuration should be analyzed by the project team for hydrologic impacts regarding flooding, wave regime, and current velocity.

- › If the shoreline is predominantly unmodified and will not be modified, or is undergoing planting or stabilization for the purposes of ecological restoration, maintain the natural shape, slope, and sinuosity (complex curvature, rather than straight) of the existing shoreline.
- › If the shoreline is currently hardened but a transition to a softer edge is planned, use the reference condition and predominant sedimentation patterns to inform the target shape, slope, and sinuosity.
- › If the shoreline is currently hardened, and is being replaced or retrofitted, but softer edges are not an option due to intended use or site constraints, increase the sinuosity of a conventional shoreline stabilization method, or reduce the slope of the hardening method.

**Scoring:** Plans indicate that at least 20 percent, but not less than 50 feet, of the shoreline is either:

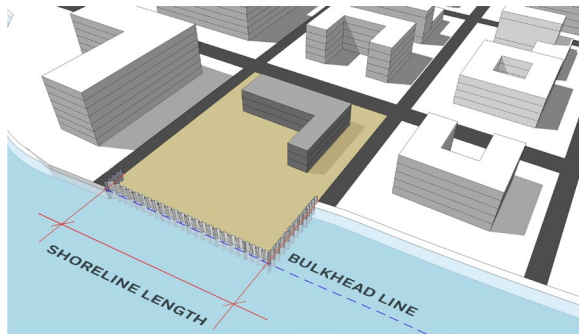
- › Sinuosity of a conventional shoreline stabilization method is increased or slope is reduced in a way that is consistent with the natural reference condition. Project team must have satisfactorily demonstrated need to stabilize the edge in credit 3.1 to score for this credit **(1 point)**.

OR

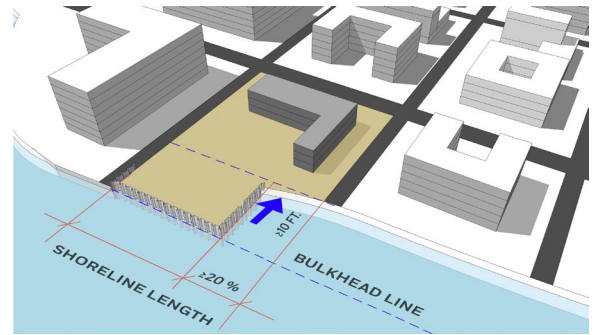
- › Natural shoreline slope is maintained or restored, consistent with appropriate local reference condition **(2 points)**.

**Materials needed to measure:** Grading plan, site assessment.

While natural and vegetated shoreline edges are best for the environment, these strategies may not always be feasible. In those cases, emulating natural shoreline shapes through fill removal or increased sinuosity can still provide some habitat benefit.



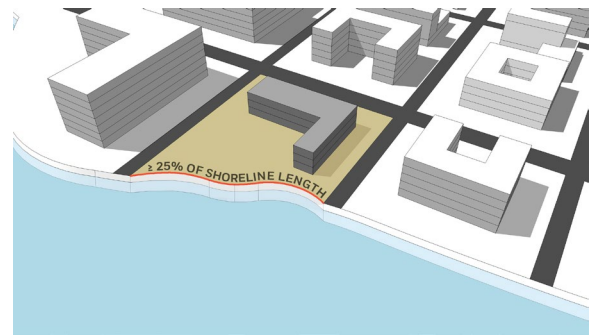
BEFORE



AFTER



BEFORE



AFTER

**CREDIT 3.3**  
Protect the working edge  
**6 PTS**

**Intent:** Protect edge from structural damage over time due to active use.

**Description:** Working docks require adequate fendering to protect them from wear and tear over time, and particularly during storm events.

**Design strategies:** Use the World Association for Waterborne Transport Infrastructure *Guidelines for the Design of Fender Systems* (2002) for appropriate fendering strategies into the final design, and consider bolstered mooring and fendering strategies to keep vessels attached with little damage during storm events and inclement weather. Do not use tires on mooring facilities, even as fenders.<sup>69</sup> In general, the design of a fender system includes determining the operational requirements, assessing the hydrodynamic conditions (see **credit 0.2**), calculating the energy to be absorbed by the fender (during berthing or when moored), analyzing these factors to determine the fender material and system type, and repeatedly testing the reaction force and related friction force incurred to the vessel and marine infrastructure.<sup>70</sup>

**Scoring:** Construction documents and narrative indicate use of fenders or other sufficient protection strategy for general use and storm conditions (**6 points**).

**Materials needed to measure:** Construction documents.

<sup>69</sup> MarCom Working Group 33. (2002). *Guidelines for the design of fender systems*. World Association for Waterborne Transport Infrastructure.

<sup>70</sup> Ibid.

**CREDIT 3.4**

Ecologically enhance structural components

**2 PTS**

**Intent:** Lower the impact and improve the biodiversity of man-made edges through mimicking the structural heterogeneity and materials of the natural, local shoreline.

**Description:** If man-made stabilization is needed to support the intended use and context, as determined in **credit 3.1**, above, incorporating complexity and living material into the structures improves the habitat value and reduces the impact of their construction. This credit focuses on “greening” the components of the edge stabilization strategy itself. Credit can only be awarded if justification for man-made stabilization is evident and based on the analysis of conditions and intended use described in **credit 3.1**. Edge stabilization for which the primary goal is habitat restoration and for which man-made edges are not required, can achieve points for this credit. Designs for nature-based features typically incorporate native living materials (e.g. vegetation and shellfish). They may include short-term or long-term components to stabilize features and establish habitat for invertebrates, algae or vegetation, and fish.

In New York City, a seawall was modified using gabions filled with rock and oyster shell, and native plantings. A product of the collaborative “Design the Edge” project, it was developed in partnership with researchers and designers to enhance the habitat value of an otherwise hardened edge. *Photo: Kate Boicourt*



**Design strategies:** If hardened or structurally-reinforced edges and components are necessary, do not use materials preserved with potentially toxic substances such as chromated copper arsenate, creosote, or others that can leach into the aquatic environment.<sup>71</sup> Use edge materials that have a chemical composition, alkalinity, toxicity, pH, and other features that support the native biological community and attachment of characteristic marine organisms. Additionally, design and enhance structural features to provide more heterogeneity and habitat-supporting complexity than conventional stabilization methods:

- Use rough, textured, surfaces or varied sizes of rock that create interstitial spaces of varied size and shape, using a material with a pH that fosters attachment or provides refugia for native aquatic organisms. Examples include habitat and reef modules, oyster castles, form liners, molds, and structural enhancements.

<sup>71</sup> United States Consumer Product Safety Commission. (n.d.) [Guidance for outdoor wooden structures: What you should know.](#)

- › Use water retaining ecological features to increase diversity of habitat and maintain some intertidal zonation, such as precast tide pools.
- › Incorporate nature-based features that provide multiple benefits, such as tiered reinforced edges with native plantings, oysters, mussels, salt marsh grasses, mangroves).<sup>72</sup>
- › Incorporate temporary stabilization strategies for wave attenuation and erosion reduction until vegetation is established.

**Scoring:** A project may be awarded zero points for this credit if hardened edges are unnecessarily implemented. Projects can achieve points depending on the site context as either:

*Case A: Necessary hard edge*

If hardened edges are required for the intended use and context, as determined in credit 3.1, construction documents and narrative indicate incorporation of enhancements or designs that are supportive of biodiversity and abundance beyond conventional methods (e.g. incorporating live plants and shellfish into rip-rap, textured surfaces) along at least 25 percent of the shorelines or no less than 50 feet **(2 points)**.<sup>73</sup>

OR

*Case B: Hard edge not necessary*

If the project's primary goal is habitat restoration and man-made edges are not required, a "not applicable" credit applies. Plans to maintain and manage features should be included in the maintenance and adaptive management plan **(2 points)**.

**Materials needed to measure:** Annotated site plan or narrative, maintenance plan.

<sup>72</sup> Dafforn, K.A., Glasby, T.M., Airoldi, L., Rivero, N.K., Mayer-Pinto, M. & Johnston, E.L. (2015). Marine urbanization: an ecological framework for designing multifunctional artificial structures. *Frontiers in Ecology and the Environment*, 13(2), 82-90.

<sup>73</sup> The effectiveness of materials in increasing biodiversity and abundance of native species beyond those of conventional methods must be established as published in academic journal or equivalent peer-reviewed process.







# Natural Resources



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## CATEGORY 4

TOTAL POSSIBLE POINTS 61 PTS

**Credit**

- 4.1 Maintain and restore biodiversity and ecosystem services** PG77
- 4.2 Restore/increase ecosystem connectivity** PG80
- 4.3 Support native habitat complexity and biodiversity** PG82
- 4.4 Avoid human disturbance to natural resources** PG82
- 4.5 Redevelop and clean-up contaminated sites** PG83
- 4.6 Sustainable fill and soil management** PG83
- 4.7 Resilient energy sources** PG85
- 4.8 Practice environmentally-responsible construction** PG86
- 4.9 Reduce and manage stormwater quantity** PG87
- 4.10 Improve stormwater discharge quality** PG91
- 4.11 Reduce water use** PG92
- 4.12 Reduce contribution to urban heat** PG93
- 4.13 Partner with academic and scientific institutes to study or monitor the site** PG94

**TOTAL POSSIBLE POINTS 61 PTS**



## Category 4: Natural Resources

Conserve, manage, and restore biodiversity and ecosystem function

61 POSSIBLE PTS

### CREDIT 4.1

Maintain and restore biodiversity and ecosystem services

12 PTS

**Intent:** Preserve or minimize impacts to natural resources and the services they provide.

**Description:** Based on the findings of **credit 0.2**, engage the project team to determine how best to avoid impacts to natural resources and preserve or enhance the site's natural resources both during construction and over time. Make a plan for pre- and post-construction management of ecosystem services and plan long-term measures to avoid or minimize impacts. Include plans to monitor and adapt management practices. In particular, construction documents and ongoing performance and adaptation plans should take measures to minimize impacts to:

- > Biodiversity.
- > Native vegetation density.
- > Habitats of special significance as defined by state, regional, or federal governments (e.g. wetlands, threatened and endangered species).<sup>74</sup>
- > Habitat quality.
- > Water quality, retention, and recharge.
- > Other locally-important ecosystem services highlighted in state, regional, and local plans.

Restoration and protection of native habitat such as wetlands provides many additional benefits. *Photo: Kate Boicourt*



<sup>74</sup> United States Environmental Protection Agency. (n.d.). [Clean Water Act Section 404 Permit Program](#).

**Design strategies:** Plans should describe how impacts to or reductions in these habitats will be avoided, minimized, or mitigated in design and construction, providing quantifiable information where possible. Include plans to adapt management practices over time to maintain those services. Design teams should avoid building in areas of high habitat quality, and those containing critical, threatened, or endangered habitats as determined by initial site assessments and addressed in **credit 1.2**. Use the assessment conducted for **credit 0.2** as an initial baseline. If significant, rare, threatened, endangered, wetland, high functioning-intact, or other protected habitat is suspected on site, consult with a qualified biologist or environmental professional. If applicable, also consult with the state Natural Heritage Program, fish and wildlife agency or local equivalent, and state or federal wetlands offices if wetlands are found on site.

*Maintain intact and significant habitats and ecosystem services*

Plan to preserve existing biodiversity, ecosystem services, and habitat to the extent feasible. Based on the quality of the existing habitat, design project in a manner that maintains and minimizes impacts to biodiversity and provision of ecosystem services. Develop a plan that demonstrates avoidance or minimizes losses to biodiversity, sensitive habitats, vegetation density, habitat quality, and ecosystem services. Provide the following:

- › An overview of potential impacts to habitat extent and quality and ecosystem services, and efforts to minimize or mitigate those impacts.
- › Current state and “with project” acreages of habitats.
- › Current state and “with project” vegetation density and canopy cover.
- › Copy of the Environmental Impact Statement, if it addresses these elements.

If rare, threatened, endangered, wetland, or other protected habitat is found on site, work with a qualified biologist or environmental professional to delineate and develop an appropriate buffer around identified significant on-site or in-water adjacent habitat, such as significant submerged aquatic vegetation. If applicable, consult with the state Natural Heritage Program, fish and wildlife agency or local equivalent, and state or federal wetlands offices if wetlands are found on site. Locate structures and modifications away from critical natural habitats and buffers as described in credit 1.2 (preferred) or site structural footprints on previously-developed land. If this is not possible, due to minor disturbances (described below), projects should delineate the extent of these habitats and determine an approach for mitigating damages in consultation with state and federal agencies, as applicable. In these cases, design teams should aim to prioritize restoration over creation.<sup>75</sup> Allowable minor and water-dependent use infrastructure disturbances include:<sup>76</sup>

- › Activities to maintain or restore native natural communities and/or natural hydrology.
- › Grade changes necessary to ensure public access.
- › Clearings, limited to one per 300 linear feet (90 linear meters) of buffer on average, not exceeding 500 square feet (45 square meters) each, for tables, benches, and access for non-motorized recreational watercraft.
- › Brownfield remediation.
- › Removal of the following tree types:
  - Hazardous trees, up to 75 percent of dead trees.
  - Trees less than 6 inches (150 millimeters) diameter at breast height

<sup>75</sup> Committee on Mitigating Wetland Losses, Board on Environmental Studies and Toxicology, Water Science and Technology Board, Division on Earth and Life Studies. (2001). *Compensating for Wetland Losses Under the Clean Water Act*. Washington, DC: National Academy Press.

<sup>76</sup> [LEED V4. ND Plan: Wetlands and water body conservation.](#)



- Up to 20 percent of trees more than 6 inches (150 millimeters) diameter at breast height with a condition rating of 40 percent or higher
- Trees under 40 percent condition rating.<sup>77</sup>
- › Limited installation of elevated boardwalks to allow for engagement and education.
- › Installation of pier and maritime operations infrastructure.

Net fill beyond the existing pier-head and bulkhead line should be avoided, and fill removal is preferred. Projects involving permanent damage to tidal and non-tidal wetlands exceeding these disturbances cannot qualify for points in this credit.

*Restore and preserve habitat*<sup>78</sup>

Ecological restoration and preservation that goes above and beyond a conservative design strategy (“Maintain intact and significant habitats and ecosystem services”) can result in multiple ecosystem service benefits, including air quality, water quality, human health, recreation, ecosystem health, and urban heat island reduction. Consider ecological preservation, restoration, or enhancements to increase these benefits, and exceed maintenance. Projects can score additional points for:

- › Habitat restoration or preservation not related to or required by mitigation. To qualify, restoration must be contiguous habitat.
- › Permanent preservation of habitat or buffer areas, such as through conservation easement, transfer of development rights, or other similar long-term preservation method.
- › Industrial projects or retrofits to existing properties in highly urban areas, with no current existing habitat and limited space or feasibility for more expanded restoration activities, should seek credit through **credit 3.4** rather than via this section of this credit.
- › Contribution to regional or local ecological restoration plans and priorities. Consult these plans to determine if there are opportunities to restore or preserve priority habitat types and areas.

A plan to monitor and adaptively manage restored habitats over time should be included in the maintenance and adaptive management plan (**credit 0.4**), including needs such as invasive species and floatables and trash management.

**Scoring:** Narrative and plans demonstrate one or more of following:

*Maintain intact and significant habitats and ecosystem services*

The project avoids a loss to ecosystem services and plans to recover lost services. If the project involves permanent disturbance to significant habitats, disturbance must be minimal as described above and narrative must describe and justify the trade-offs between the benefit of the project and its impact, including plans to mitigate that impact (**6 points**).<sup>79</sup>

AND

*Restore and preserve habitat*

<sup>77</sup> The condition rating must be based on an assessment by an arborist certified by the International Society of Arboriculture (ISA) using ISA standard measures, or for projects outside the U.S., an equivalent certified professional utilizing equivalent methodology.

<sup>78</sup> To reestablish ecosystem services, hydrological soil character and flora and fauna biodiversity must be considered. For more information, see: Duke Nicholas Institute for Environmental Policy Solutions. Focal Areas - National Ecosystem Services Partnership.

<sup>79</sup> Projects successfully meeting **SITES Site Context Prerequisite 1.3: Conserve aquatic ecosystems** and **Prerequisite 1.4: Conserve habitats for threatened and endangered species**, or **Envision V3 NW 1.1 Preserve Sites of High Ecological Value (Superior Level or greater)** satisfy this level of achievement

The project exceeds the level of restoration and preservation needed to maintain existing ecosystem services, designing to support endangered, threatened, or locally rare endemic species where possible. Includes plans to monitor and manage habitats over time in **credit 0.4**. Habitat restored or preserved is either:<sup>80</sup>

- > Greater than one acre or at least 10 percent of project size is restored, or greater than two acres or at least 20 percent of project size is preserved for habitat purposes **(2 points)**.<sup>81</sup>
- > Greater than two acres or at least 20 percent of project size is restored, or greater than four acres or at least 30 percent of project size is preserved for habitat purposes **(4 points)**.<sup>82</sup>

AND

Contributes to regional or local restoration plans and priorities **(2 points)**.

**Materials needed to measure:** Narrative, planting plan, construction documents, monitoring and adaptive management plan.

**CREDIT 4.2**

Preserve and increase ecosystem connectivity

**6 PTS**

**Intent:** Increase the diversity of habitats, restore continuity of ecosystems, and reduce fragmentation.

**Description:** Larger, more contiguous habitat patches typically provide a greater habitat quality and variety of microhabitats, leading to higher species diversity and abundance. Ecological corridors can increase viable habitat ranges, facilitate movement of critical species, and enable re-colonization of previously disturbed areas. These elements can be accomplished through planning more contiguous habitat patches and reducing the distance between habitats.

**Design strategies:** Design so that the average habitat patch size is at least five percent of the total landscaped area. Habitat patches are defined as contiguous naturalized areas, not fragmented by roads or structures, and consisting of native species suitable for the context. In the case of restoration of in-water habitats, projects can achieve points in this section for contiguous wetland, mangrove, or shellfish habitat development.

Reduce the distance between patches to increase ecological connectivity. Develop new corridors between habitats within the site and to contiguous habitat on adjacent sites. Design teams should also consider ways to connect between habitat types. For example, remove man-made fill and derelict structures from the near-shore area and reconnect upland forest or shrub, or scrub to intertidal habitats through a more natural shoreline and slope. Creating a mosaic of habitat types reduces the overall fragmentation associated with development, and facilitates reconnections of food webs strengthening the ecosystem.<sup>83</sup>

<sup>80</sup> Only habitat restoration in excess of mitigation needs may receive points for this credit

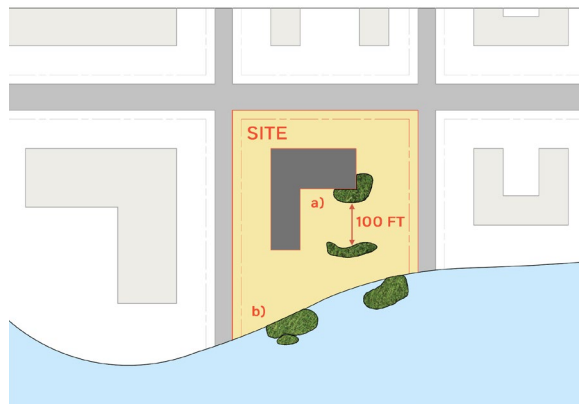
<sup>81</sup> Projects successfully meeting **LEED V4 BD + C SS Credit: Site Development- Protect or restore habitat, Envision V3 NW 1.1 Preserve Sites of High Ecological Value (Conserving Level)** are considered equivalent to WEDG "restore and/or preserve" level.

<sup>82</sup> Projects successfully exceeding the above requirements or meeting **Envision V3 NW 1.1 (Restorative Level)** satisfy WEDG requirements for this level

<sup>83</sup> For more information about fragmentation and habitat patches, see McGarigal, K., Cushman, S., & Regan, C. (2005). **Quantifying Terrestrial Habitat Loss and Fragmentation: A Protocol**.

Consolidating habitat patches or increasing connectivity helps to support intact, biodiverse habitats.

INCREASED CONNECTIVITY BETWEEN HABITAT PATCHES



BEFORE

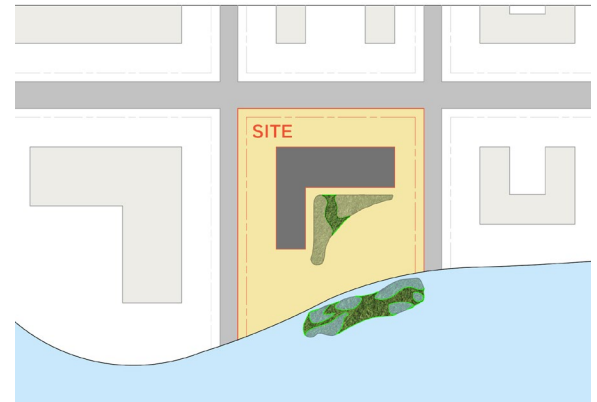


AFTER

CONSOLIDATION OF HABITAT PATCHES



BEFORE



AFTER

**Scoring:** The project must achieve **credit 4.1** to earn points for this credit. Additionally, plans and narrative indicate one or both of the following:

- Average patch size is at least five percent of the total new landscaped area (10 percent for parks), or there is a net increase in restored contiguous in-water habitats. Projects can only achieve points for this credit if their design represents an increase in habitat from previous conditions **(3 points)**.
- New habitat corridors to contiguous habitat on adjacent sites is established, or new connectivity between at least two habitat types is restored on site **(3 points)**.

**Materials needed to measure:** Site plan and narrative, GIS or CAD file showing habitat patches if available.

**CREDIT 4.3**

Support native habitat complexity and biodiversity

**6 PTS**

**Intent:** Support native, rare, and biodiverse ecosystems through planting plans and management.

**Description:** Choice of plants and management strategies affect habitat robustness and biodiversity. Choosing native species, and supporting endemic, endangered, threatened and migratory species supports that robustness and biodiversity on site and beyond. Use ecological assessment to evaluate stressors, where feasible.

**Design strategies:** Incorporate the use of locally native and habitat-appropriate plants throughout the site, considering those that are supportive of priority habitats for locally, regionally, or nationally-important species where feasible. Often these rare habitats are more susceptible to environmental stress, and may be less suited for or have a higher risk of failure in urban areas. Ensure that plantings can withstand harsh coastal conditions, floods, storms, drought, wind, and salt spray depending on planting location. Ecosystems should be designed to be flooded or washed over with minimal impact, assuming the expected repair or renovation costs after a storm or flood would not exceed 50 percent of the initial construction costs. In addition to the resilient planting plan, develop a five-year removal, prevention, and adaptive management plan for invasive species that pose a danger to planned and existing ecological communities and incorporate into **credit 0.4**.

**Scoring:** Plans for adaptive management and maintenance of native species mix over time must be included in the plan developed for **credit 0.4**. Native plants comprise either:

- > 75 percent or more of total planned coverage as indicated on planting plan and plan includes no plants listed on state invasive species lists. Plants used are tolerant of shoreline context (**4 points**); or
- > 85 percent or more of total planned coverage and plan includes no plants listed on state invasive species lists. Plants used are tolerant of shoreline context (**6 points**).

**Materials needed to measure:** Planting plan, maintenance and adaptive management plan.

**CREDIT 4.4**

Avoid human disturbance to natural resources

**4 PTS**

**Intent:** Avoid ongoing disturbance to wildlife due to human activity.

**Description:** Ongoing human disturbances can harm sensitive habitats, and include but are not limited to: light pollution, excessive noise, litter, trampling of vegetation by foot or paddle, compacting of soils, and disturbing sediment due to prop wash and wakes from motorized boats. Waterfront light pollution can impact fauna and night navigation of boats. There are trade-offs between the provision of public access and natural resource protection, and projects should aim for achieving a balance that reflects the sensitivity of the ecosystems and human needs through separation of recreational activity from sensitive habitats and sensitive lighting.

**Design strategies:**

*Avoid ongoing disturbance*

Based on identification of suitable habitat via assessment of natural resources, design barriers and buffers where needed to separate sensitive ecosystems from human activities, such as elevated walkways. Provide a buffer between areas of high vessel traffic and submerged aquatic vegetation or wetlands exposed to moderate or high waves or wakes without any protection or stabilization strategy. Incorporate plans for monitoring and adaptively managing and accommodating “desire lines,” alternative paths developed by users, over time.

*Use sensitive lighting:*

Use information provided by the Illuminating Engineering Society of North America and the International Dark-Sky Association to reduce impacts on migratory birds, fish, and other species affected by nighttime ambient light. For maritime or industrial projects, avoid use of light skirting on over-water structures or along edges. Ambient light and light projected seawards should be less than those of existing conditions. Localities also may have their own requirements.

**Scoring:** Site plan and narrative demonstrate measures taken to reduce disturbance. Plans to review effectiveness over time should be incorporated into maintenance and adaptive management plan **(4 points)**.

**Materials needed to measure:** Site plan, narrative, maintenance and adaptive management plan.

**CREDIT 4.5**

Redevelop and clean up degraded sites

**4 PTS**

**Intent:** Reduce contamination in the environment.

**Description:** Waterfront sites are often contaminated due to past industrial uses, which can affect human and environmental health and leach into waterways.

**Design strategies:** Use the results of **credit 0.2** to determine whether the level of site contamination exceeds state and federal standards. Secondly, if the site is entered into a state or local voluntary cleanup or brownfield cleanup program, or the US Environmental Protection Agency’s Brownfields Program, ensure that the controlling public authority approves the protective measures or cleanup process as effective, safe, and appropriate for the planned use of the site. All investigations and evaluations must be conducted by a state licensed environmental professional, as defined by the federal regulation 40 CFR 312.10(b) or local equivalent for projects outside of the United States. Ensure that sea level rise is taken into account.

**Scoring:** Agency approval demonstrates that cleanup is complete and meets the requirements of state or federal authorities for the intended use **(4 points)**.<sup>84</sup>

**Materials needed to measure:** Letter or memo demonstrating agency approval of completed cleanup.

**CREDIT 4.6**

Sustainable fill and soil management

**2 PTS**

**Intent:** Reduce environmental impacts associated with fill use and management.

**Description:** Responsible provision and management of fill material and soils can result in lower carbon footprints for construction, cost-savings, and reduced environmental impacts both on- and off-site. This can be achieved by developing a plan for sourcing material on-site or locally.

**Design strategies:**

*Reuse materials on-site*

Use fill material sourced from the site during construction, in accordance with state and local regulations. Maintain for reuse and minimize disturbance to healthy topsoil on site. This helps to lower the project’s carbon footprint and reduce shipping costs.<sup>85</sup>

<sup>84</sup> Or meet the requirements for **SITES V2, credit 1.5 Case two: “brownfield sites”**; or **LEED V4 BD + C LT Credit: High Priority Site, Option 3**; or **Envision V3 NW2.1 Reclaim Brownfields (Restorative Level or greater)**

<sup>85</sup> See also **Sites V2 Credit 4.1: Create and communicate a soil management plan**.



*Beneficial reuse of dredged material*

Use material dredged from waterways in accordance with governing regulations, preferably from local sources or sourced within 30 miles if moved by truck or up to 50 miles if moved by barge, provided that this is the most efficient way to avoid waste. Beneficial reuse of dredged material from onsite or nearby is a form of materials exchange removing the intermediary when there is a need to dispose of dredged material and a need for fill material.<sup>86</sup> Provide a narrative of suitability of dredged material for its proposed use and all associated permits to demonstrate compliance with this credit.

*Use locally-sourced fill material*

Use suitable fill material from off-site sources within 30 miles if trucked, or up to 50 miles if barged, provided that this is the more sustainable choice of feasible options. This minimizes the need to import construction materials from more distant sources and increases the possibility of shipping through barging methods, lowering the project's carbon footprint and reducing overall shipping costs.

**Scoring:**

Narrative and documentation indicate either:

*Re-use materials on-site*

- At least 30 percent of total usable (i.e. not exceeding state-regulated contamination levels) fill material is sourced from the site and has been authorized by state or local regulatory agencies for re-use, or is exempt from those regulations based on soil quality **(1 point)**;<sup>87</sup> or
- Greater than 50 percent of total fill material is sourced from the site and has been authorized by state or local regulatory agencies for re-use, or is exempt from those regulations based on soil quality **(2 points)**.<sup>88</sup>

OR

*Beneficial reuse of dredged material/Use locally-sourced fill material:*

- At least 50 percent of total fill used is from local sources within 30 miles if moved by truck or up to 50 miles if moved by barge. Reuse of clean dredge material authorized by state or local regulatory agencies or exempt from such regulations can qualify for this credit) **(2 points)**.

**Materials needed to measure:** Narrative, relevant permits, soil quality documentation.

<sup>86</sup> United States Environmental Protection Agency and United States Army Corps of Engineers. (2007). [Identifying, Planning, and Financing Beneficial Use Projects Using Dredged Material Beneficial Use Planning Manual](#).

<sup>87</sup> Or meet at least **Envision V3 RA1.5 Balance Earthwork On Site (Improved Level)**

<sup>88</sup> Or meet at least **Envision V3 RA1.5 Balance Earthwork On Site (Enhanced Level)**

Reuse of fill and soil onsite is an important way to reduce impact of construction. *Photo: Ian Douglas*



**CREDIT 4.7**  
Resilient energy sources  
**2 PTS**

**Intent:** Provide lower-impact, renewable energy systems.

**Description:** Use independently powered, resilient, off-the-grid infrastructure for outdoor site features and auxiliary structures where feasible.

**Design strategies:** Self-contained, renewable energy such as wind, solar, or tidal or wave energy are lower impact than conventional energy supplies, can minimize the use of wiring and equipment susceptible to damage from flooding, and can power mission-critical functions during extreme events. For maritime operations, provide electric cold ironing. Cold ironing provides a cleaner environment by providing shore-side electrical power as opposed to a ship at berth using its own engines. Provide documentation to demonstrate compliance with this credit.

**Scoring:** A total of two points is possible for this credit. Documentation with calculations and a description of energy generated by quantity, not cost (e.g. kilowatts), demonstrate either:

- > Renewable systems power at least 50 percent of annual site-wide, outdoor energy needs or dockside electric cold ironing is provided for active maritime properties **(1 point)**,<sup>89</sup> or
- > Renewable systems power 100 percent of annual site-wide, outdoor energy needs **(2 points)**.<sup>90</sup>

**Materials needed to measure:** Site plan, energy production documentation, narrative.

<sup>89</sup> From **SITES Credit 8.6: Use renewable sources for landscaped electricity needs**. Projects meeting this credit may satisfy.

<sup>90</sup> Ibid.

Incorporation of renewable systems can boost a site's resilience and reduce its impact.  
 Photo: Sean Dixon



**CREDIT 4.8**

Practice environmentally-responsible construction  
**2 PTS**

**Intent:** Reduce the environmental impact of construction practices.

**Description:** Minimizing the impacts of construction can have lasting effects on environmental quality, cost, and carbon footprint. Consider potential construction impacts and incorporate strategies to reduce them. Diverting waste from landfills and re-use of clean materials on site should be pursued to the extent feasible.

**Design strategies:**

*Minimize construction impacts*

Based on assessment of possible ecosystem construction impacts, incorporate preventive strategies into construction phasing and plans:

- › Reduce in-water construction time and work within approved work timeframes for fish and wildlife protection as prescribed by regulatory agencies.
- › Use modular construction to decrease footprint and disruption to natural habitat.
- › Construction company and waste hauler provide clearly labeled, separate dumpsters for all non-recyclable waste and recyclable material is used on site.
- › Protect water bodies from contaminants and particulate matter with redundant barriers such as doubling up on turbidity curtains and silt barriers.
- › Keep construction equipment off wetlands and marshes and minimize size of construction area.
- › Minimize impacts to aquatic plants and bottom sediment topography when installing piles.
- › Minimize soil compaction.
- › Use prefabrication techniques to reduce construction time and minimize area affected by construction.
- › Work from the water to avoid damaging natural features and habitat, and anchor construction barges away from aquatic habitat especially when creating structures over wetlands.

- › Install piles using drop or small, low-pressure vibratory hammers rather than high-pressure-jetting installation.
- › Barge materials/use water-based transport to reduce truck traffic and associated emissions and soil compaction.
- › Barge materials/use water-based transport to reduce truck traffic (and associated emissions and soil compaction).

*Reuse materials*

Participate in a materials exchange program to reduce disposal and purchase costs and lower carbon emissions.

**Scoring:** Provide a narrative that explains measures to reduce construction impacts on site and divert waste generated from construction and demolition from landfills:<sup>91</sup>  
**(2 points)**

**Materials needed to measure:** Narrative, relevant agreements, materials exchange program documentation, if applicable.

**CREDIT 4.9**

Reduce and manage stormwater quantity

**10 PTS**

**Intent:** Reduce the overall volume of stormwater quantity, using recharge or infiltration whenever feasible.

**Description:** Stormwater can harm habitats and the quality of receiving waters in numerous ways, such as contributing to overflows of sewage in older, combined sewer infrastructure; accumulating contaminants as it travels over impervious surfaces, and entering storm sewer systems, scouring stream edges, increasing velocity, and causing flooding. Climate change is expected to shift the intensity, frequency, and cumulative annual amount of precipitation, affecting precipitation-based flooding potential and drought. This is particularly important in urban areas. Broader strategies will be needed to ensure safety, and exemplary stormwater management can contribute to cumulative improvements.

Through employing evaporation, infiltration, retention, reuse, and treatment, these impacts can be reduced or removed. In highly urban and contaminated sites, infiltration and retention are less feasible and treatment and discharge may be employed. Captured stormwater has many benefits, and can be purified and used for greywater purposes within building operations and for irrigation. Projects should, to the maximum extent technically feasible, maintain or restore the natural functional hydrology of the property with regard to the temperature, rate, volume, and duration of flow, taking into account contamination considerations

<sup>91</sup> Projects achieving **SITES V2 Prerequisite 7.2: Control and retain construction pollutants** and at least the equivalent of one other credit in **SITES V2 section 7: Construction** are considered equivalent for this credit. Additionally, projects achieving **LEED V4 BD+ C MR Credit: construction and demolition waste management** satisfy this credit.



Oregon's extensive stormwater efforts (exhibited by this detail of the Oregon Convention Center) help to reduce impacts to aquatic ecosystems as well as erosion on and off site. *Photo: Jeremy Jeziorski*



**Design strategies:** Design to retain, infiltrate, evapotranspire, reuse, or detain stormwater, in order to manage precipitation to the maximum extent feasible. Given the multiple benefits of green infrastructure, reducing urban heat, improving aesthetic value, and supporting habitat, these methods are preferred wherever possible. Depending on whether the site is connected to a storm sewer or is primarily direct drainage, approach may vary. The target rain event for capture and management may vary depending on local conditions, policies and regulations, technical feasibility, and environmental considerations. Design teams should use the following strategies to manage flows and quantity:

*Reduce unmanaged stormwater and manage peak flow*

Using the precipitation data aggregated in the site-wide assessment described in **credit 0.2**, determine the target precipitation event, adjusted to accommodate projected shifts in precipitation due to climate change and the design life of the project. Design to accommodate projected precipitation and the target precipitation event, using the following strategies:

- › Use topographic and soil type maps as a means to strategically implement green infrastructure.
- › If excess stormwater primarily drains into combined sewer infrastructure and is treated off-site (e.g. a wastewater treatment facility), design based on target storm duration and frequency, quality, and reduced peak discharge into the system. For parks, aim to match natural and vegetated state runoff volume and peak flow discharges. Determine “with project” target design storm capture and discharge rate. Design to reduce discharge rate from the pre-project condition, or to exceed applicable municipal requirements for discharge rate, whichever is the higher standard.
- › If excess stormwater primarily drains off the land and into separate storm sewer infrastructure, and adjacent or receiving water body, or infiltrates, design to improve the quality of discharge and manage stormwater quantity through infiltration, evapotranspiration, reuse, or treatment by green infrastructure for clean freshwater discharge. Determine “with project” projected percentile design storm.



- Reduce coastal hazard risk and prevent negative impacts from tidal or surge-based flooding, by locating or modifying stormwater treatment systems as described in **credit 1.1**. Use tide gates and backflow preventers, or floodproofing of other areas vulnerable to overtopping and surge. At some sites, additional upland stormwater detention capacity may be needed to manage stormwater where infrastructure is susceptible to inundation.
- Employ sustainable design techniques that have multiple benefits:
  - Design to minimize impervious surfaces.
  - Ensure that discharge volumes and rates do not increase the natural rate of erosion in receiving waters or negatively affect ecological flows or natural groundwater replenishment rates and volumes.
  - Use infiltration and recharge, employing engineered soil mixes, plants and vegetated areas as filters. In areas containing mobile contaminants, determine the scope and potential for leaching prior to proceeding.
  - Select native plants that are suited for location and able to reduce pollutant loadings for specific pollutants of concern in the watershed.
  - Ensure that the operations and maintenance plan in **credit 0.4** includes activities to ensure long-term effectiveness of stormwater features.

**Scoring:** Hydrologic analysis is provided with calculations showing that the project retains, infiltrates, evapotranspires, reuses, or detains the target design storm and includes a plan to maintain stormwater controls over time. Scoring is based on either percentile storm if excess stormwater primarily drains into the water or an Intensity Duration Frequency (IDF) curve-based storm event if excess stormwater primarily drains into municipal stormwater and sewer infrastructure (see *Appendix A* for methods).<sup>92</sup> Projects can achieve points depending on their intended use as either:

*Case A: Industrial*

On-site stormwater controls retain, infiltrate, evapotranspire, reuse, or detain either:

- A 2-year, 24-hour or 85th percentile precipitation event or greater and the discharge rate relative to the pre-project condition is not exceeded, or municipal requirements for discharge are exceeded, whichever is more stringent **(8 points)**,<sup>93</sup> or
- A 10-year, 24-hour or 90th percentile precipitation event or greater and the discharge rate relative to the pre-project condition is not exceeded **(10 points)**.<sup>94</sup>

OR

*Case B: Parks*

On-site stormwater controls retain, infiltrate, evapotranspire, reuse, or detain either:

- A 50-year, 24-hour rainfall event or 95th percentile precipitation event and the discharge rate relative to the pre-project condition is not exceeded, the pre-development runoff conditions are preserved following construction, or municipal requirements for discharge are exceeded, whichever is more stringent **(6 points)**,<sup>95</sup> or
- A 100-year, 24-hour rainfall event or more than the 95th percentile precipitation event and the discharge rate relative to the pre-project condition is not exceeded, or the pre-development runoff conditions are preserved following construction **(8 points)**.<sup>96</sup>

<sup>92</sup> For percentile-based analysis, see: United States Environmental Protection Agency. (2009). [Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act](#).

<sup>93</sup> Or meet **Envision V3 NW2.2 Manage stormwater (Enhanced Level)** or **SITES V2 Credit 3.3** (90 percent).

<sup>94</sup> Or meet **Envision V3 NW2.2 Manage stormwater (Superior Level)** or **SITES V2 Credit 3.3** (90 percent).

<sup>95</sup> Or meet **Envision V3 NW2.2 Manage stormwater (Conserving Level)** or **SITES V2 Credit 3.3** (90 percent).

<sup>96</sup> Or meet **LEED V4 BD+C SS Credit: Rainwater management** or **Envision V3 NW2.2 Manage stormwater (Restorative Level)** or **SITES V2 Credit 3.3** (90 percent)

If the project captures additional volume to accommodate projected regional increases in precipitation due to climate change based on initial assessments (**credit 0.2**), or accommodates stormwater volume from sites beyond the project boundary, supports relevant local stormwater management goals, and is designed to prevent negative impacts from tidal or surge-based flooding of infrastructure, additional points are awarded **(2 points)**.

OR

*Case C: Other project types*

On-site stormwater controls retain, infiltrate, evapotranspire, reuse, or detain either:

- A 10-year, 24-hour or 90th percentile precipitation event or more and do not exceed the discharge rate relative to the pre-project condition, or municipal requirements are exceeded, whichever is more stringent **(6 points)**;<sup>97</sup> or
- 50-year, 24-hour rainfall event or 95th percentile precipitation event or greater and the discharge rate relative to the pre-project condition is not exceeded, the pre-development runoff conditions are preserved, or municipal requirements are exceeded, whichever is more stringent **(8 points)**.<sup>98</sup>

If the project captures additional volume to accommodate projected regional increases in precipitation due to climate change based on initial assessments (**credit 0.2**), or accommodates stormwater volume from sites beyond the project boundary, supporting relevant local stormwater management goals, and is designed to prevent negative impacts from tidal or surge-based flooding of infrastructure, additional points are awarded. **(2 points)**

On sites where retention or infiltration of precipitation is not feasible due to site constraints such as clay soils, high groundwater, geotechnical issues, below-ground contamination, underground utilities or transportation systems, or watershed water balance considerations, retention of the maximum feasible stormwater amount and on-site detention and treatment before discharging may qualify for partial points upon review.

**Materials needed to measure:** Site plans, hydrologic analysis, identification of discharge point for onsite runoff, and letter or memo of confirmation from local environmental agency if handling off-site stormwater as well as onsite.

<sup>97</sup> Or meet **Envision V3 NW2.2 Manage stormwater (Superior Level)** or **SITES V2 Credit 3.3** (90 percent)

<sup>98</sup> Or meet **Envision V3 NW2.2 Manage stormwater (Conserving Level)** or **SITES V2 Credit 3.3** (90 percent)

**CREDIT 4.10**

Improve  
stormwater  
discharge quality  
**4 PTS**

**Intent:** Reduce water quality impacts of stormwater.

**Description:** Stormwater, particularly in urban areas, can acquire particulates, chemicals, litter, excessive nutrients, and other pollutants. Properties at the water’s edge are the last opportunity for stormwater to be treated by natural or mechanical systems before entering receiving waters.

**Design strategies:** Implement designs that would reduce Total Suspended Solids (TSS) from the existing conditions, or exceed Total Maximum Daily Load (TMDL) requirements, whichever is more stringent, using green infrastructure where feasible. For landscaped areas, limit fertilizer application. In operations and maintenance plan, plan to avoid fertilizing during the wettest periods of any calendar year, or reference other efforts to minimize or eliminate fertilizer use.

For industrial and maritime operations, stormwater facilities must be designed to sequester pollutants prior to discharge, developing a plan to control features such as equipment wash areas, hazardous materials, and aggregate piles. Locate sources of litter and discharges away from the water, enclose them, or provide adequate buffers and capture mechanisms to prevent them from entering waterways. Meet standards for elevating or otherwise flood-proofing these substances as detailed in **credit 1.1**. Use low-toxicity, biodegradable oil for fixed hydraulic equipment located near the shore of the Vessel General Permit (VGP).<sup>99</sup>

**Scoring:** Projects may be awarded points for achieving one or more of the following:

*Stormwater quality*

Based on pre- and post-development analysis, provide calculations showing that the TSS of any stormwater not retained on site achieves an average discharge concentration of less than or equal to 25 milligrams per liter, or exceeds local or TMDL requirements, whichever is more stringent. For industrial operations, to achieve credit, narrative and/or annotated site plans must demonstrate that stormwater facilities are designed to treat and avoid pollution prior to discharge, or that stormwater quality is managed through additional treatment techniques (e.g. using oil and water separators). Ongoing maintenance and management plan should include plans for managing infrastructure over time **(2 points)**.<sup>100</sup>

AND

*Fertilizer use*

Narrative or ongoing maintenance and management plan provided in credit 0.4 indicate that either:

- > Application of fertilizer and chemical pest or herbicide control avoids the wettest periods of the year and controls are employed to minimize runoff. Ongoing maintenance plan indicates use of only pesticides and fertilizers with low toxicity, persistence, and bioavailability **(1 point)**;<sup>101</sup> or
- > No pesticides, fertilizers, or herbicides will be used on site **(2 points)**.<sup>102</sup>

**Materials needed to measure:** Hydrologic analysis includes design calculations indicating requirements have been met, narrative describes pollutant control method (industrial and maritime sites only), and operations and maintenance plan is provided.

<sup>99</sup> Green Marine Environmental Program. (2017). [Performance Indicators for Terminals & Shipyards](#).

<sup>100</sup> Or meets **Sites V2 Section 3: Site Design–Water. Credit 3.3: Manage precipitation beyond baseline**.

<sup>101</sup> Or meets **Envision V3 NW 2.2: Reduce Pesticide and Fertilizer Impacts (Superior Level)**

<sup>102</sup> Or meets **Envision NW 2.2: Reduce Pesticide and Fertilizer Impacts (Conserving Level)** or greater

**CREDIT 4.11**

Reduce water use

**3 PTS**

**Intent:** Reduce impact on freshwater resources as well as load to municipal systems and potential for combined sewer overflows.

**Description:** Efforts to reduce freshwater withdrawals through managing potable water use can have multiple benefits, including supporting aquatic habitats through maintenance of flows of rivers and streams, and reducing load to municipal systems.

**Design strategies:***Reduce outdoor water use*

The project does not require irrigation or provides 50 percent reduction from the baseline for the site's peak watering month, as calculated using the US Environmental Protection Agency WaterSense Water Budget Tool.<sup>103</sup> Exemptions include water used for: irrigation of plantings during a two-year vegetation establishment period, irrigation of non-commercial food production, and fire suppression. Design water features to act as retention basins for stormwater capture and infiltration or re-use. All landscapes and irrigation systems shall meet applicable national, state, and local regulations. In addition, plumbing and irrigation installers shall meet all applicable state and local licensing requirements. Use WaterSense-certified professionals whenever possible for the installation of irrigation systems. Cisterns and other water captured for re-use can be considered reductions of total use.

*Treat sewage using green infrastructure*

Additional wastewater volume reductions can be achieved by treating a significant portion of sewage on site, though using advanced hydroponic reactors, constructed filtration wetlands, algal turf scrubbers, and the use of living machines. These solutions should only be pursued if regulatory certifications allow such systems and should include contingency connections and procedures in the event of system failure.

*Reduce indoor water use*

Reduce aggregate indoor water consumption by an average of 20 percent from the baseline case. All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labeling must be WaterSense labeled. Install potable water use meters to track use over time.<sup>104</sup>

**Scoring:** Greywater reuse (e.g. for toilet flushing) and use of captured rainwater (cisterns) can be considered as part of use reduction. Hydrologic analysis shows that the project is designed to accomplish one or more of the following:

*Reduce outdoor water use*

For landscaped features, water use is reduced by at least 50 percent or more from the baseline case, or 75 percent for parks, beyond the plant establishment period. No more than 50 percent of the annual water use for irrigation and water features comes from potable sources or no more than 10,000 gallons (37,855 liters) annually, or landscape requires no irrigation **(1 point)**.<sup>105</sup>

*Treat sewage using green infrastructure*

At least 20 percent of wastewater is treated on-site using green infrastructure. On-site septic systems do not count for this credit unless explicitly for environmental purposes or tertiary treatment above municipal tie-ins **(1 point)**.

<sup>103</sup> See [LEED BD+LEED v4 BD+C V4 standard for WE Credit: Outdoor Water Use Reduction](#).

<sup>104</sup> See [LEED BD+C V4 WE Prerequisite Indoor Water Use Reduction](#).

<sup>105</sup> Or meets [BD+C V4 standard for WE Credit: Outdoor Water Use Reduction](#) or [SITES V2 Credit 3.4: Reduce outdoor water use](#).

*Reduce indoor water use*

Project either:

- > Meets or exceeds a 20 percent reduction **(0.5 points)**<sup>106</sup>
- > Exceeds 50 percent reduction **(1 point)**

Exemptions include: Irrigation during planting establishment period, non-commercial food production, and water used for fire suppression.

**Materials needed to measure:** Site plans, hydrologic analysis with design calculations indicating that scoring requirements have been met.

**CREDIT 4.12**  
Reduce contribution to urban heat  
**2 PTS**

**Intent:** Reduce contributions to the cumulative impacts of impervious and heat-absorbing surfaces.

**Description:** In our built environment, the cumulative impact of heat-absorbing materials (e.g. asphalt pavement, roofing material) and local industrial and air-conditioning processes, which increase heat into the air, can drive localized temperatures even higher than regional averages, impacting human health and environment and increasing energy demands. Measures should be taken to minimize the contribution to the urban heat island effect, or improve existing conditions.

**Design strategies:** In addition to efforts to minimize heat impact on the functioning and structural integrity of buildings and infrastructure (see **credit 1.1**), develop a design that includes the following considerations:

*Reduce impervious surfaces*

Use green infrastructure to the extent feasible. For example:

- > Use green roofs as both a stormwater and cooling strategy.<sup>107</sup>
- > Minimize use of pavement.
- > Use pervious pavement where feasible, particularly open-grid pavement.
- > Maximize plantings and canopy cover to at least 50 percent.
- > Use green walls and structures, reducing heat loading on vertical walls.

*Use high-albedo materials*

If hardscapes are installed, lighter or reflective surfaces with a solar reflectance of 29 or greater have multiple benefits beyond reducing impacts on ambient temperature.<sup>108</sup> They also reduce internal building temperatures and extend the lifespan of rooftops and heating, ventilation and air conditioning (HVAC) equipment. Use light colors in pavement, roof paint, and other impervious surfaces.<sup>109</sup>

**Scoring:** Narrative and annotated site plan with calculations indicate that:

- > At least 50 percent of the unbuilt portion of the project (without buildings) is composed of greenscapes or plantings **(0.5 points)**; or
- > More than 50 percent of the unbuilt portion of the project (without buildings) is composed of greenscapes or plantings **(1 point)**.

AND

- > High-albedo materials are used on 75 percent of applicable materials,

<sup>106</sup> Or meets standard for **LEED BD+C V4 WE Prerequisite Indoor Water Use Reduction**.

<sup>107</sup> Green infrastructure that functions both to cool and reduce stormwater can score in both this section and **credit 4.9**

<sup>108</sup> Urban Green Council (2010). *Green Codes Task Force. Proposed code EF 12: Reduce Summer Heat with Cool, Shady Building Lots.*

<sup>109</sup> New York City Mayor’s Office of Recovery & Resiliency. (2018). *Climate Resiliency Design Guidelines.*



- including roofs, pavement, and awnings **(0.5 points)**; or
- High-albedo materials are used on all applicable materials, including roofs, pavement, and awnings **(1 point)**

**Materials needed to measure:** Narrative and site plan (including design calculations indicating that scoring requirements have been met.

**CREDIT 4.13:**

Partner with academic and scientific institutes to study or monitor the site

**4 PTS**

**Intent:** Expand capacity for tracking, monitoring, and evaluating waterfront areas and contribute to a broader body of knowledge about waterfront issues and best practices.

**Description:** Create a partnership with an academic or research institution or other non-profit organization to study or monitor the site in order to advance understanding of environmental systems or human connections to waterways. Studies may evaluate pilot shoreline stabilization techniques and associated habitat quality, efficacy of nature-based features, floodplain management, or human health.

**Design strategies:** Establish a research partner to contribute to study or monitor the site over time. Research partners that plan to monitor data listed in *Appendix A* will improve site management over time by providing information to indicate ongoing performance and inform adaptive management.

Partnering with academic and research partners can help to both contribute to regional science and also inform management over time.  
*Photo: Kate Boicourt*



**Scoring:** An agreement with a research partner is provided, including a brief narrative describing the scope of the partnership and a plan for publishing data collected. Citizen science programs that are for educational purposes only, and not synthesized and reported over time, can qualify for **credit 2.3**, but not in **4.13. (2 points)**.

AND

The research partner is charged with independently monitoring and reporting key relevant performance indicators over time, with an agreement to support at least five years of monitoring **(1 point)**.

AND

Permission is given to the Waterfront Alliance to make at least a subset of assessment (**credit 0.2**) and monitoring data (over time) available to researchers (**1 point**).

**Materials needed to measure:** Narrative, agreement with academic, scientific, or research institution.



# Innovation



## CATEGORY 5

TOTAL POSSIBLE POINTS 16 PTS

**Credit**

**5.1 Inventive design** PG97

**5.2 Exemplary performance** PG98

**TOTAL POSSIBLE POINTS 16 PTS**





## Category 5: Innovation

Significantly surpass guidelines or develop new ways to significantly increase resilience, ecology, or public access

16 POSSIBLE PTS

### CREDIT 5.1

Inventive Design

8 PTS

**Intent:** Encourage innovative design and pilot studies of new materials and methods.

**Description:** Using approaches, materials, and techniques not addressed in this version of WEDG, project teams can propose a new credit that achieves significant, measurable performance in resilience, ecology, or public access for innovative waterfront edge design.

The designers of Hunters Point South Park in New York City received points in innovation for a pavilion that serves to provide shade structure, solar energy, and stormwater capture. *Photo: Ian Douglas*



**Scoring:** Proposed credit reflects inventive design that achieves measurable improvements in resilience, access, or ecology and is not currently included in WEDG. Use of a new material complemented by a pilot study led by a research partner can also achieve points for this credit. Examples include implementing innovative shoreline design and a plan to monitor measures of habitat quality for at least three years. The achievement of these points is at the sole discretion of the WEDG Program. A project can submit a maximum of two proposed credits for four points each, for a total of up to **(8 points)** maximum.

**Materials needed to measure:** Proposed credit, details of the design approach, and projected goals/achieved measurements.

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**CREDIT 5.2**  
Exemplary  
Performance  
**8 PTS**

**Intent:** Encourage projects to exceed the current standards of WEDG.

**Description:** Project teams can score credit for significantly surpassing the requirements for up to two credits, as determined by the reviewer.

**Scoring:** A project can submit a maximum of two proposed credits for four points each, for a total of up to **(8 points)** maximum.

**Materials needed to measure:** Narrative and any relevant supporting documentation.



## REFERENCES

- American Society of Civil Engineers. (2017). *Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE/SEI 7-16)*.
- Barton, J. & Pretty, J. (2010). What Is the Best Dose of Nature and Green Exercise for Improving Mental Health. *Environmental Science & Technology*, 44, 3947–3955.
- Beatley, T. (2014). Chapter 7. In *Blue Urbanism: Exploring Connections between Cities and Oceans*. Washington, DC: Island Press.
- Browning, W., Ryan, C., & Clancy, J. (2014). *14 patterns of biophilic design*. New York: Terrapin Bright Green LLC. Retrieved from <<http://www.terrapinbrightgreen.com/wp-content/uploads/2014/04/14-Patterns-of-Biophilic-Design-Terrapin-2014e.pdf>>.
- Cardona, O.D., van Aalst, M.K., Birkmann, J., Fordham, M., McGregor, G., Perez, R., . . . Sinh, B.T. (2012). Determinants of risk: exposure and vulnerability. In C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, . . . P.M. Midgley (Eds.), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC)* (pp. 65-108). Cambridge, UK: Cambridge University Press.
- CIRIA. (2012). *The Rock Manual: The Use of Rock in Hydraulic Engineering* (2nd ed.). London: C683, CIRIA. Retrieved from <<http://kennisbank-waterbouw.tudelft.nl/DesignCodes/rockmanual>>.
- Coastal Green Infrastructure and Ecosystem Services Task Force. (2015). *Ecosystem-Service Assessment: Research Needs for Coastal Green Infrastructure*. Retrieved from <[https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/cgies\\_research\\_agenda\\_final\\_082515.pdf](https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/cgies_research_agenda_final_082515.pdf)>.
- Committee on Mitigating Wetland Losses, Board on Environmental Studies and Toxicology, Water Science and Technology Board, Division on Earth and Life Studies. (2001). *Compensating for Wetland Losses Under the Clean Water Act*. Washington, DC: National Academy Press. Retrieved from <<https://www.nap.edu/read/10134/chapter/1>>.
- Cowardin, L., Carter, V., Golet, F., & LaRoe, E. (1979). *Classification of Wetlands and Deepwater Habitats of the United States*. Washington, DC: United States Department of the Interior, Fish and Wildlife Service. Retrieved from *Classification of Wetlands and Deepwater Habitats of the United States*.
- Dafforn, K.A., Glasby, T.M., Airoldi, L., Rivero, N.K., Mayer-Pinto, M. & Johnston, E.L. (2015). Marine urbanization: an ecological framework for designing multifunctional artificial structures. *Frontiers in Ecology and the Environment*, 13(2), 82-90.
- Douglass, S.L. & Pickel, B.H. (1999). The tide doesn't go out anymore- the effect of bulkheads on urban bay shorelines. *Shore and Beach* 67(2-3), 19-25.
- Duke Nicholas Institute for Environmental Policy Solutions (n.d.). *Focal Areas – National Ecosystem Services Partnership*. Available from: <<https://nicholasinstitute.duke.edu/focal-areas/national-ecosystem-services-partnership>>
- Envision. Institute for Sustainable Infrastructure. Retrieved from <<https://sustainableinfrastructure.org/envision/>>.
- FEMA. (1993). *Technical Bulletin 7-93, Wet floodproofing requirements for structures located in special flood hazard areas in accordance with the National Flood Insurance Program*. Retrieved from <[https://www.fema.gov/media-library-data/20130726-1511-20490-8042/tb\\_7\\_complete\\_scan.pdf](https://www.fema.gov/media-library-data/20130726-1511-20490-8042/tb_7_complete_scan.pdf)>;

## REFERENCES

- FEMA. (1993). *Technical Bulletin 6-93, Below-grade parking requirements for buildings located in special flood hazard areas*. Retrieved from <<https://www.fema.gov/media-library-data/20130726-1511-20490-1163/job12.pdf>>;
- FEMA. (1993). *Technical Bulletin 6-93, Non-residential floodproofing – Requirements and certification for buildings located in special flood hazard areas*. Retrieved from <<https://www.fema.gov/media-library-data/20130726-1511-20490-5294/job6.pdf>>.
- FEMA. (2002). Appendix D. In *Federal Emergency Management Administration. Volume 2: Revisions and Amendments*. Retrieved from <[https://www.fema.gov/media-library-data/1389623095740-8aaa2f386002ab23b1bd39bd88c837dc/Guidelines\\_and\\_Specifications\\_for\\_Flood\\_Hazard\\_Mapping\\_Partners\\_Volume\\_2-Map\\_Revisions\\_and\\_Amendments\\_\(Apr\\_2003\).pdf](https://www.fema.gov/media-library-data/1389623095740-8aaa2f386002ab23b1bd39bd88c837dc/Guidelines_and_Specifications_for_Flood_Hazard_Mapping_Partners_Volume_2-Map_Revisions_and_Amendments_(Apr_2003).pdf)>.
- FEMA. (2005). *Design and Construction in Coastal A Zones*. Retrieved from <[https://www.fema.gov/pdf/rebuild/mat/coastal\\_a\\_zones.pdf](https://www.fema.gov/pdf/rebuild/mat/coastal_a_zones.pdf)>.
- FEMA. (2008). *Free-of-Obstruction Requirements for Buildings Located in Coastal High Hazard Areas in accordance with the National Flood Insurance Program (Technical Bulletin 5-08)*. Retrieved from <[https://www.fema.gov/media-library-data/20130726-1511-20490-9526/fema\\_tb\\_5.pdf](https://www.fema.gov/media-library-data/20130726-1511-20490-9526/fema_tb_5.pdf)>.
- FEMA. (2008). *Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas in accordance with the National Flood Insurance Program (Technical Bulletin)*. Retrieved from <[https://www.fema.gov/media-library-data/20130726-1502-20490-9949/fema\\_tb\\_1\\_1.pdf](https://www.fema.gov/media-library-data/20130726-1502-20490-9949/fema_tb_1_1.pdf)>.
- FEMA. (2008). *Design and Construction Guidance for Breakaway Walls (Technical Bulletin 9)*. Retrieved from <[https://www.fema.gov/media-library-data/20130726-1511-20490-8359/fema\\_tb\\_9.pdf](https://www.fema.gov/media-library-data/20130726-1511-20490-8359/fema_tb_9.pdf)>.
- FEMA. (2013). *Floodproofing Non-Residential Buildings (P-936)*. Retrieved from <[https://www.fema.gov/media-library-data/9a50c534fc5895799321dcdd4b6083e7/P-936\\_8-20-13\\_508r.pdf](https://www.fema.gov/media-library-data/9a50c534fc5895799321dcdd4b6083e7/P-936_8-20-13_508r.pdf)>.
- FEMA. (2015). *Highlights of ASCE 24-14 Flood Resistant Design and Construction*. Retrieved from <[https://www.fema.gov/media-library-data/1436288616344-93e90f72a5e4ba75bac2c5bb0c92d251/ASCE24-14\\_Highlights\\_Jan2015\\_revise2.pdf](https://www.fema.gov/media-library-data/1436288616344-93e90f72a5e4ba75bac2c5bb0c92d251/ASCE24-14_Highlights_Jan2015_revise2.pdf)>.
- FEMA. 2015. *Fact Sheet: Importance of the Limit of Moderate Wave Action (LiMWA)*. Retrieved from <[https://www.fema.gov/media-library-data/1436816523486-15e2af5cfc6514c156adacd337d3caed/FPM\\_1\\_Page\\_LiMWA.pdf](https://www.fema.gov/media-library-data/1436816523486-15e2af5cfc6514c156adacd337d3caed/FPM_1_Page_LiMWA.pdf)>.
- General Services Administration. (2017). 6.12: Emergency Power Systems. Available from <<https://www.gsa.gov/node/86992>>.
- Green Marine Environmental Program. (2017). *Performance Indicators for Terminals & Shipyards*. Retrieved from <[https://www.green-marine.org/wp-content/uploads/2017/01/2017-Summary\\_TerminalsShipyards\\_FINAL.pdf](https://www.green-marine.org/wp-content/uploads/2017/01/2017-Summary_TerminalsShipyards_FINAL.pdf)>.
- Hampson, R., MacMahan, J., & Kirby, J. (2011). A Low-Cost Hydrographic Kayak Surveying System. *Journal of Coastal Research*, 27(3), 600-603. Retrieved from <<http://www.jcronline.org/doi/abs/10.2112/JCOASTRES-D-09-00108.1?code=cerf-site>>.
- Hardaway Jr., C. G., Zacherle, A., & Fowler, B. (1984). *Vegetative Erosion Control Project Final Report*. Gloucester Point, VA: Technical Report, Virginia Institute of Marine Science.

## REFERENCES

- Hardaway, C., Milligan, D., & Duhring, K. (2010). *Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments*. Gloucester Point, VA: Virginia Institute of Marine Science, College of William and Mary.
- Hardaway, CS & J Byrne.1999. *Shoreline Management in Chesapeake Bay*. Virginia Institute of Marine Science. Gloucester Point, VA. Retrieved from <<http://www.dcr.virginia.gov/soil-and-water/document/shoreline-management-in-chesapeake-bay.pdf>>
- Intergovernmental Panel on Climate Change's Representative Concentration Pathway (RCP). Available from <<http://www.ipcc.ch/>>.
- Knutson, P., Seeling, W., & Inskeep, M. (1982). Wave Dampening in Spartina Alterniflora Marshes. *Wetlands*, 2, 87-104.
- Korfmacher, K., Aviles, K., Cummings, B., Daniell, W., Erdmann, J., & Garrison, V. (2015). Health Impact Assessment of Urban Waterway Decisions. *International Journal of Environmental Health*, 12(1), 300-321. doi: 10.3390/ijerph120100300.
- LEED v4 for Building Design and Construction (BD+C). Retrieved from: <<https://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version>>
- MarCom Working Group 33. (2002). *Guidelines for the design of fender systems*. World Association for Waterborne Transport Infrastructure. Retrieved from <<http://www.pianc.org/2872231250.php>>.
- Maryland Living Shoreline Waiver. Available from <<http://mde.maryland.gov/programs/Water/WetlandsandWaterways/Pages/LivingShorelines.aspx>>.
- McGarigal, K., Cushman, S., & Regan, C. (2005). Quantifying Terrestrial Habitat Loss and Fragmentation: A Protocol. Retrieved from <[http://www.umass.edu/landeco/teaching/landscape\\_ecology/labs/fragprotocol.pdf](http://www.umass.edu/landeco/teaching/landscape_ecology/labs/fragprotocol.pdf)>.
- Mileti, D. & Sorensen, J. (2015). *A Guide to Public Alerts and Warnings for Dam and Levee Emergencies*. United States Army Corps of Engineers Risk Management Center. Retrieved from <[https://silverjackets.nfrmp.us/Portals/0/doc/WarningGuidebook\\_USACE.pdf](https://silverjackets.nfrmp.us/Portals/0/doc/WarningGuidebook_USACE.pdf)>?ver=2015-08-10-213008-520.>
- Miller, J., Rella, A., Williams, A., & Sproule, E. (2016). *Living Shorelines Engineering Guidelines (Prepared for New Jersey Department of Environmental Protection)*. Stevens Institute of Technology. Retrieved from <<http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf>>.
- Miller, J. (2011). Beach Research Survey Vehicle: DUCKS Jet Ski. Retrieved from <<https://www.youtube.com/watch?v=3ZraiYGmgZM>>.
- National Oceanic and Atmospheric Administration. (2015). *Guidance for Considering the Use of Living Shorelines*. Retrieved from <[https://www.habitatblueprint.noaa.gov/wp-content/uploads/2018/01/NOAA-Guidance-for-Considering-the-Use-of-Living-Shorelines\\_2015.pdf](https://www.habitatblueprint.noaa.gov/wp-content/uploads/2018/01/NOAA-Guidance-for-Considering-the-Use-of-Living-Shorelines_2015.pdf)>.
- National Park Service. (2012). *Clean Marina Guidebook*. Denver: NPS Commercial Services. Retrieved from <<https://concessions.nps.gov/docs/policies/NPSCS%20Clean%20Marina%20Final%202012.pdf>>.
- The Nature Conservancy. (2015). *Urban Coastal Resilience: Valuing Nature's Role, Case Study: Howard Beach, Queens, NY*. Retrieved from <<https://www.nature.org/media/newyork/urban-coastal-resilience.pdf>>.



## REFERENCES

- New Jersey General Permit 17. Available from <<http://www.nj.gov/dep/opi/regulations---permits.html>>.
- New York City Department of City Planning. (2013). *Coastal climate resilience: Designing for flood risk*. Retrieved from <[http://www1.nyc.gov/assets/planning/download/pdf/plans-studies/sustainable-communities/climate-resilience/designing\\_flood\\_risk.pdf](http://www1.nyc.gov/assets/planning/download/pdf/plans-studies/sustainable-communities/climate-resilience/designing_flood_risk.pdf)>.
- New York City Department of City Planning. (2013). *Coastal climate resistance: Urban waterfront adaptive strategies*. Retrieved from <<https://www1.nyc.gov/assets/planning/download.pdf>>/plans-studies/sustainable-communities/climate-resilience/urban\_waterfront.pdf>.
- New York City Department of Housing Preservation & Development. (2015). *NYC Neighborhood Planning Playbook*. Retrieved from <<https://www1.nyc.gov/assets/hpd/downloads.pdf>>/community/neighborhood-planning-playbook.pdf>.
- New York City Mayor's Office of Recovery & Resiliency. (2017). *Preliminary Climate Resiliency Design Guidelines*. Retrieved from <[http://www1.nyc.gov/assets/orr/images/content/header/ORR\\_ClimateResiliencyDesignGuidelines\\_PRELIMINARY\\_4\\_21\\_2017.pdf](http://www1.nyc.gov/assets/orr/images/content/header/ORR_ClimateResiliencyDesignGuidelines_PRELIMINARY_4_21_2017.pdf)>.
- New York Department of State. (2017). *State Coastal Policies, Policy 2*. Albany, NY: New York State Department of State Coastal Management Program. Retrieved from <<https://www.dos.ny.gov/opd/programs.pdfs/CoastalPolicies.pdf>>.
- New York City Economic Development Corporation. (2013). *Comprehensive Citywide Ferry Study*. Retrieved from <[https://www.nycedc.com/sites/default/files/filemanager/Resources/Studies/2013\\_Citywide\\_Ferry\\_Study/Citywide\\_Ferry\\_Study\\_-\\_Final\\_Report.pdf](https://www.nycedc.com/sites/default/files/filemanager/Resources/Studies/2013_Citywide_Ferry_Study/Citywide_Ferry_Study_-_Final_Report.pdf)>.
- Nutsford, D., Pearson, A. L., Kingham, S., & Reitsma, F. (2016). Residential exposure to visible blue space (but not green space) associated with lower psychological distress in a capital city. *Health and Place*, 39, 70-78. DOI: 10.1016/j.healthplace.2016.03.002.
- Patrick, C., Weller, D.E., LI, X. & Ryder, M. (2014). Effects of shoreline alteration and other stressors on submerged aquatic vegetation in subestuaries of Chesapeake Bay and the Mid-Atlantic Coastal Bays. *Estuaries and Coasts* 37, 1516-1531.
- Rebuild by Design. (2016). *Elements of Effective Engagement*. Available from <<http://www.rebuildbydesign.org/our-work/research/elements-of-effective-engagement-report>>
- Rella, A., Miller, J., LaPann-Johannessen, C. & Rodriguez, E. (2015). *Hudson River Wake Study*. Stevens Institute of Technology, Hudson River Sustainable Shorelines Project. Retrieved from <<https://www.hrner.org/doc/?doc=274514894>>.
- SAGE. (n.d.) *Systems approach to geomorphic engineering*. Available from <<http://sagecoast.org/>>.
- Seitz, R.D. & Lawless, A. S. (2006). Landscape-level impacts of shoreline development on Chesapeake Bay benthos and their predators. In S. Erdle (Ed.), *Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay. Proceedings of the 2006 Living Shoreline Summit*. CRC Publ. No. 08-164.
- The Sustainable SITES Initiative (SITES). Retrieved from <<http://www.sustainablesites.org/>>.
- Sorensen, R. (1997). *Prediction of Vessel-Generated Waves with Reference to Vessels Common to the Upper Mississippi River System*. St. Louis, MO: United States Army Corps of Engineers, Upper Mississippi River - Illinois Waterway System Navigation Study.

## REFERENCES

- Southwest Brooklyn Industrial Development Corporation. (2016). *About Us*. Retrieved from <<http://www.sbidc.org/about/>>.
- Stedman, R. (2003). Is it really just a social construction? The Contribution of the Physical Environment to Sense of Place. *Society & Natural Resources: An International Journal*, 16(8), 671-685. <<https://doi.org/10.1080/08941920309189>>.
- Task Committee on Marinas 2020 of the Ports and Harbors Committee of the Coasts, Oceans, Ports, and Rivers Institute of ASCE. (2012). *Planning and Design Guidelines for Small Craft Harbors*. Baltimore: ASCE.
- United States Army Corps of Engineers Nationwide Permit 54, available from <<http://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/Nationwide-Permits/>>.
- United States Army Corps of Engineers Cold Regions Research and Engineering Laboratory. (2004). Method to Estimate River Ice Thickness Based on Meteorological Data. Hanover, NH: ERDC/CRREL Technical Note 04-3. Retrieved from <<http://acwc.sdp.sirsi.net/client/search/asset/1001540;jsessionid=1683B9D8A5499B82984FE2D16196A230.enterprise-15000>>.
- United States Consumer Product Safety Commission. (n.d.) *Guidance for outdoor wooden structures: What you should know*. Retrieved from <[https://www.cpsc.gov/s3fs-public/270\\_0.pdf](https://www.cpsc.gov/s3fs-public/270_0.pdf)>.
- United States Department of Agriculture. 2002. *Plant Fact Sheet: Smooth Cordgrass* Retrieved from <<https://plants.usda.gov/factsheet.pdf>>/fs\_spal.pdf>
- United States Environmental Protection Agency. (n.d.). *Clean Water Act Section 404 Permit Program*. Retrieved from <<https://www.epa.gov/cwa-404/section-404-permit-program>>.
- United States Environmental Protection Agency. (n.d.). *Wetlands Monitoring and Assessment*. Retrieved from <<https://www.epa.gov/wetlands/wetlands-monitoring-and-assessment>>.
- United States Environmental Protection Agency and US Army Corps of Engineers. (2007). Identifying, Planning, and Financing Beneficial Use Projects Using Dredged Material Beneficial Use Planning Manual. Retrieved from <[https://www.epa.gov/sites/production/files/2015-08/documents/identifying\\_planning\\_and\\_financing\\_beneficial\\_use\\_projects.pdf](https://www.epa.gov/sites/production/files/2015-08/documents/identifying_planning_and_financing_beneficial_use_projects.pdf)>.
- United States Environmental Protection Agency. (2009). *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*. Retrieved from <[https://www.epa.gov/sites/production/files/2015-08/documents/epa\\_swm\\_guidance.pdf](https://www.epa.gov/sites/production/files/2015-08/documents/epa_swm_guidance.pdf)>.
- Urban Green Council. (2010). Green Codes Task Force. Proposed code EF 12: Reduce Summer Heat with Cool, Shady Building Lots. Retrieved from <<https://urbangreencouncil.org/sites/default/files/a15U0000000LrghIAC1388005221.pdf>>.
- Urban Harbors Institute, University of Massachusetts Boston. (2013). Conservation Mooring Study. *Urban Harbors Institute Publications*, 41. Retrieved from <[https://scholarworks.umb.edu/uhi\\_pubs/41/](https://scholarworks.umb.edu/uhi_pubs/41/)>.
- Urban Land Institute. (2015). *Building Healthy Places Toolkit: Strategies for Enhancing Health in the Built*

## REFERENCES

- Environment*. Washington, DC: Urban Land Institute. Retrieved from <<http://uli.org/wp-content/uploads/ULI-Documents/Building-Healthy-Places-Toolkit.pdf>>.
- Völker, S. & Kistemann, T. (2011). The impact of blue space on human health and well-being – Salutogenetic health effects of inland surface waters: A review. *International Journal of Hygiene and Environmental Health* 214, 449–460. doi:10.1016/j.ijheh.2011.05.001>.
- Whalen, L., Kreeger, D., Bushek, D., Moody, J., & Padeletti, A. (2011). *Practitioner's Guide: Shellfish-Based Living Shorelines for Salt Marsh Erosion Control and Environmental Enhancement in the Mid-Atlantic*. Partnership for the Delaware Estuary, Report # 11-04. Retrieved from <<https://livingshorelinesacademy.org/index.php/resources/literature/item/whalen-2011>>.

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# Appendix A

## APPENDIX A: ASSESSMENT AND ONGOING PERFORMANCE

The purpose of this Appendix is to 1) identify methods for completing initial baseline assessments (**Credit 0.2, Assess site-wide considerations**); 2) identify which assessments are needed to inform each credit; and 3) support the development of an operations and maintenance plan (**Credit 0.4, Create a maintenance and adaptive management plan**). It also provides the performance goals, design level (i.e. “How Scored”), and documentation required for each credit.

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### How to use this table:

- › Identify credits sought in the left-hand column.
- › To inform the design process, address the “Initial Assessments” listed to for each credit sought first, using the methods following the table for reference (satisfies **Credit 0.2**).
- › As the design process progresses, use the suggestions in the “Maintenance and Adaptive Management” column to inform the development of a maintenance and adaptive management plan (satisfies **Credit 0.4**)
- › Projects may submit separate documentation for each credit (**Credit 0.2** and **Credit 0.4**), as long as the credits sought are clearly indicated and all listed components are addressed.



	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
0.1	N/A	An integrated multi-disciplinary process is employed from pre-design to implementation	<ul style="list-style-type: none"> <li>Multidisciplinary team includes at least the following disciplines: biologist/environmental professional, coastal and/or geotechnical engineer, and landscape architect or architect</li> <li>Contracts show required disciplines employed from pre-design to construction</li> </ul>	<ul style="list-style-type: none"> <li>Narrative including list of project team discipline and/or CVs of project team</li> <li>Contracts indicating required disciplines engaged from pre-design to construction</li> </ul>	N/A		
0.2	This credit requires all relevant assessments for credits sought to be completed	Initial assessments for all credits sought are completed, thoroughly describing the site's existing conditions relating to resilience, ecology, and access	Site assessment of applicable metrics is provided and includes analysis of the elements required for credits sought	<ul style="list-style-type: none"> <li>Assessment with each component listed for credits sought</li> <li>Narrative elaborating on analysis and results found</li> </ul>	N/A - ongoing monitoring and adaptive management are described in each relevant credit		
0.3	<ul style="list-style-type: none"> <li>Community and historical context</li> <li>Community connectivity, health and wellbeing</li> </ul>	<p>Community needs and priorities shape project outcomes:</p> <ul style="list-style-type: none"> <li>Existing plans are reflected</li> <li>Participatory workshops held to gather input (at least 2 for residential, commercial, mixed-use and parks; 1 for industrial)</li> <li>Means of two-way communications established</li> <li>Health and affordability impacts assessed</li> </ul>	<p>Narrative and documentation describe:</p> <ul style="list-style-type: none"> <li>Existing community visions</li> <li>Demographic assessment used to inform outreach</li> <li>Number of participatory workshops and results</li> <li>Two-way communications channel</li> <li>Health and affordability considerations</li> </ul>	<ul style="list-style-type: none"> <li>Narrative describing analysis of existing plans, demographics, and input to inform/implement outreach strategies and designs</li> <li>Evidence of outreach activities (e.g. testimonials)</li> <li>Supporting documentation if applicable (e.g. Health Impact Assessments)</li> </ul>		E.g. participatory workshops held at least at pre-design (10% design) and near final design (75%). Bi-weekly public updates and as-needed communications	If participation is low or narrow, adapt outreach strategies to target new groups (e.g. provide workshops in a more relevant language)

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
0.4		Project team plans for for for maintenance and adaptive management from the beginning of the design process	Plan for maintenance and adaptive management is provided for each credit sought	Maintenance and adaptive management plan	N/A - ongoing monitoring and adaptive management are described in each relevant credit		
1.1	<ul style="list-style-type: none"> <li>• Risk and vulnerability to sea level rise and storm surge</li> <li>• Tidal range</li> <li>• Wind</li> <li>• Waves</li> <li>• Wakes</li> <li>• Stability, soils, and marine asset condition</li> </ul>	Hazard risk exposure is minimized through one or more of the following: <ul style="list-style-type: none"> <li>• Setbacks of structures from erosion hazard areas (or meet ASCE 7) and any natural protective features</li> <li>• Setbacks of structures or meet design flood elevation for future sea level rise and adequate durability strategies</li> <li>• Other protective measures</li> </ul>	<ul style="list-style-type: none"> <li>• Structure proximity to erosion hazard areas (or description of how design meets ASCE 7 for the area) and natural protective features</li> <li>• Structure proximity to and designed modifications to meet target design flood elevation and durability standards</li> <li>• Secondary protective measures are included</li> </ul>	<ul style="list-style-type: none"> <li>• Site plans in the context of future sea level rise and floodplain</li> <li>• Narrative describing approach</li> <li>• Maintenance for protective features included in operations and maintenance plan</li> </ul>	Review of updates to sea level rise projections	Conduct the following at regular intervals (e.g. every 5-10 years) and following extreme events: <ul style="list-style-type: none"> <li>• Evidence of erosion/erosion rate</li> <li>• Structural integrity of protective measures and buildings</li> </ul>	
1.2	Critical and vulnerable habitats	Impacts to sensitive habitats avoided through siting: <ul style="list-style-type: none"> <li>• Buffers</li> <li>• Additional setbacks for habitat migration due to sea level rise</li> </ul>	<ul style="list-style-type: none"> <li>• Extent of/buffer around sensitive habitats is consistent with habitat type and erosion rate</li> <li>• Presence and extent of sea level rise buffer of at least 20 additional feet along at least 25% of the shoreline</li> </ul>	<ul style="list-style-type: none"> <li>• Site plans noting width of buffers around critical areas</li> <li>• Justification for the width determination (habitat type, erosion rate, design life)</li> </ul>	See credit 4.1	See credit 4.1	
1.3	<ul style="list-style-type: none"> <li>• Habitat extent</li> <li>• Community connectivity, health and wellbeing</li> </ul>	<ul style="list-style-type: none"> <li>• View corridors align with existing street grid</li> <li>• Enhance existing view corridors, or create one new or widened view corridor, using recommended design strategies to enhance the quality of the open space</li> </ul>	<ul style="list-style-type: none"> <li>• View corridors align with existing street grid</li> <li>• New, widened, or enhanced existing view corridors are appropriate for the site context and implement recommended design strategies</li> </ul>	Narrative and site plans showing existing, widened, and added view corridors.	E.g. pruning to retain views		

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
1.4	<ul style="list-style-type: none"> <li>Stability, soils, and marine asset condition</li> <li>Community connectivity, health and wellbeing</li> </ul>	<ul style="list-style-type: none"> <li>Water-dependent uses (industrial/ transportation) supported</li> <li>25% or more of inbound/outbound industrial transport is through maritime</li> <li>Working edge is condensed to less than 75% of the total shoreline length</li> </ul>	<ul style="list-style-type: none"> <li>Water-dependent uses supported</li> <li>% of marine shipping of total transport</li> <li>% of condensed working edge of shoreline length</li> </ul>	<ul style="list-style-type: none"> <li>Narrative</li> <li>Site plan indicating measures to preserve/create water-dependent uses</li> </ul>			
1.5	Emergency preparedness	Hazard risk to people is minimized through: <ul style="list-style-type: none"> <li>Developing/adapting an emergency preparedness protocol</li> <li>Regular trainings or information sessions planned by landowners for employees or tenants</li> </ul>	<ul style="list-style-type: none"> <li>Emergency preparedness protocol developed</li> <li>Number of trainings/ information sessions landowners plan to provide to employees and/or tenants per year</li> </ul>	<ul style="list-style-type: none"> <li>Emergency preparedness plan</li> <li>Narrative describing training/outreach plans (as applicable)</li> </ul>	E.g. annual staff training, monitoring of local, state, and federal emergency warnings and US Coast Guard, as applicable. If deployables are a part of a buildings flood mitigation plan, include plans to ensure safe egress or ensure all occupants are evacuated	Emergency preparedness plans should be updated annually. Trainings and information sessions for tenants/employees should be held at least annually and following an extreme event	E.g. identify potential changes for the site/facilities which could permanently reduce the impact of flood (barriers, raising key equipment above flood levels)
2.1	<ul style="list-style-type: none"> <li>Habitat extent</li> <li>Community and historical context</li> <li>Community connectivity, health and wellbeing</li> </ul>	Public access is developed or enhanced based on community needs and priorities, meeting or exceeding the following % of total project area: <ul style="list-style-type: none"> <li>10% for industrial (or monitored tours), 90% for parks, 30% all other projects</li> <li>Designs must avoid sensitive habitats and enhance community connectivity, health and wellbeing</li> </ul>	<ul style="list-style-type: none"> <li>% of total area created, enhanced, and/or preserved for public access (or evidence of monitored public access/tours provided for industrial)</li> <li>Alignment with community goals and level of connectivity, health and wellbeing enhancement</li> </ul>	<ul style="list-style-type: none"> <li>Site plans/calculation indicating % new, enhanced, and/or preserved public access area</li> <li>Narrative describing how the community/historical context and connectivity, health and wellbeing assessments influenced designs</li> </ul>		E.g. monitor the following activities and user characteristics annually: <ul style="list-style-type: none"> <li>The number of handicapped users on site</li> <li>The percentage of children and elderly of total visitors</li> </ul>	

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
2.2	<ul style="list-style-type: none"> <li>Community and historical context</li> <li>Community connectivity, health and wellbeing</li> </ul>	Significantly minimize impacts of industrial operations on community health and wellbeing	Implementation of designs to significantly reduce industrial impacts on community health and wellbeing	Annotated construction documents or narrative showing measures to reduce impacts from industrial operations			
2.3	<ul style="list-style-type: none"> <li>Community and historical context</li> <li>Community connectivity, health and wellbeing</li> </ul>	<ul style="list-style-type: none"> <li>Regular seasonal environmental and/or cultural/historical programming is provided via agreement with program partners, and informed by/consistent with community priorities and context.</li> <li>Development subsidizes at least two % of programming operating budget</li> <li>Facilities provided for programming partners</li> <li>Three or more passive educational design features implemented</li> </ul>	<ul style="list-style-type: none"> <li>Agreement with programming partners established or plan to provide seasonal educational and/or cultural/historical programs</li> <li>% of programming costs covered by landowner</li> <li>Facilities and resources provided for partners</li> <li>Implementation of passive educational features</li> <li>Alignment with community/historical context assessment</li> </ul>	Narrative or documentation describing programming activities (and community influence on their design). And, as applicable: <ul style="list-style-type: none"> <li>Partnership agreements</li> <li>Program costs (and amount subsidized)</li> <li>Construction documents indicating programming facilities</li> </ul>		Annual assessment and reevaluation of programming (e.g. number of programs, number of attendees/program, request for new programs)	
2.4	<ul style="list-style-type: none"> <li>Stability, soils, and marine asset condition</li> <li>Transportation access</li> <li>Community and historical context</li> </ul>	<ul style="list-style-type: none"> <li>User-friendly and sustainable ferry docking facilities and transit wayfinding/upland connections are created or preserved or improved</li> <li>Operating funds for a water or land-based transportation service or agreement with transit authorities to obtain public transit extension</li> </ul>	<ul style="list-style-type: none"> <li>Ferry infrastructure is implemented using recommended strategies (including providing wayfinding/upland connections)</li> <li>% ferry operations subsidized or shuttle/ public bus transit route extended</li> <li>Sensitive habitat is avoided</li> </ul>	Annotated construction documents indicating new or renovated ferry and public transit infrastructure (must indicate sustainability and accessibility features), transit service agreements, operating funding documentation, maintenance plan.	See credit 3.3 and ASCE routine inspection guidance	Refer to ASCE_ Table 2.2 Recommended Maximum Interval between Routine Inspections (years)	

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
2.5	<ul style="list-style-type: none"> <li>• Employment opportunities</li> <li>• Community and historical context</li> </ul>	<ul style="list-style-type: none"> <li>• At least 75% of full-time maritime-related jobs provided on site with minimum benefits</li> <li>• Partnership or financial support for vocational training in maritime careers</li> <li>• Preserve at least 25% of new full-time positions for low-income/ under-represented residents</li> </ul>	<ul style="list-style-type: none"> <li>• % of full-time maritime-related jobs is provided on site with minimum benefits</li> <li>• Financial support for maritime vocational training provided</li> <li>• % of new positions or vocational training reserved for low-income/ under-served residents</li> </ul>	<ul style="list-style-type: none"> <li>• Narrative and documentation showing required provision of jobs, training, and support,</li> <li>• Description of how analysis of community demographics/community feedback determined local hiring needs</li> </ul>			
2.6	<ul style="list-style-type: none"> <li>• Community connectivity, health and wellbeing</li> <li>• Community and historical context</li> <li>• Transportation access</li> <li>• Stability, soils, and marine asset condition</li> <li>• Tidal range</li> </ul>	<ul style="list-style-type: none"> <li>• Pathways continue along entire shoreline (unless siting conflicts with sensitive habitat)</li> <li>• Designs accommodate a range of physical capabilities and activities</li> <li>• Regional greenway priorities are incorporated</li> <li>• Boardwalks elevated above future MHHW</li> </ul>	<ul style="list-style-type: none"> <li>• A continuous shoreline pathway/greenway is implemented to the extent feasible</li> <li>• Measures taken to accommodate a range of physical capabilities and activities</li> <li>• Regional greenway priorities incorporated</li> <li>• Actual boardwalk elevation (must be above future MHHW)</li> </ul>	<ul style="list-style-type: none"> <li>• Site plans</li> <li>• Maintenance plan</li> <li>• Narrative identifying measures to avoid sensitive habitat, design for future sea level rise, increase accessibility, safety, and visual interest</li> <li>• Contribution to regional greenway plans, if applicable</li> </ul>	See credit 3.3 and ASCE routine inspection guidance	Refer to ASCE_ Table 2.2 Recommended Maximum Interval between Routine Inspections (Years)	
2.7	<ul style="list-style-type: none"> <li>• Community connectivity, health and wellbeing</li> <li>• Community and historical context</li> <li>• Stability, soils, and marine asset condition</li> <li>• Offshore depth</li> <li>• Tidal range</li> <li>• Slope and shoreline shape</li> <li>• Waves</li> <li>• Wakes</li> <li>• Currents</li> </ul>	<p>Provide any one or more of the following direct connections to the water based on required initial assessments:</p> <ul style="list-style-type: none"> <li>• Beaches</li> <li>• Get-downs</li> <li>• Human-powered shoreline boat launches</li> <li>• Public fishing amenities</li> </ul> <p>Designs must incorporate recommended strategies</p>	<ul style="list-style-type: none"> <li>• Type and quantity of direct connections (beaches, get-downs, human-powered boat launches, public fishing amenities) implemented using recommended design strategies</li> <li>• Alignment with community goals</li> <li>• Design are appropriate for site hydrodynamic and ecological conditions</li> </ul>	Annotated construction documents indicating required design features (noting any features directly informed by community and historical context)	See credit 3.3 and ASCE routine inspection guidance	Refer to ASCE_ Table 2.2 Recommended Maximum Interval between Routine Inspections (Years)	

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
2.8	<ul style="list-style-type: none"> <li>Community and historical context</li> <li>Stability, soils, and marine asset condition</li> <li>Offshore depth</li> <li>Tidal range</li> <li>Currents</li> <li>Ice</li> </ul>	<p>Support diverse and sustainable maritime activation by providing any one or more of the following in-water features (consistent with context and intended use):</p> <ul style="list-style-type: none"> <li>Mooring fields</li> <li>Floating docks</li> <li>Piers</li> <li>Clean marinas (design and operations follow best practices from the National Park Service's Clean Marina Guidebook and provide at least 10% slip/dock space for public programming)</li> </ul> <p>Designs must incorporate recommended strategies</p>	<ul style="list-style-type: none"> <li>Type and quantity of in-water features implemented using the recommended strategies</li> <li>Alignment with community goals</li> <li>Designs are appropriate for site hydrodynamic and ecological conditions</li> <li>Clean Marina certification attained (if state has Clean Marinas program) or narrative describes implementation of Clean Marinas best practices</li> <li>For Clean marinas, % of slip/dock space reserved for public programming achieved</li> </ul>	<ul style="list-style-type: none"> <li>Annotated site plans and construction documents indicating relevant design features (noting any features directly informed by community)</li> <li>Maintenance plan</li> <li>For marinas, Clean Marina certification is attained (if state has Clean Marinas program) or narrative is provided to describing implementation of NPS best practices and % reserved public dock space</li> </ul>	See credit 3.3 and ASCE routine inspection guidance	Refer to ASCE Table 2.2 Recommended Maximum Interval between Routine Inspections (years)	
3.1	<ul style="list-style-type: none"> <li>Slope and shoreline shape</li> <li>Risk and vulnerability to sea level rise and storm surge</li> <li>Tidal range</li> <li>Wind</li> <li>Stability, soils, and marine asset condition</li> <li>Offshore depth</li> <li>Habitat quality</li> <li>Habitat extent</li> <li>Waves</li> <li>Wakes</li> <li>Currents</li> </ul>	<ul style="list-style-type: none"> <li>Stabilization method is consistent with the intended use and context, as informed by Appendix B</li> <li>Nature-based features are employed along at least 25% or 50% or of the shoreline</li> </ul>	<ul style="list-style-type: none"> <li>Stabilization method is consistent with the intended use and context, as informed by Appendix B</li> <li>% of shoreline covered by nature based features</li> </ul>	<ul style="list-style-type: none"> <li>Initial assessment from credit 0.2</li> <li>Narrative describing analysis as related to Appendix B</li> <li>Construction documents</li> <li>Maintenance plan</li> </ul>	Plans to conduct regular maintenance	<p>Monitor structural stability/health, at least every five years and following extreme events including evidence of erosion/rate and scour/wave damage and:</p> <ul style="list-style-type: none"> <li>For structural components: ASCE Waterfront Facilities Inspection and Assessment Manual</li> <li>For soft edges: habitat extent</li> </ul>	



	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
3.2	<ul style="list-style-type: none"> <li>Slope and shoreline shape</li> <li>Offshore depth</li> </ul>	Slope and shape of designed shoreline are consistent to natural reference condition (or improved from existing condition) along at least 20% or no less than 50 feet of shoreline	% of shoreline with slope and shape that is: <ul style="list-style-type: none"> <li>Consistent with site and local natural reference condition or;</li> <li>Improved to increase consistency with natural reference condition (conventional method)</li> </ul>	<ul style="list-style-type: none"> <li>Grading plan</li> <li>Site assessment</li> </ul>	See <b>credit 3.1</b>	Monitor slope and shape in reference to original construction/target (every 5 years and following extreme events)	
3.3	<ul style="list-style-type: none"> <li>Waves</li> <li>Wakes</li> </ul>	Fendering strategy protects marine assets for general use and storm conditions	Construction documents indicate use of fenders or other sufficient protection strategy for general use and storm conditions	Construction documents indicating use of fenders	Inspect and adjust fendering strategy as needed	Effectiveness of fendering strategy on preventing wear/tear of maritime structures (regular/seasonal, event-based)	E.g. Inspect and adjust fendering strategy as needed
3.4	N/A	Reduce impacts of in-water structural components along at least 25% of shoreline or no less than 50 feet through use of materials supportive of beyond conventional methods	% of shoreline with enhancements or designs that are supportive of biodiversity and abundance beyond conventional methods or N/A (natural shoreline edge)	<ul style="list-style-type: none"> <li>Annotated site plan or narrative</li> <li>Maintenance plan</li> </ul>	See <b>credit 3.1</b>	Biodiversity and abundance associated with materials/surfaces over time (seasonal/annual)	

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
4.1	<ul style="list-style-type: none"> <li>Habitat extent</li> <li>Habitat quality</li> <li>Vegetation density/cover</li> <li>Ecosystem services</li> <li>Relevant regional restoration plans/priorities</li> <li>Impacted area</li> </ul> <p>If restoring in-water habitats, add:</p> <ul style="list-style-type: none"> <li>Currents</li> <li>Waves</li> <li>Wakes</li> <li>Slope and shoreline shape</li> <li>Risk and vulnerability to sea level rise and storm surge</li> <li>Tidal range</li> <li>Stability, soils, and marine asset condition</li> <li>Sunlight exposure</li> <li>Water quality</li> </ul>	<ul style="list-style-type: none"> <li>Avoids loss of habitats and ecosystem services</li> <li>Restores at least 10 or 20% habitat of total project size/or preserves 20 or 30% habitat of total project size</li> <li>Contributes to regional restoration plans/priorities</li> </ul>	<ul style="list-style-type: none"> <li>Avoids loss of habitats and ecosystem services (Y/N)</li> <li>% restoration/preservation extent (acreage/% project size)</li> <li>Contributes to regional restoration plans/priorities (Y/N)</li> </ul>	<ul style="list-style-type: none"> <li>Narrative, planting plan</li> <li>Construction documents</li> <li>Monitoring and adaptive management plan.</li> </ul>			

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
4.2	<ul style="list-style-type: none"> <li>Habitat quality</li> <li>Habitat extent</li> <li>Vegetation density/cover</li> </ul>	<ul style="list-style-type: none"> <li>Average patch size is at least five % (10% for parks) of the total new landscaped area, or a net increase in restored contiguous in-water habitat</li> <li>New habitat corridors to contiguous habitat established or new connectivity between at least two habitats is restored on site</li> </ul>	<ul style="list-style-type: none"> <li>% average patch size of total landscaped area or net increase in restored contiguous in-water habitat (Y/N)</li> <li>New habitat corridors established (Y/N)</li> </ul>	<ul style="list-style-type: none"> <li>Planting plan</li> <li>Maintenance and adaptive management plan</li> </ul>			
4.3	<ul style="list-style-type: none"> <li>Habitat quality</li> <li>Vegetation density/cover</li> </ul>	Increased native plant coverage by either at least 75% or 85% of total planned coverage	% designed native plant coverage in relation to pre-design achieved	<ul style="list-style-type: none"> <li>Planting plan</li> <li>Habitat map</li> <li>Narrative</li> </ul>	Adaptive management and maintenance of native species mix		
4.4	<ul style="list-style-type: none"> <li>Habitat quality</li> <li>Habitat extent</li> </ul>	Project minimizes and manages human disturbance over time	Site plan and narrative demonstrate measures taken to reduce disturbance caused by human activity and lighting	<ul style="list-style-type: none"> <li>Construction documents</li> <li>Narrative</li> <li>Maintenance and adaptive management plan</li> </ul>	Monitor effectiveness of strategies to prevent human disturbance over time	E.g. evidence of human disturbance to natural areas (seasonal/annual)	E.g. increase in buffer width or installation of vegetation or structural barriers between people/habitats
4.5	Contamination	Standard to which the project aims to achieve (e.g. environmental or recreational standard as defined by the state)	Contamination level at construction	<ul style="list-style-type: none"> <li>Agency certification of completion of cleanup</li> <li>Documentation of sustainability and resilience features</li> </ul>	Only applicable if site is at risk for ongoing exposure	Only applicable if site is at risk for ongoing exposure	Only applicable if site is at risk for ongoing exposure
4.6	N/A	<ul style="list-style-type: none"> <li>At least 30% or 50% of total fill material re-used on site</li> <li>At least 50% fill/ clean dredged material is sourced from within 30 miles if trucked or 50 miles if barged</li> </ul>	<ul style="list-style-type: none"> <li>% of fill material re-used on site</li> <li>% of sourced fill/clean dredged material sourced off-site and number of miles transported/ mode of transportation</li> </ul>	<ul style="list-style-type: none"> <li>Narrative</li> <li>Relevant permits</li> <li>Soil quality documentation</li> </ul>	N/A - at the time of construction only		

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
4.7	N/A	<ul style="list-style-type: none"> <li>Renewable power systems power at least 50% or 100% of annual, site-wide outdoor energy (or active maritime) needs and/or;</li> <li>Dock-side electric cold ironing provided</li> </ul>	<ul style="list-style-type: none"> <li>% renewable energy provided for site-wide outdoor energy (or active maritime) needs</li> <li>Dock-side electric cold ironing provided</li> </ul>	<ul style="list-style-type: none"> <li>Site plans</li> <li>Narrative and documentation of energy production</li> </ul>			
4.8	Habitat extent	<ul style="list-style-type: none"> <li>Reuse of materials, waste minimization, and reduction of construction impacts</li> <li>Participation in materials exchange program</li> </ul>	Narrative describes: <ul style="list-style-type: none"> <li>Plans to reuse materials, minimize waste, and reduce construction impacts</li> <li>Participation in materials exchange program</li> </ul>	<ul style="list-style-type: none"> <li>Narrative</li> <li>Diverted waste documentation</li> <li>Participation in materials exchange program</li> </ul>	N/A - at the time of construction only		
4.9	<ul style="list-style-type: none"> <li>Precipitation</li> <li>Discharge rate</li> </ul>	Capture, infiltrate, or treat a target percentile storm or intensity/duration/frequency to at least the minimum standard for achievement (see credit for levels of achievement)	<ul style="list-style-type: none"> <li>Percentile or IDF-curve-based rain event capture (if drains to sewer, does not exceed the discharge rate f<sup>3</sup>/s relative to the pre-existing condition)</li> <li>Additional volume captured to accommodate climate change or adjacent properties</li> </ul>	<ul style="list-style-type: none"> <li>Site plans</li> <li>Hydrologic analysis</li> <li>Identification of discharge point for onsite runoff</li> <li>Letter or memo of confirmation from local environmental agency if handling off-site stormwater as well as onsite</li> </ul>	E.g. maintenance of stormwater features, cleaning of sediment from pervious pavement, etc.	Presence of flooding and/or scour, capacity exceedance of stormwater features, annual monitoring	
4.10	<ul style="list-style-type: none"> <li>Precipitation</li> <li>Stormwater quality</li> </ul>	Avoid new pollution and improve the quality of stormwater before it enters water bodies	<ul style="list-style-type: none"> <li>Stormwater quality: TSS achieves avg concentration less than or = 25 mg/L or exceeds local or TMDL requirements</li> <li>Fertilizer use: application of fertilizers or chemical pest control avoid the wettest parts of the year or no chemical pest control/ fertilizers will be used</li> </ul>	<ul style="list-style-type: none"> <li>Hydrologic analysis includes design calculations indicating requirements have been met</li> <li>Narrative describes pollutant control method (industrial and maritime sites only)</li> <li>Operations and maintenance plan</li> </ul>	E.g. maintenance of stormwater features, cleaning of sediment from pervious pavement, etc.		

	INITIAL ASSESSMENT	PERFORMANCE			MAINTENANCE AND ADAPTIVE MANAGEMENT		
Credit	Initial assessment(s)	Performance goal	Design level	Documentation	Operations & maintenance	Monitoring type & interval	Adaptive strategies
4.11	Water use and wastewater management	<ul style="list-style-type: none"> <li>Indoor water use: 20% reduction or more</li> <li>Outdoor water use: 50% reduction or more</li> <li>Sewage use: 20% or more treated on site</li> </ul>	% indoor and outdoor water use and wastewater volume production achieved	<ul style="list-style-type: none"> <li>Site plans</li> <li>Hydrologic analysis with (including design calculations indicating that scoring requirements have been met)</li> </ul>	E.g. monitor water use and wastewater volume	Actual water volume used/ wastewater volume over time	
4.12	Temperature	<ul style="list-style-type: none"> <li>Greenscape coverage (at least 50% or 75% of unbuilt total site)</li> <li>Low-albedo material use (at least 50% of total hardscapes)</li> </ul>	<ul style="list-style-type: none"> <li>% greenscaping of total built site</li> <li>% low-albedo material used on total hardscapes</li> </ul>	<ul style="list-style-type: none"> <li>Narrative</li> <li>Site plan with (including design calculations indicating that scoring requirements have been met)</li> </ul>			
4.13	N/A	Agreement is procured with an academic/research partner to provide data and/or to study the site for five years or more	Agreement is procured with an academic/research partner to provide data and/or to study the site for five years or more	Agreement with partner institution	E.g. regular/ planned communication with partner over time to inform decision-making		
5.1	Depends on focus	Target inventive design and performance level	Proposed credit reflects inventive design that achieves measurable improvements in resilience, access, and/or ecology and is not currently included in WEDG	<ul style="list-style-type: none"> <li>Narrative</li> <li>Other supporting documents, as needed</li> </ul>			
5.2	Depends on focus	Target credit and exceedance level	Project significantly surpasses the requirements for up to two credits	<ul style="list-style-type: none"> <li>Narrative</li> <li>Other supporting documents, as needed</li> </ul>			

## Initial Assessment Suggested Methods<sup>1</sup>

The following is a list of suggested methods and levels of analysis to support the baseline analysis of site context.

### COMMUNITY AND HISTORICAL CONTEXT

**Existing plans:** Identify and note significant findings and priorities of existing community vision plans, neighborhood studies, and planning policies.

**Needs:** Identify areas where community has identified outstanding needs (e.g. in a community needs assessment), such as resilient, affordable housing or waterfront green space.

**Demographics:** Conduct a baseline community assessment with demographic components (income, age, language, ethnicity, race) of communities geographically or functionally affected by the project. The community's geographic boundaries are typically within one quarter mile for dense residential or mixed-use areas, but may be expanded for industrial or low-density areas. Geographic boundaries of the assessment should be adjusted to incorporate marginalized groups who may not be represented by the immediate geographic community. For example, for projects sited in low-income or historically underserved communities in dense urban neighborhoods, design teams might focus on residents within one quarter of a mile, while for those located in higher-income areas, tourist districts, or areas with high employment, teams might focus on engaging populations from surrounding under-served areas.<sup>2</sup>

**Stakeholders:** Identify key community stakeholder groups (e.g. residents, small business owners, locally-active nonprofit organizations and informal stewardship groups, others) for engagement during the planning process.

**History and culture:** conduct background research on site history and culture (e.g. historic industrial and maritime use, indigenous artifacts) and note significant findings/site features (**credit 2.3**).

**Relevant credits: 0.3, 2.1-2.8**

### COMMUNITY CONNECTIVITY, HEALTH AND WELLBEING

Identify existing visual connections (e.g. visual corridors, and site-wide transparency) to the water, and identify opportunities to preserve or enhance these connections. Note location of any combined sewer outlets for sites where in-water access or direct access is planned (and tier, if applicable). Additionally, identify existing greenway or pathway networks, and identify connections within site. Finally, note location of any combined sewer outlets for sites where in-water access or direct access is planned (and tier, if applicable).

**Relevant credits: 1.3, 1.4, 2.1, 2.2, 2.6- 2.7**

**Additional resources:** Gehl Institute Tools for Measuring Public Life.

### CONTAMINATION

Identify any pre-design contaminants and levels relevant to exceedance of defined state or federal standards for the intended use based on a Phase I Environmental Site Assessment as described in ASTM E1527-05 (or local equivalent). Required if there is any evidence of contamination on site or history of contamination on adjacent sites. If contamination is suspected, conduct a Phase II Environmental Site Assessment as described in ASTM E1903-11 (or local equivalent).<sup>3</sup> Additionally, assess whether site is entered

<sup>1</sup> Note: those seeking LEED V4 BD+C and/or sites; some elements of this site assessment are equivalent to LEED V4 BD+C SS Credit: Site Assessment and SITES Prerequisite 2.2: Conduct a pre-design site assessment

<sup>2</sup> LEED v4 BD+C: New Construction, "Social equity within the community."

<sup>3</sup> Methods from (and satisfied by successfully achieving) LEED V4 BD+C SS Prerequisite: Environmental Site Assessment



into a local, state, or federal brownfield voluntary cleanup program or is part of an EPA Superfund listing or ongoing investigation.

**Relevant credit: 4.5**

### CURRENTS

Although waves are generally considered to be the primary force impacting the design of coastal structures, currents also play an important role, particularly when planning living shorelines or boat launches and in-water structures. Currents have the capacity to uproot vegetation, scour the bank, and during storms can transport debris which increases the scour potential.

**Level 1, desktop analysis:** It is rare that sufficient data exists to perform a desktop analysis. General data can be obtained from NOAA, USGS, and the US Army Corps of Engineers. These sources do not provide enough localized detail for final design of in-water or edge features. However, for some locations, detailed hydrodynamic models exist, from which typical or even storm currents may be extracted, or statistical summaries or climatologies based on measured and/or modeled data may exist.<sup>4</sup>

**Level 2 analysis, current measurements:** an Acoustic Doppler Velocimeter (ADV) or Acoustic Doppler Current Profiler (ADCP) or similar on-site measurement can be used to assess local currents and force effects on structures, sediment transport, and scour potential.

**Level 3 analysis, current modeling:** depending on the level of complexity and scale of the project, more sophisticated hydrodynamic modeling may be needed.<sup>5</sup>

**Relevant credits: 2.7, 2.8, 3.1, 4.1 (if in-water or wetland restoration is included)**

### DISCHARGE RATE

If stormwater leaves the site via direct drainage or is otherwise managed on site, this analysis is not necessary. If the stormwater system is in an urban area and will be connected to a municipal stormwater or combined sewer system, determine the current discharge rate, using the Natural Resource Conservation Service Technical Release 55 (TR-55) or comparable method to attain a runoff curve number (inches of runoff discharge/inches of rainfall) to calculate runoff discharge from pre- and post-development conditions to project effectiveness of options for managing runoff volume and peak flow discharges.

**Relevant credit: 4.9**

### ECOSYSTEM SERVICES

List key ecosystem services that the site currently provides.

**Relevant credit: 4.1**

### EMERGENCY PREPAREDNESS

Identify existing emergency preparedness plans applicable to your site. Identify network of on-site leaders and local, state, and federal authorities, hurricane evacuation zone (or relevant disaster zone), and any necessary emergency operational procedures (e.g. deploying flood barriers, running generators, securing equipment, ensuring egress for tenants/employees and ingress for evacuation teams).

**Relevant credit: 1.5**

<sup>4</sup> For New York, see NYHOPS and physical forces climatology for the Hudson River

<sup>5</sup> Readily available packages include FVCOM, SWAN, Delft 3D, Mike21, ROMS, and Ecomsed (see "waves, level 3 analysis")

## EMPLOYMENT OPPORTUNITIES

Based on the results and of the community assessment (**credit 0.3**), and input from partnerships with local community organizations, assess the economic conditions affecting the site and determine what jobs and vocational training opportunities are possible to provide on site, particularly for industrial and maritime sites. Use the demographic and community assessment to determine the need to prioritize local hiring (i.e. if the local community is predominantly low-income and historically underrepresented groups).

**Relevant credit: 2.5**

## HABITAT EXTENT

**Level 1, desktop analysis (appropriate for retrofits and urban infill with little habitat):** map extent of existing habitats, with an emphasis on critical and vulnerable habitats, including, but not limited to, the following

- › Wetlands and mangroves and jurisdiction as mapped by federal agencies, the US Army Corps of Engineers and/or state regulatory entities or via natural resources investigation and delineation by a professional (denoting presence and extent of hydric soils and hydrophytic vegetation, and wetlands hydrology). Wetlands are defined in the US Clean Water Act and delineated according to the appropriate state supplement to the US Army Corps of Engineers delineation manual. *Note: if wetlands are not mapped but suspected on site, contact state regulatory agencies or an environmental professional, who can also perform a site review to assist with delineation;*<sup>6</sup>
- › Water bodies, including streams and unconnected ponds or lakes;
- › Coastal shrublands and maritime forest;
- › Significant habitats and those supporting threatened, endangered, or locally-rare species, as designated by federal or state agencies;
- › Regional, state, or local habitat restoration plan priority restoration and conservation areas;
- › Coastal barriers resource system (USFWS) and natural protective features or those vulnerable to erosion (dunes, bluffs);
- › Ecological Systems of the United States (NatureServe).

**Level 2 (on-site) analysis:** in addition to referencing the data collected via a desktop (level 1) analysis, delineate habitats on site and develop a detailed existing conditions habitat map.

**Relevant credits: 1.2, 2.1, 3.1, 4.1, 4.2, 4.4**

## HABITAT QUALITY

In addition to an inventory of current and historical land use (if available), use one of two approaches to assess habitat quality. If in-water modification (other than minor) is pursued, a benthic index of biotic integrity is required.

**Level 1, rapid inventory assessment (retrofit, urban infill):** conduct a field assessment of the project site including upland, intertidal, and in-water areas (if there will be in-water construction) with consideration given to adjacent sites. The rapid inventory assessment must identify and determine the quality of these ecological communities through measures of biodiversity, species richness, and abundance or other measures of productivity. Estimate habitat and soil type and extent.

<sup>6</sup> For more detail, see: 1987 US Army Corps of Engineers Wetlands Delineation Manual and Regional Supplements. And United States Environmental Protection Agency. (n.d.). Wetlands Monitoring and Assessment. Retrieved from <https://www.epa.gov/wetlands/wetlands-monitoring-and-assessment>. And Cowardin, L., Carter, V., Golet, F., & LaRoe, E. (1979). Classification of Wetlands and Deepwater Habitats of the United States. Washington, DC: United States Department of the Interior, Fish and Wildlife Service. Retrieved from Classification of Wetlands and Deepwater Habitats of the United States.

**Level two, intensive functional assessment:** conduct an in-depth, intensive functional assessment of ecological assessment and habitat suitability analysis for any planned restoration or mitigation. Identify the performance and value of ecosystems functions and services provided by the natural resources on site. An advanced hydrologic analysis should accompany this assessment. Option two is required for projects expecting to result in impacts to critical habitats as defined in **Responsible Siting & Coastal Risk Reduction, Credit 3: Site with ecological sensitivity**. If potentially relevant, consult the US Army Corps of Engineers' Wetlands Delineation Manual, state guidance, and/or a professional trained in wetlands delineation to determine the extent of wetlands and any adjacent regulated areas.

*Note: for retrofit and redevelopment projects in areas with no existing habitat, assessment of habitat quality may be omitted (must be consistent with "presence and extent of existing habitat" analysis).*

**Relevant credits: 3.1, 4.1-4.4**

**Additional resources:**

- › Developing Conceptual Models for Monitoring
- › Wetlands monitoring and assessment
- › A Practitioners Guide to the Design and Monitoring of Shellfish Restoration Projects
- › Living shorelines: A Framework for Standardized Monitoring of Living Shorelines In the Delaware Estuary and Beyond
- › Coastal and Marine Ecological Classification Standard
- › Ecological Integrity Assessment and Performance Measures
- › Locally-appropriate Benthic Indices of Biotic Integrity for nearshore habitats
- › Evaluation for Planned Wetlands (for coastal wetlands)
- › Uniform Mitigation Assessment Methods

## ICE

Like wakes, ice is known to have a significant impact on shoreline and coastal structure stability, though data characterizing and understanding of impacts of ice are lacking.<sup>7</sup> Estimate thickness of ice based on available data or observation.<sup>8</sup>

*Note: in absence of multi-year data, a rough estimate is acceptable.*

**Relevant credits: 2.8, 3.1**

## IMPACTED AREA

Identify the acreage of and describe any impacted areas or provide a draft environmental impact statement.

**Relevant credits: 4.1**

<sup>7</sup> In some locations, the Coast Guard and other organizations collect ice records or data. For example, The National Ice Center archives ice cover within Delaware Bay, based on an analysis of MODIS (Moderate Resolution Imaging Spectroradiometer) imagery and provides estimates of ice presence but not thickness. Or, in New York State, some historic ice analysis has been conducted in the Hudson.

<sup>8</sup> See also United States Army Corps of Engineers Cold Regions Research and Engineering Laboratory. (2004). Method to Estimate River Ice Thickness Based on Meteorological Data. Hanover, NH: ERDC/CRREL Technical Note 04-3. Retrieved from <http://acwc.sdp.sirsi.net/client/search/asset/1001540;jsessionid=1683B9D8A5499B82984FE2D16196A230.enterprise-15000>.

## OFFSHORE DEPTH

For edge stabilization and in-water access features (e.g. piles, floating docks, beaches, get-downs), offshore depth is an important consideration. Deeper water has less ability to dissipate wave and wake energy, and affects the amount of fill material and size and type of stabilization.

**Level 1, desktop analysis:** the datasets available for assessing offshore water depths are essentially the same as those for nearshore slopes. However the resolution issues are generally less of a concern when determining offshore depths. Bathymetry data can be found via NOAA charts from which nearshore slopes can be inferred. Additionally, the NOAA Coastal Services Center maintains a database of estuarine bathymetry data digital elevation models created by merging multiple surveys collected over time together.

**Level 2, bathymetric survey:** in projects involving more significant in-water features or edge stabilization, an on-site bathymetric survey is likely needed for final design. The nearshore region tends to be dynamic and older surveys may miss important features. Project specific bathymetric surveys can be conducted using a jet-ski, boat or kayak, equipped with GPS and sonar.<sup>9</sup> To maximize the amount of area that can be covered during the hydrographic survey, the survey should be performed at high tide.

**Relevant credits: 2.7-2.8; 3.1, 3.2**

## PRECIPITATION

Calculate the current and regionally-adjusted climate projections for your region, as follows. This information will inform the approach for managing stormwater described in **credits 4.9-4.10**.

**Option 1: Percentile storm event-based analysis:** *this option may be more suitable for suburban and less urban sites, or municipalities in which this is the standard method.*

- Obtain a long-term rainfall record using the EPA Stormwater Calculator tool or from a nearby weather station (daily precipitation is fine, but try to obtain at least the most recent 30 years of daily records), available from many sources including NOAA.
- Remove data for small rainfall events that are 0.1 inch or less and snowfall events that do not immediately melt from the data set (events that don't typically cause runoff and could potentially render the analysis inaccurate).
- Using a spreadsheet or simple statistical package, sort the rainfall events from highest to lowest in inches or centimeters. In the next column, calculate the percentage of rainfall events that are less than each ranked event (event number/total number of events). For example, if there were 1,000 rainfall events and the highest rainfall event was a 4-inch event, then 999 events (or a percentile of 999/1000, or 99.9 percent) are less than the 4-inch rainfall event.
- Review expected future precipitation trends based on downscaled climate change projections, via the USGS National Climate Change Viewer, local, municipal, or state regional climate projections. Adjust target precipitation event to accommodate expected regional shifts in precipitation based on the design life of the project and infrastructure [https://www2.usgs.gov/climate\\_landuse/clu\\_rdr/nccv/viewer.asp](https://www2.usgs.gov/climate_landuse/clu_rdr/nccv/viewer.asp) assets.

**Option 2: Storm event capture based on intensity/frequency/duration:** *this option may be more suitable for highly urban sites with high levels of impervious surface and for which the majority of stormwater flows into stormwater or combined sewer-stormwater infrastructure.* Obtain precipitation frequency estimates using NOAA Atlas 14 to inform target storm and frequency capture. Adjust target precipitation event to accommodate expected regional shifts in precipitation based on the design life of the project using expected future precipitation trends, based on downscaled regional climate change projections using the USGS National Climate Change Viewer, or local or state regional climate projections.

**Relevant credits: 4.9-4.10**

<sup>9</sup> Hampson, R., MacMahan, J. & Kirby, J. (2011). A Low-Cost Hydrographic Kayak Surveying System. *Journal of Coastal Research*, 27(3), 600-603. Retrieved from <http://www.jcronline.org/doi/abs/10.2112/JCOASTRES-D-09-00108.1?code=cerf-site>. See also Miller, J. (2011). Beach Research Survey Vehicle: DUCKS Jet Ski. Retrieved from <https://www.youtube.com/watch?v=3ZraiYGmgZM>.

## RISK AND VULNERABILITY TO SEA LEVEL RISE AND STORM SURGE

An assessment of risk and vulnerabilities associated with future inundation and storm surge in the site context (including existing structures) should be conducted to at least a level one analysis. In this assessment and planning context, risk is considered to be a combination of exposure to hazard events and future inundation, and existing vulnerabilities. Designers should then use this analysis to reduce the vulnerabilities of existing and future structural and natural components. Vulnerability refers to the propensity of exposed elements to suffer adverse impacts (based on their sensitivity and capacity for responding to that risk).<sup>10</sup>

As sea level rises, the extent, frequency, and duration of coastal flooding will increase. It is important to consider the effects of both regular inundation (flooding associated with regular tidal cycles, spring tides, on-shore winds, and extreme rainfall) and event-based flooding (inundation from surge and waves during coastal storm events) in siting and design. The below steps support a risk and vulnerability assessment to inform a design approach consistent with guidance detailed in **credit 1.1**. *Note: WEDG and these analyses are targeted for areas vulnerable to coastal flooding, and are less suitable for those subject to riverine/inland flooding.*

**Level 1, desktop analysis:** the following mapping data and project layers at the site scale should be collected, along with any existing structures and their current finished floor elevations:

- **Site topography:** a topographic analysis will inform site design and integrated flood risk reduction strategy, through identification of areas vulnerable to flooding and sea level rise. Design teams should gather the highest resolution topographic data (usually LiDAR) available. The US Geological Survey's National Map page provides some one-meter resolution data, and many states and municipalities also have more extensive or higher resolution topographic information available in GIS databases, and therefore should be consulted as well. Depending on the level of complexity of the project, and whether or not high-resolution data are available), a more detailed topographic survey should be performed. These topographic analyses should be overlain with FEMA current 100-year flood maps including base flood elevation and considering future high water levels (see "sea level rise," below) to determine detailed grading, design flood elevation for structures and paths, and planting/landscape design. Additionally, low-lying hydrologically unconnected areas that may also flood due to extreme rainfall should be mapped for these purposes.<sup>11</sup>
- **Sea level rise:** an understanding of the regionally-adjusted rate of sea level rise is critical to determining site-wide planning and design, including plantings, elevation, and any site-wide flood risk reduction measures (when paired with site topography and base flood elevation). In addition to raising local risks to extreme flooding, regular inundation from future high tides can affect infrastructure, built structures, natural resources, and edge stabilization as well as day-to-day access, operations, or activities. Conduct the following analyses to inform site planning and design:

  - Determine the local/regional sea level rise rate and expected level of sea level rise (moderate/RCP 4.5 scenario or higher) throughout the design life of the project, using the following data sources in order of preference: 1) peer-reviewed local/regional sources;<sup>12</sup> 2) NOAA/federal;<sup>13</sup> or 3) Climate Central's Surging Seas Risk Finder. Depending on whether a particular structure must maintain uninterrupted operations throughout a storm (e.g. a hospital), has high-value components (machinery), or includes storage of hazardous or potentially-polluting substances design teams may consider using the "high" (rather than moderate) sea level rise scenario. This should be especially considered for projects not yet within, but close to, the current Limit of Moderate Wave Action (LiMWA), due to potential changes in wave height and inland shifts in the LiMWA.

<sup>10</sup> Cardona, O.D., van Aalst, M.K., Birkmann, J., Fordham, M., McGregor, G., Perez, R., . . . Sinh, B.T. (2012). Determinants of risk: exposure and vulnerability. In C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, . . . P.M. Midgley (Eds.), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change* (IPCC) (pp. 65-108). Cambridge, UK: Cambridge University Press

<sup>11</sup> A coarse analysis of low-lying, hydrologically unconnected areas is available from NOAA Sea Level Rise Viewer's Local Scenarios

<sup>12</sup> As rates of sea level rise vary regionally (due to climatic, hydrologic, and geomorphic factors including glacial rebound and subsidence), regional or locally-specific sea level rise data are preferred.

<sup>13</sup> NOAA's Sea Level Rise Viewer provides a "Local Scenarios" feature for some areas, which depicts local sea level rise rates

- Map future high tide water level extent: mapping sea level rise provides a useful reference for planning, though it should be noted that high-resolution topographic data are primarily critical to determining a detailed design approach.<sup>14</sup> Use the following data sources in order of preference for geographic data: 1) peer-reviewed local/regional sources;<sup>15</sup> or 2) NOAA/federal resources.
- **Storm surge and flood risk (current and future):** event-based extreme or intense inundation, high water velocity and wave attack can severely damage structures, natural resources, and both green and grey infrastructure; put people’s lives and safety at risk; and put many land uses out of regular operation or access for extended periods of time. Note that mapping storm extent provides a useful reference for spatial planning and the potential likelihood, intensity, and extent of flooding. However, high-resolution topographic data combined with base flood, freeboard, and regionally-adjusted sea level rise (**credit 1.1, Table 1**) provide the most accurate means to determining a detailed design approach for elevation and other protective measures if needed
  - Map the current 100-year and 500-year floodplains, V Zone, associated base flood elevation, and LiMWA, available from FEMA via the National Flood Hazard Layer.<sup>16,17</sup>
  - Map the future 100-year and 500-year floodplain, using high-resolution peer-reviewed local/regional sources as the preferred data source if available.<sup>18</sup> In areas where future floodplain maps are unavailable, approximate the future floodplain by mapping the existing floodplain over site topography. Using a regionally-adjusted sea level rise projection consistent with the moderate sea level rise scenario or higher and based on the target design life, identify future flood-prone areas. For example, if the current 100-year floodplain most closely follows NAVD +10’ and the sea level rise adjustment for the region and time frame is 24”, use NAVD +12’ contour lines as an approximation for areas on site that are likely to experience future flooding. It is important to note that these maps are based primarily on still water “bathtub” modeling, and most do not take into account waves, an important consideration for risk, structural integrity, and overall flood elevation. While there is much less certainty surrounding future wave height (and the movement of the LiMWA along a horizontal landward plane), it is recommended that design teams consider some increased risk/height in areas near the existing LiMWA when reviewing site risk and vulnerability.
- **Structural and natural vulnerabilities** that may contribute to flooding should be identified, and points of existing vulnerability should be annotated. These may include, but are not limited to:
  - Low-lying areas and areas where heavy precipitation is likely to become trapped (not hydrologically connected);
  - Existing buildings, piers, and other structures (including edge stabilization) vulnerable to scour or with low durability;
  - Stormwater drains;
  - Existing flood management berms or structures likely to be overtopped and retain floodwaters;
  - Plantings or habitats that are likely to be more frequently inundated or exposed to (but unable to handle) saltwater.

<sup>14</sup> Additionally water levels and topographic data may be paired using NOAA’s VDatum tool to provide a more seamless site elevation data set

<sup>15</sup> Many states, localities, and regions (e.g. New York City, New York State, New Jersey, the San Francisco Bay Area) have also developed their own datasets and maps for this type of inundation and should be consulted where available.

<sup>16</sup> A thorough review of extreme value analysis approaches and methodologies can be found in FEMA (2002). Appendix D. In Federal Emergency Management Administration. Volume 2: Revisions and Amendments. Retrieved from [https://www.fema.gov/media-library-data/1389623095740-8aaa2f386002ab23b1bd39bd88c837dc/Guidelines\\_and\\_Specifications\\_for\\_Flood\\_Hazard\\_Mapping\\_Partners\\_Volume\\_2-Map\\_Revisions\\_and\\_Amendments\\_\(Apr\\_2003\).pdf](https://www.fema.gov/media-library-data/1389623095740-8aaa2f386002ab23b1bd39bd88c837dc/Guidelines_and_Specifications_for_Flood_Hazard_Mapping_Partners_Volume_2-Map_Revisions_and_Amendments_(Apr_2003).pdf).

<sup>17</sup> In addition to the Flood Insurance Rate Maps (FIRMs), FEMA publishes Flood Risk Reports or Flood Insurance Studies that provide additional modeled flood risk information for the geographies covered by each Flood Insurance Study and Map. FEMA is developing guidance on mapping future coastal hazards related to sea-level rise that can be used for non-regulatory (community planning) and regulatory (permitting and zoning) purposes. For regulatory purposes, FEMA does not presently have authority to show future conditions directly on a community’s FIRM.

<sup>18</sup> Available in some cases from state or municipal governments (e.g. New York City’s Flood Hazard mapper). Geographic data are also available via NOAA’s Sea Level Rise viewer at 5-meter resolution.



**Level 2, advanced modeling or hydrologic analysis** should be conducted for larger projects or those in more vulnerable, or providing in-water structures.

**Relevant credits:** 1.1<sup>19</sup>

**Additional resources:** US Climate Resilience Toolkit.

### SLOPE AND SHORELINE SHAPE

Slope may be easiest measured in two parts, upland and shoreline slope, via transects from the shoreline. Note predominant slope (if consistent), or slope of representative transects (if slope varies, capture all), including any vertical interruptions or shifts from gradual to steep, based on berms, eroded banks, vertical stabilization, or other elements. Note the shoreline's existing predominant shape (is it straight, or is it sinuous, having more diversity in shape) and existing shoaling or sediment deposition patterns.

**Level 1 analysis:** estimate the following by examining topographic maps or measuring slope on site across representative transects.<sup>20</sup>

- **Upland slope** is defined as the slope of the land from the elevation of the spring high tide landward to the point at which the upland levels off. The upland slope is critical for determining the type of vegetation that can be supported and the likelihood of acute erosion during storms.
- **Shoreline slope** in the intertidal area (defined for these purposes as between mean lower low water and spring high water) is an important factor for restoring or mimicking natural edges, as well as for wave energy and public access development considerations. Slopes of between 1 on 8 and 1 on 10 or milder have been identified as optimal for the marsh development.<sup>21</sup>
- **Nearshore slope** is defined as the subtidal slope (below mean lower low water).

**Level 2 analysis:** determine the upland, shoreline, and nearshore slope as defined above, using more detailed on-site measurements and digital elevation models or LiDAR data.

Note that width and sea level rise are also an important consideration for success over time, particularly if restoring natural or employing nature-based features. For tidal marsh success, for example, a minimum width of between 30-70 feet is recommended for low-moderate energy sites.<sup>22</sup> Further, the presence or absence of upland barriers that impede natural edge migration over time as sea level rises is critical to determining the best design approach. Designing to gain shoreline width below the pierhead/bulkhead or low water line through placement of fill material is not a recommended strategy, and is prevented through regulation in many states.

**Relevant credits:** 2.7, 3.1, 3.2

**Additional resources:** Hudson River Sustainable Shorelines Initiative.

### STABILITY, SOILS, AND MARINE ASSET CONDITION

For most projects, a basic analysis of erosion rate and stability is important, becoming critically more so when edge stabilization or in-water features are involved. Designers and engineers should take into account

<sup>19</sup> Those seeking Envision certification may also use this assessment to support achievement of CR2.1: Assess Climate Threat.

<sup>20</sup> Miller, J., Rella, A., Williams, A., & Sproule, E. (2016). Living Shorelines Engineering Guidelines (Prepared for New Jersey Department of Environmental Protection). Stevens Institute of Technology. Retrieved from <http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf>.

<sup>21</sup> Hardaway, C., Milligan, D. & Duhring, K. (2010). Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Gloucester Point, VA: Virginia Institute of Marine Science, College of William and Mary.

<sup>22</sup> Hardaway, CS & J Byrne.1999. Shoreline Management in Chesapeake Bay. Virginia Institute of Marine Science. Gloucester Point, VA. Retrieved from <http://www.dcr.virginia.gov/soil-and-water/document/shoreline-management-in-chesapeake-bay.pdf>

the following when planning projects:

**Erosion:**

- > **Hazard areas:** determine whether the area is in a coastal erosion hazard area, as determined by state or local agencies, or by identification of adjacency to dunes, bluffs, beaches, or other highly erodible soils.
- > **Erosion rate or potential:** estimate the erosion rate based on aerial imagery or state or local maps, or (if unavailable), erodibility potential measured by K-factor available from the USDA Natural Resource Conservation Service's National Soil Survey.
- > **Presence of nearshore protective features:** identify presence or absence of features including breakwaters, shellfish beds, and edge vegetation.

**Soil type:** soil type is an important consideration for edge stabilization and structural features, as well as vegetation.<sup>23</sup> Data are available via the USDA Natural Resources Conservation Service or via on-site sampling. In sites with primarily urban soil designations, soil may need to be built up or remediated to accommodate vegetation.

**Soil bearing capacity:** a geotechnical investigation should be carried out to assess the bearing capacity of the underlying soils. Accurate prediction of sill or edge settlement is critical, as diminished capacity to dissipate wave energy can threaten stability, particularly for restored natural edges. For natural or nature-based features, if settlement is expected, the designer should incorporate a foundation layer (e.g. geotextile membrane, a gravel base, or a flexible gabion mattress) to distribute the weight of any sills or stabilization methods.

**Existing edge condition and structural integrity:** existing condition and any evidence of vulnerabilities to erosion and scour (e.g. human use, ice) should be noted:

- > **For man-made structures or marine assets:**
  - Examine any previous inspection reports or repair data.
  - If the structure has been inspected prior, or if the inspection is in response to a specific event (e.g. hurricane), conduct a routine/rapid inspection.
  - If the structure has not been inspected prior, conduct a baseline inspection.
    - If repairs are required, but no further testing is required, conduct a design-level investigation.
    - If repairs may be required (but it is not clear), or if repairs and further testing are required, conduct an engineering-level investigation.
    - For more detailed inspection methods for waterfront facilities, see the ASCE Waterfront Facilities Inspection and Assessment Manual.
- > **For natural edges:** note an evidence of eroding soils at the seaward edge. Establish a fixed point or benchmark landward of the high tide line (e.g. walkway, building, or tree. Choose more than one if at risk of movement or loss) from which to monitor erosion and slope change over time (note location of benchmark in maintenance and adaptive management plan).

**Relevant credits: 1.4, 2.4, 2.6-2.8, 3.1**

<sup>23</sup> Note: two of the most common marsh plants used in the northeast are *Spartina alterniflora* and *Spartina patens*. *Spartina alterniflora* generally prefers sandy aerobic or anaerobic soils with pH values ranging from 3.7 to 7.9. *Spartina patens* is adapted to a wide range of soils from coarse sands to silty clays with pH values ranging from 3.7 to 7.9 See USDA. 2002. *Plant Fact Sheet: Smooth Cordgrass* Retrieved from [https://plants.usda.gov/factsheet/pdf/fs\\_spal.pdf](https://plants.usda.gov/factsheet/pdf/fs_spal.pdf)

### STORMWATER QUALITY

Calculate pre-design total suspended solids of any stormwater not retained on site

**Relevant credit: 4.10**

### SUNLIGHT EXPOSURE

Sunlight exposure is important primarily for vegetated edges and should be taken into account during design. Marsh plantings generally require at least six hours of direct sunlight per day and should be avoided where large trees or shading structures will prevent adequate exposure.<sup>24</sup>

**Relevant credits: 4.1 (if restoring wetland habitat)**

### TEMPERATURE

Identify current regional mean annual temperature and projected shifts, and frequency of heat waves (days above 90 degrees Fahrenheit) published in up to date (within the past five years) federal, state, or regional government or regional inter-agency reports, or via the National Oceanic and Atmospheric Administration (NOAA) Climate Explorer. Additionally, map out sun path to inform building massing and orientation in regard to solar gain.<sup>25</sup>

**Relevant credits: 1.1, 4.12**

### TIDAL RANGE

Tidal range is an important factor in the design of edges, and is critical for any “living” component of a shoreline or ecological enhancement. For submerged or low-crested structures such as sills or small breakwaters, the position of the crest relative to the water level plays a role in the amount of energy dissipation that can be expected and the amount of force the structure is subjected to. For vegetated edges, selection of the appropriate vegetation is highly dependent on placement relative to water level.

**Level 1 analysis:** A first order assessment of the tidal datums and variation at a site can be obtained by identifying the nearest tidal gauges from NOAA Tides and Currents and to identify annual highest and lowest tides to assess the full tidal range, adapting to local conditions using tide sticks, tide gauges, or pressure gauges at the site.

**Level 2 analysis:** A full hydrodynamic assessment is recommended when larger in-water features are developed or modified in sites with moderate-high wave energy and currents. NOAA’s VDatum tool also provides a way to transform water level and site elevation data to a consistent format for more seamless site analysis. *Note: users of the VDatum tool are cautioned that errors can occur during the transformations. Further, significant water level variations can occur over relatively small distances, in rivers and coastal bays.*

**Relevant credits: 1.1, 2.6-2.8, 3.1**

<sup>24</sup> Whalen, L., Kreeger, D., Bushek, D., Moody, J., & Padeletti, A. (2011). Practitioner’s Guide: Shellfish-Based Living Shorelines for Salt Marsh Erosion Control and Environmental Enhancement in the Mid-Atlantic. Partnership for the Delaware Estuary, Report # 11-04. Retrieved from <https://livingshorelinesacademy.org/index.php/resources/literature/item/whalen-2011>.

<sup>25</sup> New York City Mayor’s Office of Recovery & Resiliency. (2017). Preliminary Climate Resiliency Design Guidelines. Retrieved from [http://www1.nyc.gov/assets/orr/images/content/header/ORR\\_ClimateResiliencyDesignGuidelines\\_PRELIMINARY\\_4\\_21\\_2017.pdf](http://www1.nyc.gov/assets/orr/images/content/header/ORR_ClimateResiliencyDesignGuidelines_PRELIMINARY_4_21_2017.pdf).

### TRANSPORTATION ACCESS

Conduct a transportation proximity analysis to determine if any public transportation options exist within one half mile (appropriate walking distance) of the site. Research any local or regional greenway initiatives and assess how greenway or pathway designs on site would achieve broader regional/local goals. If no existing public transportation options are within range, assess for creating or renovating waterborne transit modes (using credit 1.4).

**Relevant credits: 2.4, 2.6**

### VEGETATION DENSITY/COVER

Pre-design and post-implementation vegetative cover should be calculated, noting more “naturalized” areas or areas of denser vegetation.

**Relevant credits: 4.1-4.3**

### WAKES<sup>26</sup>

Wakes or ship-generated waves can be one of the most significant sources of wave energy within sheltered water bodies. Available data characterizing wakes is very limited, but understanding local wake conditions is particularly important for green infrastructure and “soft” shoreline stabilization methods. For on-site observations, measurements should be repeated several times to reduce bias due to factors like variations in boat traffic (e.g. seasonality, weather, time of day). For sites with regular boat traffic (ferries, barges), measurements should be taken during time periods where these wakes will be encountered (Miller et al., 2016). A number of methods are possible:

**Level 1, desktop analysis:** due to limited available data a cursory evaluation of wakes can be made by identifying features such as nearby marinas or navigation channels that will influence the size and frequency of ship traffic. Methods for estimating the divergent and transverse wakes based on the characteristics of the vessel and waterbody can be found in Sorensen, 1997, and CIRIA; CUR; CETMF, 2012, respectively.<sup>27</sup>

**Level 2, on-site analysis:** to obtain a basic sense of the wake energy at a site, a simple low cost approach consisting of mounting a graduated rod to a fixed structure or the river bottom and then visually recording wakes can be used.<sup>28</sup> Video recordings can be made to check initial observations and to obtain a better estimate of the wake period.

**Level 3 (advanced) on-site analysis:** many of the methods for measuring wind waves can also be used to collect wake data. Due to the shallow depths and short wave periods, pressure transducers, wave wires, and surface attached acoustic gauges are most common.

**Relevant credits: 2.7, 2.8, 3.1, 3.3**

<sup>26</sup> This section adapted from Miller, J., Rella, A., Williams, A., & Sproule, E. (2016). Living Shorelines Engineering Guidelines.

<sup>27</sup> Sorensen, R. (1997). Prediction of Vessel-Generated Waves with Reference to Vessels Common to the Upper Mississippi River System. St. Louis, MO: United States Army Corps of Engineers, Upper Mississippi River - Illinois Waterway System Navigation Study; CIRIA. (2012). The Rock Manual: The Use of Rock in Hydraulic Engineering (2nd ed.). London: C683, CIRIA. Retrieved from <http://kennisbank-waterbouw.tudelft.nl/DesignCodes/rockmanual/>.

<sup>28</sup> Rella, A., Miller, J., LaPann-Johannessen, C. & Rodriguez, E. (2015). Hudson River Wake Study. Stevens Institute of Technology, Hudson River Sustainable Shorelines Project. Retrieved from <https://www.hrner.org/doc/?doc=274514894>.

## WAVES

Waves generated by local winds and meteorological conditions tend to be one of the dominant forces impacting shorelines. The wind speed, duration, and open water distance over which wind acts (fetch) will determine how large waves grow. For shoreline stabilization, there are generally two design waves which may be important. The first are the maximum expected or extreme waves, typically considered in all engineered shoreline improvements. The second are the frequent waves, or those within the normal range of conditions. A wave load analysis of horizontal wave forces, vertical wave uplift forces, and wave peaking damage should be conducted for sites with in-water features and modified edge stabilization. Frequent wave energy and height may be measured on-site. The following methods are excerpted or adapted from Miller et al. (2016) and Hardaway Jr. et al. (1984).<sup>29</sup>

**Maximum expected waves:** for in-water and edge structures a peak wave damage analysis should be conducted in order to predict critical areas of a structure that will receive excessive wave action during storms.

### Wave energy, frequent waves:

- > **Level 1 (desktop) analysis of wave energy using fetch as a proxy:** while there are several desktop approaches for estimating the wave conditions expected at a site, the simplest approach developed by Hardaway Jr. et al. (1984), Table 1 and refined by Hardaway Jr. & Byrne (1999) uses fetch. It is recommended that both the average fetch and the longest fetch are considered when designing a shoreline.

TABLE 1

#### FETCH AND WAVE ENERGY, FROM HARDAWAY ET AL.(1984)

ENERGY	FETCH (MI)
Very Low	< .5
Low	0.5 - 1.0
Medium	1.0 - 5.0
High	5.0 - 15.0
Very High	> 15.0

<sup>29</sup> Miller, J., A Rella, A., A Williams, A., & Sproule, E. (2016). Living Shorelines Engineering Guidelines; Hardaway Jr., C. G., Zacherle, A. & Fowler, B. (1984). Vegetative Erosion Control Project Final Report. Gloucester Point, VA: Technical Report, Virginia Institute of Marine Science.

- > **Level 2 on-site measurement:** multiple methods to measure wave energy and height on-site are available. Depending on the level of infrastructure and whether or not shoreline edges are soft or hard, a less or more-precise approach may be appropriate:
  - Simple or low cost approach: record wave height on a graduated staff and use erosion of a plaster cast as a proxy for wave energy;
  - Pressure gauge;
  - Accelerometer buoy;
  - Acoustic wave gage;
  - Wave wire;
  - LiDAR and radar.
- > **Level 3 analysis:** for complex projects, sophisticated wave models may be needed to provide a detailed analysis of the wave patterns in and around a site. Some wave modes are included as a part of a modeling package containing fully 3-D hydrodynamic and morphologic models (e.g. FVCOM, SWAN, Delft 3D, Mike21, ROMS). These models will have the advantage of being able to consider more complicated processes and even predict the sediment transport and coastal evolution with and without the proposed project. Regardless of the model selected, a thorough calibration and validation procedure should be followed to ensure that the model results accurately reproduce the physical measurements.<sup>30</sup>

**Relevant credits: 2.7, 2.8, 3.1, 3.3**

**Additional resources:**

- > American Society of Civil Engineers. 2017. Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE/SEI 7-16)
- > US Army Corps of Engineers, 2002. Coastal Engineering Manual, Washington, D.C.: US Army Corps of Engineers

## **WATER QUALITY**

An understanding of local water quality, dissolved oxygen concentrations, water temperature, salinity, and turbidity are important factors for understanding habitat suitability, restoration, and even planting or use of shellfish in edge stabilization projects. A desktop analysis is usually feasible and generally appropriate. Look for at a minimum, temperature, dissolved oxygen, and salinity data from local and state environmental agencies, USGS, EPA, or NOAA. Absent these sources, academic and environmental organizations may be options, provided that data quality and extent are sufficient.

**Relevant credits: 4.1**

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<sup>30</sup> Local models may also be available. In the New York and New Jersey area, a localized version of the Ecomsed model is available via NYHOPS.



### **WATER USE AND WASTEWATER MANAGEMENT**

For retrofits, note volume of current water use (number of gallons), estimating irrigation frequency and volume of wastewater produced. For all other projects, the baseline design case will be developed in **credit 4.11**.

### **WIND**

Identify seasonal predominant wind direction, speed, and frequency to the extent feasible, using data from the nearest meteorological station and wind gage (on-water or airport stations preferred, to minimize obstructed measurements). ASCE 7 and the International Building Code provide wind speed engineering criteria as well as wind speed maps. For other analysis, including for the purposes of analyzing frequency and direction of wind speeds (e.g. for determining planting plans), additional wind data are available from the National Oceanic and Atmospheric Administration's National Centers for Environmental Information or via regional observing system data (e.g. MARACOOS).

**Relevant credits: 1.1, 3.1**

The first part of the document discusses the importance of maintaining accurate records in a business setting. It highlights how proper record-keeping can help in decision-making, legal compliance, and financial management. The text emphasizes that records should be organized, up-to-date, and easily accessible.

Next, the document addresses the challenges of data management in the digital age. It notes that while digital storage offers convenience, it also introduces risks such as data loss, security breaches, and information overload. Solutions like cloud storage, encryption, and regular backups are suggested to mitigate these risks.

The third section focuses on the role of technology in streamlining business processes. It describes how automation and software solutions can reduce manual errors, save time, and improve overall efficiency. Examples include using accounting software for invoicing and project management tools for task delegation.

Finally, the document concludes by stressing the importance of employee training and awareness. It suggests that investing in education and providing clear guidelines can ensure that all staff members understand the correct procedures for handling data and records, leading to a more professional and organized business environment.

# Appendix B

## APPENDIX B: SHORELINE STABILIZATION DECISION-MAKING

The purpose of this Appendix is to guide analysis and inform decision-making regarding methods to stabilize shorelines and prevent erosion, applicable to **credit 3.1**, and informed by the initial assessments detailed in **credit 0.2**, including the following parameters:

- > Erosion rate
- > Physical forces
  - Wakes
  - Waves (regular and storm waves)
  - Currents
  - Ice
- > Upland context
  - Existing edge condition and structural integrity
  - Soil-bearing capacity
  - Upland slope
  - Shoreline slope
  - Nearshore slope
  - Width
- > Water level
  - Offshore depth
  - Tidal range
  - Storm surge
  - Rate of sea level rise
- > Ecological considerations
  - Sunlight exposure
  - Water quality
  - Soil type

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Design teams should determine an approach that is appropriate for the context and use. Questions to be considered include

1. *What are the existing site conditions? Is there significant erosion?* Refer to the erosion rate and analysis of existing edge condition and structural integrity, if structural stabilization is in place and needed over time. If no significant erosion is present, the existing stabilization method is intact, and the project does not need any modifications to support a working edge or water-dependent use, stabilization is not needed and should be pursued only for habitat restoration purposes. If significant erosion is present, the current stabilization method is failing, or the project requires modification to support the end use, proceed to the following questions.
2. *If there is erosion, what are the primary contributing factors? Is the edge or adjacent upland heavily mown or unvegetated and exposed to significant wave and wakes? Are soils unconsolidated and exposed? Or, have storm waves recently overtopped the existing edge stabilization method and caused scour? How are the physical forces combining with upland conditions to lead to edge loss? How are these conditions likely to change over time?*
3. *What are the goals for function at the site's edge?* Consider the end use goals and site use to inform the approach. Goals may include storm surge protection, gradual erosion prevention, sudden erosion prevention, or reduction in wave forcing, among others. For example, if frequent wake or wave height

significantly impacts function of an active marina or other maritime use, off-shore strategies such as wave screens may be sufficient to address site needs. If the project is a park development and the site is experiencing moderate erosion due to bare land cover and minimal stabilization, on-shore strategies such as natural edge restoration may be most appropriate.

4. *What strategies are feasible, effective, and minimize impact for the context and use goals?* Informed by the assessments and goals (steps one through three), evaluate the feasibility and effectiveness of all appropriate alternatives, prioritizing green infrastructure, or “soft” stabilization methods. Common on-shore and off-shore strategies and their associated relative habitat values are included in **Table 1** and **Table 2**, respectively. Shoreline edges that include natural materials, mimic the local natural slope and shape, or have complex surfaces are generally more supportive of higher biodiversity. The “**Naturally Resilient Communities**” tool, available online, is also a useful reference for natural and nature-based feature options. These strategies are associated with varied effectiveness and feasibility depending on the site context and environmental characteristics. Additionally, in determining the strategy, designers should consider the associated maintenance with each strategy and capacity of the owner or sponsor to provide that maintenance. For sites in which soils are highly contaminated, the ability of a particular strategy to reduce risk of future exposure should be considered.

**Table 1. On-shore stabilization methods and associated relative habitat value**

The following stabilization strategies are used as on-shore strategies to reduce erosion and protect edges from wakes and waves. They are listed in descending order from the steepest to most gentle slope.

STABILIZATION TYPE	DEFINITION	HABITAT VALUE
Bulkhead	A structure or partition built to retain or prevent sliding of the land into the water. Also referred to as a seawall.	Low
Ecologically-enhanced bulkhead	Walls or barriers that incorporate ecological enhancements including complex surfaces with a pH that fosters attachment or provides refugia for mobile organisms, living plants, or stakes into their design. This term is used to refer to a collection of approaches, all of which attempt to soften a traditionally hard edge through the introduction of ecologically friendly modifications.	Medium
Timber cribbing	Box-like arrangement of interlocking logs or timbers used to form a “crib,” which is then filled with broken rock.	Low-medium
Live crib walls	A box-like chamber that is constructed out of untreated log or timber and placed at the stream’s base flow level. The interior of the structure has alternating layers of soil and/or fill material and live branches that are meant to root themselves inside the box and eventually extend into the slope of the bank.	Medium

Gabions	Structures composed of masses of rocks, rubble or masonry held tightly together usually by wire mesh so as to form blocks or walls. Sometimes used on heavy erosion areas to retard wave action or as a foundation for breakwaters or jetties.	Low-medium
Vegetated gabions	Rock gabions that incorporate vegetation (such as branches) to increase structural integrity and provide natural habitat along the shoreline edge.	Medium
Rock revetment	Shoreline structures which protect natural edges against wave energy and erosion.	Low-medium
Eco revetment	A natural revetment constructed of logs, rootwads, boulders and other natural materials that once established serves both as a habitat for insects and water organisms and as a shoreline stabilization structure.	Medium
Joint planted revetment	Adding live stakes or vegetation into the open spaces or joints of an existing rip rap or rocky slope. The established root system provides a living root mat beneath the rocks, creating habitat, and binding the soil to prevent washout of nutrients and fine material.	Medium
Rip-rap	Layer of large stones used to protect soil from erosion in areas of concentrated runoff. Can also be used on slopes that are unstable because of seepage problems.	Low-medium
Vegetated geogrid	A terraced wall consisting of alternating horizontal layers of soil wrapped in synthetic fabric and live branch cuttings.	Medium-high
Sill	Low-profile mounds placed offshore to retain sediment and elevate the nearshore profile. Sills can be constructed of natural or synthetic (e.g. geotextile rolls) materials, and are typically used as a perched beach system or fringe marsh.	Medium
Geotextile roll	Cylindrical sand filled geotextile tubes which are placed along the shoreline to reduce erosion. The rolls may either be exposed or designed to remain hidden within the dune or bank, and only becoming active during storms.	Medium
Coconut fiber (coir) rolls	Long cylindrical structures composed of coconut husks that are laid parallel to the shore. These structures are intended to help prevent minor slides while encouraging sediment deposition and plant growth.	Medium-high



Vegetated slopes	<p>Vegetated slopes encompass a range of techniques such as Brush Mattress, Branch Packing, Live Fascines, Reed Clumps, and Dormant Post Planting. A brush mattress is a combination of live stakes, live fascines, and branch cuttings that form a protective cover on an eroding shoreline that acts to protect the shoreline against oncoming waves, capture sediment during floods, and enhance habitat for vegetation. Branch packing consists of segments of compacted back fill separated by layers of live branches. This approach is a relatively inexpensive technique used to fill in missing areas of the shoreline, which also provides a succession of barriers to prevent further erosion and scouring. Live fascines are cylindrical bundles of branch cuttings that are placed in trenches on sloping shorelines with the purpose of dissipating wave energy at the shoreline. The Latin term for “bundle of sticks” is fascine. Reed clumps are individually wrapped root systems that are placed in trenches and staked down on the water’s edge. These individual plant systems create a root mat that reinforces and retains soil at the shoreline. Dormant post are installed into an eroded bank at or above the waterline. Rootable vegetative material is added to form a permeable revetment along the shoreline.</p>	High
Beach	<p>The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach – unless otherwise specified – is the mean low water line.</p>	High

**Table 2. Off-shore stabilization methods and associated relative habitat value**

These strategies may be used in cases where the primary need is to reduce regular wave and wake height to reduce physical erosive forces on the shoreline edge, or to protect water-dependent uses and function.

<b>STABILIZATION TYPE</b>	<b>DEFINITION</b>	<b>HABITAT VALUE</b>
Living reef	A breakwater constructed of living (or once living) organisms such as oysters or mussels that reduce shoreline erosion by dissipating incident wave energy.	High
Reef balls/oyster castles	Provide a durable substrate for reef development in areas with intense wave conditions. Ideally, generations of reef species grow over time and large reef structures are eventually formed. Reef Ball breakwaters function similarly to submerged breakwaters, sills, and living reefs, and are more common in the Caribbean and southern United States than the northeast.	High
Groins and stream barbs	Groins are fingerlike shaped barriers that are built perpendicular or at an angle to the shoreline that have the effect of creating pockets of reduced currents. These lower currents have the two-fold effect of reducing the erosional pressure on the shoreline, while also encouraging sediment deposition. Stream barbs are low sitting rock piles that protrude out from the shore and are constructed to redirect the flow of a stream away from the eroding shores. Stream barbs function similarly to river groins; however are typically more modest in nature.	Low-medium
Breakwater	A man-made structure protecting a shore area, harbor, anchorage, or basin from waves.	Low-medium
Wave screens	Offshore structures which reduce wave and current energy at the shoreline. Typically placed perpendicular to the dominant wave direction, these structures consist of horizontal, vertical, and diagonal slats affixed to structural support members. The amount of energy dissipation is directly related to the porosity of the structure.	Low
Floating breakwater	A special type of breakwater that floats within the water column, but performs the same function as a traditional breakwater. Floating breakwaters can be constructed from many different types of buoyant materials including tires, logs, timber, hollow concrete modules, and heavy duty plastic, and must be securely anchored to the bottom to withstand frequent wave and current forces.	Low





the 1990s, the number of people in the world who are poor has increased from 1.1 billion to 1.5 billion.

There are a number of reasons for this. One is that the world population has increased from 5 billion to 6 billion.

Another reason is that the world economy has not grown fast enough to create enough jobs for all the people who are entering the workforce.

There are also a number of other factors that are contributing to the increase in poverty, such as the effects of climate change and the impact of the global financial crisis.

It is clear that the world is facing a serious challenge in terms of poverty. We need to find ways to reduce the number of people who are poor and to ensure that everyone has access to basic needs such as food, shelter, and education.

One of the most important things we can do is to invest in education. Education is the key to economic growth and development, and it is the best way to ensure that everyone has the opportunity to improve their lives.

We also need to invest in infrastructure, such as roads, bridges, and public transportation. This will help to create jobs and to improve the quality of life for people in poor areas.

Finally, we need to address the issue of climate change. Climate change is a global problem that affects everyone, and it is one of the biggest threats to our planet. We need to take action now to reduce our carbon footprint and to protect the environment for future generations.

There is no doubt that the world is facing a difficult future. But if we work together, we can make a difference. We can create a world where everyone has the opportunity to live a better life.

The world is a beautiful place, and it is our responsibility to take care of it. We need to work together to create a better world for ourselves and for future generations.

Let us all do our part to make the world a better place. Let us all work together to create a world where everyone has the opportunity to live a better life.

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# Appendix C

<b>Adaptive Management</b>	A structured, iterative process using monitoring and future climatic, ecological, and social projections to change or “adapt” project designs or operations.
<b>Alkalinity</b>	A substance having a pH of 7 or greater, this pH level would constitute a substance as an alkali or base.
<b>Armoring</b>	The act of incorporating or implementing structural design elements to stabilize sediments while protecting against the forces of erosion.
<b>Base Flood Elevation (BFE)</b>	The computed elevation in feet to which floodwater is anticipated to rise during the 1% annual chance storm shown on the Flood Insurance Rate Maps issued by the Federal Emergency Management Agency. A building’s flood insurance premium is determined by the relationship between the BFE and the level of the lowest floor of a structure.
<b>Beach</b>	The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach – unless otherwise specified – is the mean low water line.
<b>Beneficial Reuse</b>	Reusing waste or materials which would otherwise be sent to a landfill for onsite operations.
<b>Berm</b>	An elevated landscape feature or ridge of compacted soil located in such a manner as to channel water to a desired location.
<b>Berth</b>	A space allotted to a vessel at anchor, at a pier/wharf, or in a slip.
<b>Biomass</b>	The amount of living matter usually given in a dry weight per unit area of habitat. Typical measurements include kg/m <sup>2</sup> , lbs/yd <sup>2</sup> , tons/acre, or kt/ha.
<b>Bluefield Development</b>	Construction over water bodies or wetlands.
<b>Breakwater</b>	A man-made structure protecting a shore area, harbor, anchorage, or basin from waves.
<b>Bulkhead</b>	A structure or partition built to retain or prevent sliding of the land into the water. Also referred to as a seawall.
<b>Cathodic Protection</b>	A method of protecting metal surfaces from corrosion by making all the active sites of corrosion into passive sites by supplying electrical current through it.
<b>Cleats</b>	A device consisting of two hornlike prongs projecting horizontally in opposite directions from a central base, used for securing lines from vessels to piers, wharves, docks or similar structures.
<b>Coastal Erosion Hazard Area (CEHA)</b>	There are two types of coastal erosion hazard areas: <ul style="list-style-type: none"> <li>➤ CEHA Natural Protective Feature Areas (NPFA): Areas that contain the following natural features: beaches, dunes, bluffs, and nearshore areas. NPFAs protect natural habitats, infrastructure, structures, and human life from wind and water erosion, along with storm-induced high water. Human activities (for example, development or modification of beaches, dunes, or bluffs) may</li> </ul>



decrease, or completely remove the erosion buffering function of natural protective features.

- › CEHA Structural Hazard Areas: Lands located landward of natural protective feature areas and have shorelines receding at a long-term average annual recession rate of one foot or more per year. Development within structural hazard areas is limited by regulation to reduce the risk to people and property from coastal erosion and flood damage.

**Coastal Geomorphology**

Coastal geomorphology, by definition, is the study of the morphological development and evolution of the coast as it acts under the influence of winds, waves, currents, and sea-level changes.

**Coconut Fiber (Coir) Rolls**

Long cylindrical structures composed of coconut husks that are laid parallel to the shore. These structures are intended to help prevent minor slides while encouraging sediment deposition and plant growth.

**Cold Ironing**

Supplying docked vessels with shore-side power while at berth allowing docked vessels to power their engines down and reduce emissions.

**Combined Sewer Overflow**

A combined sewer overflow is the discharge from a combined sewer system that is caused by snowmelt or stormwater runoff.

**Combined Sewer System**

Combined sewer systems are sewer systems that are designed to collect stormwater runoff, domestic sewage, and industrial wastewater in the same pipe and bring it to the publicly owned treatment works facilities. During rain events, when storm water enters the sewers, the capacity of the sewer system may be exceeded and the excess water will be discharged directly to a waterbody (rivers, streams, estuaries, and coastal waters).

**Community Boathouse**

A launch and storage facility entrusted or contracted to a community group and/or recreational organization, with minimal membership requirements, if any, for the purposes of fostering public programming and bringing people onto the water.

**Critical Structures**

Uses and facilities which require ongoing operation and special consideration for floodplain alternative and management plans. Examples of critical structures include, but are not limited to: hospitals and health care facilities, emergency response/fire facilities, major food distribution centers, wastewater treatment plants, facilities which store or process toxic or hazardous substances, and those where residents have limited mobility or ability (e.g. nursing homes). *Note: local definitions of critical structures and facilities may vary. See FEMA and local authorities' regulations for more guidance.*

**Davits**

A cantilever crane designed for carrying light water craft.

**Design Flood Elevation (DFE)**

The minimum elevation to which a structure must be elevated or floodproofed. It is the sum of the Base Flood Elevation (BFE) and a specified amount of freeboard based on the building's structural category. The NYC Building Code defines the Design Flood Elevation (DFE) as the BFE plus the designated amount of freeboard.

**Detention/Retention Basin**

Both types of basins are intended to reduce the negative effects of excessive stormwater caused by impervious structures and paving in the built environment. Detention basins (also known as detention ponds and dry ponds) are basins designed to detain stormwater for a period of time. These facilities do not typically have a large

permanent pool of water. Retention basins (also known as stormwater ponds and wet retention ponds), however, have a permanent pool of water throughout the year (or season). The primary removal mechanism in a retention basin is settling.

**Dry Floodproofing** See Floodproofing

**Ecological Corridors** Also known as a wildlife, biological, habitat, wildlife movement, or dispersal corridors; are linear features whose primary wildlife function is to connect at least two significant habitat areas

**Ecologically Enhanced Bulkhead** Walls or barriers that incorporate living plants or stakes into their design. This term is used to refer to a collection of approaches, all of which attempt to soften a traditionally hard edge through the introduction of ecologically friendly modifications.

**Eco Revetment** A natural revetment constructed of logs, rootwads, boulders and other natural materials that once established serves both as a habitat for insects and water organisms and as a shoreline stabilization structure.

**Ecosystem Services** Ecosystems services are the benefits people obtain from ecosystems. These include provisioning services such as food and water, regulating services such as flood and disease control, cultural services such as spiritual, recreational, and cultural benefits, and supporting services, such as nutrient cycling, that maintains the conditions for life on earth.

**Edge Resiliency Strategies** Restoration and reinforcement measures used to promoting ecological productivity and stabilization of sediments while protecting uplands from the forces of erosion, sea level rise, and climate change. Edge resiliency strategies can be divided amongst four main strategies: landscape features, stabilization techniques, natural features, and nearshore structures.

**Estuarine** See Estuary

**Estuary** These areas and their surrounding wetlands are bodies of water usually found where rivers meet the sea. Estuaries are home to unique plant and animal communities that have adapted to brackish water – a mixture of fresh water draining from the land and salty seawater. Estuaries are delicate and extremely diverse ecosystems.

**Federal Emergency Management Agency (FEMA)** An agency of the United States Department of Homeland Security, whose primary purpose is to coordinate the response to a disaster that has occurred in the United States.

**FEMA A-Zone** Areas subject to inundation by the one percent annual chance flood event without wave action. Mandatory flood insurance purchase and floodplain management standards apply.

**FEMA Community Rating System (CRS)** The Community Rating System (CRS) recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards. Depending upon the level of participation, flood insurance premium rates for policyholders can be reduced up to 45 percent. Besides the benefit of reduced insurance rates, CRS floodplain management activities enhance public safety, reduce damages to property and public infrastructure, avoid economic disruption and losses, reduce human suffering, and protect the environment.

<b>FEMA National Flood Insurance Program (NFIP)</b>	NFIP sets national building design and construction standards for new construction and substantial improvements (including buildings that have been substantially damaged) more than or equal to 50 percent of the value of the building in Special Flood Hazard Areas. NFIP underwrites flood insurance coverage only in communities that adopt and enforce floodplain regulations that meet or exceed NFIP criteria.
<b>FEMA Special Flood Hazard Area (SFHA)</b>	The SFHA is the portion of the floodplain subject to a one percent or greater change of inundation by the base flood, designated Zone A, AE, V, VE on a FIRM. Mandatory flood insurance purchase requirements and floodplain management standards apply. It is also called the 100 year flood zone or the base flood.
<b>FEMA V-Zone</b>	Areas along coasts subject to inundation by a one percent annual chance flood event with additional hazards associated with storm-induced waves over three feet high.
<b>Fender</b>	A piece of timber, bundle of rope, system of buoys, or the like, hung over the side of a vessel to lessen the shock or prevent chafing, such as between the vessel and a dock or another vessel. Fenders include systems to lessen the shock of mooring on a dock, pier, wharf, or the like.
<b>Fetch</b>	Distance along open water over which wind blows. For any given shore there may be several fetch distances depending on predominant wind direction.
<b>Fill</b>	Man-made deposits of natural soils and rock products; may include organic matter and waste materials.
<b>Floating Breakwater</b>	A special type of breakwater that floats within the water column, but performs the same function as a traditional breakwater. Floating breakwaters can be constructed from many different types of buoyant materials including tires, logs, timber, hollow concrete modules, and heavy duty plastic, and must be securely anchored to the bottom to withstand frequent wave and current forces.
<b>Floating Dock</b>	Structures located on, in, or over public water; normally not connected to or otherwise in contact with the shoreline.
<b>Floating Launches</b>	Structures that provide access while floating on the water. Typically composed of a deck, frame, and floats, they are anchored to the shore.
<b>Floodplain (100-year floodplain)</b>	The land area susceptible to being inundated by stream derived waters with a one percent chance of being equaled or exceeded in any given year.
<b>Floodproofing</b>	Any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents. See <b>Credit 1.1</b> for more detail.
<b>Fragmentation (Habitat)</b>	Habitat fragmentation involves alteration of habitat resulting in spatial separation of habitat units from a previous state of greater continuity.
<b>Freeboard</b>	An additional amount of height above the BFE to provide a factor of safety to address the modeling and mapping uncertainties associated with Flood Insurance Rate Maps, as well as a degree of anticipated future sea level rise. Vessel freeboard is the height of a vessel or a dock above the surface of the water

<b>Gabions</b>	Structures composed of masses of rocks, rubble or masonry held tightly together usually by wire mesh so as to form blocks or walls. Sometimes used on heavy erosion areas to retard wave action or as a foundation for breakwaters or jetties.
<b>Gangway</b>	Provides access from land or pier to a boat or craft.
<b>Geotextile Roll</b>	Cylindrical sand filled geotextile tubes which are placed along the shoreline to reduce erosion. The rolls may either be exposed or designed to remain hidden within the dune or bank, and only becoming active during storms.
<b>Get-down</b>	A structural feature that provides public access to the water's edge.
<b>Grasslands</b>	Grasslands are found where there is not enough regular rainfall to support the growth of a forest, but not so little as to form a desert.
<b>Greenway</b>	A strip of undeveloped land near an urban area, set aside for recreational use or environmental protection.
<b>Groins</b>	Fingerlike shaped barriers built perpendicular or at an angle to the shoreline that reduce currents. These lower currents help prevent erosion and encourage sediment deposition.
<b>Habitat</b>	The physical location in which a population of plants or animals lives.
<b>Habitat Patches</b>	An area of distinct habitat type. In landscape ecology, patches are spatial units at the landscape scale. Patches are areas surrounded by matrix, and may be connected by corridors. The geomorphology of the land interacting with climate factors, along with the other factors such as the establishment of flora and fauna, soil development, natural disturbances, and human influences work to determine patch size, shape, location, and orientation.
<b>High-Albedo Pavement</b>	Materials ability to reflect the visible, infrared, and ultraviolet wavelengths of sunlight. Increased surface reflectance of pavement materials may be the most straightforward heat island reduction strategy, reducing absorption and reradiation of solar heat.
<b>Human Disturbance</b>	An unnatural disturbance created by human action or activity such as clear cutting or habitat fragmentation.
<b>Human-Powered Boat Launch</b>	A human-powered boat launch means a place or facility, including beaches, ramps, dock structures, derricks, railways, hoists, trailers, or other devices from which or by which human-powered vessels are put or placed into or removed from the water, but shall not include such facilities, devices or structures used exclusively as part of a residential or association dock by the owner or the owner's family.
<b>Hydrodynamic Assessment</b>	A hydrodynamic model is a tool able to describe or represent in some way the motion of water.
<b>Hydrodynamics</b>	Hydrodynamic forces are imposed on an object, such as a building, by water flowing against and around it. Among the forces are positive frontal pressure against the structure, drag effect along the sides, and negative pressure in the downstream side.

Hydrodynamic forces are one of the main causes of flood damage. Typical areas where hydrodynamic forces are of particular concern are along rivers and streams with high velocity floodwaters and coastal and other areas subject to wave forces.

<b>Impervious Cover</b>	(a) Those surfaces in the urban landscape that cannot effectively infiltrate rainfall consisting of building rooftops, pavement, sidewalks, driveways. Steep slopes and compact soils are not typically included as impervious cover. (b) Impervious cover is defined as all impermeable surfaces and includes: paved and gravel road surfaces, paved and gravel parking lots, paved driveways, building structures, paved sidewalks, and miscellaneous impermeable structures such as patios, pools, and sheds. Porous or modular block pavement may be considered 50 percent impervious. The measured area of a site plan that does not have permanent vegetative or permeable cover shall be considered total impervious cover.
<b>Intertidal Zone</b>	The land area between mean low water and mean high water that is inundated periodically by tides.
<b>Insurance Premiums</b>	The amount of money homeowners or business owners must pay for a flood insurance policy. In particular for WEDG, flood insurance premiums also represent the amount of risk insurance companies are willing to take on in order to cover claims made against the policy.
<b>Joint Planted Revetment</b>	Adding live stakes or vegetation into the open spaces or joints of an existing rip rap or rocky slope. The established root system provides a living root mat beneath the rocks, creating habitat, and binding the soil to prevent washout of nutrients and fine material.
<b>Lacustrine</b>	Relating to lake ecosystems.
<b>Light Pollution</b>	Light pollution is an unwanted consequence of outdoor lighting that includes such affects as sky glow, light trespass, and glare.
<b>Live Crib Walls</b>	A box-like chamber that is constructed out of untreated log or timber and placed at the stream's base flow level. The interior of the structure has alternating layers of soil and/or fill material and live branches that are meant to root themselves inside the box and eventually extend into the slope of the bank.
<b>Living Breakwater</b>	A man-made structure protecting a shore area, harbor, anchorage, or basin from waves incorporating nature based features.
<b>Living reef</b>	A breakwater constructed of living (or once living) organisms such as oysters or mussels that reduce shoreline erosion by dissipating incident wave energy.
<b>Lowest Occupiable Floor</b>	See Occupiable Space.
<b>Marina</b>	A docking facility is any marina, boat basin, marine terminal and any other areas on navigable waters containing a single structure or a collection of related structures such as docks, piers, bulkheads, breakwaters and pilings used for the reception, securing and protection of boats, ships, barges or other watercraft.
<b>Marine</b>	Relating to the sea or ocean ecosystems.

<b>Maritime Fouling</b>	The accumulation of unwanted material on solid surfaces, leading to the detriment of function on a maritime structure, vessel, or facility.
<b>Mangrove Swamps</b>	Mangrove swamps are coastal wetlands found in tropical and subtropical regions. They are characterized by their halophytic shrubs and other plants growing in brackish to saline tidal waters. These wetlands are often found in estuaries where fresh water meets salt water and are infamous for their impenetrable maze of woody vegetation.
<b>Mean Higher High Waterline (MHHW)</b>	The average height of the higher high waters over a 19-year period. For shorter periods of observation, corrections are applied to eliminate known variations and reduce the result to the equivalent of a mean 19-year value.
<b>Mean High Water (MHW)</b>	The average of all high water heights observed over the National Tidal Datum Epoch.
<b>Mean Sea Level (MSL)</b>	The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch.
<b>Mitigation (Compensatory)</b>	Compensatory mitigation refers to the restoration, establishment, enhancement, or in certain circumstances, preservation of wetlands, streams, or other aquatic resources for the purpose of offsetting adverse impacts.
<b>Mooring Field</b>	Any group of devices that is fixed in navigable waters to which a vessel can be made fast including buoys, chains, ropes, piles, spars, and dolphins.
<b>Nature Based Feature</b>	Natural features are techniques and components implemented into the edge design that are composed of medium to large scale ecosystems and habitats that stabilize sediments, resist erosion, attenuate wave energy, retain stormwater, combat sea level rise, as well as provide a functional and productive ecological community. Natural features utilize but are not limited to existing ecosystems that have been naturally developed over time however man made ecosystems and restoration efforts are considered natural features since the end goal of these techniques is the creation of a self-sustaining ecosystem. Nature based features are those that mimic characteristics of natural features but are created by human design, engineering, and construction to provide specific services such as coastal risk reduction.
<b>National Flood Insurance Program Elevation Certificate</b>	An administrative tool of the National Flood Insurance Program which provides the elevation information necessary to determine the flood insurance premium rate, in addition to other procedures.
<b>Natural Features</b>	An edge resiliency strategy that uses vegetated ecosystems and other coastal features to provide erosion control and restore the conditions of a natural shoreline environment. Natural features are created over time through many physical, biological, geologic, and chemical processes operating in nature and can attempt to be recreated through man-made restoration efforts.
<b>Natural Resources</b>	Land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other

such resources.

<b>Nearshore Structure</b>	An edge resiliency strategy that uses submerged, emergent, or floating structures to attenuate wave action and dissipate wave energy before reaching the shoreline. These features include but are not limited to living breakwaters, toe berms, and floating breakwater islands.
<b>Occupiable Space</b>	A room or enclosed space, other than a habitable space, designed for human occupancy or use in which individuals may remain for a period of time for rest, amusement, treatment, education, dining, shopping, employment, labor, or other similar purposes. See Habitable Space.
<b>Palustrine</b>	Relating to a system of inland, nontidal wetlands characterized by the presence of trees, shrubs, and emergent vegetation (vegetation that is rooted below water but grows above the surface).
<b>Participatory Event</b>	A group gathering organized and facilitated by the project team, to learn about different priorities for waterfront development solicit ideas and input for the project. Ideally, projects conduct these events both as part of any regulatory land use review process, and as additional, targeted events to engage different stakeholders outside formal procedures.
<b>Pier</b>	A structure at the water's edge that used for maritime activities. Unlike a platform, a pier's seaward dimension is twice as long as its dimension along the land or platform to which it is connected. For use within WEDG, credits that refer to a pier structure may also apply to a wharf or platform structure.
<b>Pile</b>	A long, heavy timber or section of concrete or metal that is driven or jetted into the earth or seabed to serve as a support or protection.
<b>Platform</b>	A pile-supported or solid-core structure at the water's edge, or a portion thereof that is permanently connected to the land and has a seaward dimension that does not exceed 50% of its dimension along the land to which it is connected.
<b>Propeller Wash ("Prop Wash")</b>	Water thrown backward by the motion of oars, propellers, paddle wheels, etc.
<b>Range</b>	The limits within which any fluctuation takes place a range of values.
<b>Reach</b>	A segment of a shoreline where influences and impacts, such as wind direction, wave energy, littoral transport, etc. mutually interact.
<b>Reef Balls</b>	Provide a durable substrate for reef development in areas with intense wave conditions. Ideally, generations of reef species grow over time and large reef structures are eventually formed. Reef Ball breakwaters function similarly to submerged breakwaters, sills, and living reefs, and are more common in the Caribbean and southern United States than the northeast.
<b>Revetments</b>	Bank protection by armor, that is, by facing a bank or embankment with erosion-resistant material.



<b>Rip-rap</b>	Layer of large stones used to protect soil from erosion in areas of concentrated runoff. Can also be used on slopes that are unstable because of seepage problems.
<b>Riverine</b>	Relating to river ecosystems.
<b>Rock Revetment</b>	Shoreline structures which protect natural edges against wave energy and erosion.
<b>Rocky Intertidal</b>	The rocky intertidal is a marine zone that sits at the juncture of crashing ocean waves and rocky shorelines. It can take the form of exposed rocky cliffs, boulder rubble, wave pounded rocky shelves, and sheltered rocky shores.
<b>Salt Marsh</b>	<p>A grassland containing salt-tolerant vegetation established on sediments bordering brackish or saline water bodies where water level fluctuates either tidally or non-tidally within an estuarine system.</p> <ul style="list-style-type: none"> <li>› Salt Marsh (High Marsh): The part of a marsh that lies between the low marsh and the marsh's upland border, and typically experiences less inundation than the low marsh which is reflected in the differences in vegetation species.</li> <li>› Salt Marsh (Low Marsh): The seaward edge of a salt marsh, usually a narrow band along a creek or ditch which is flooded at every high tide, and exposed at low tide. Low marshes are usually set in more saline conditions within an estuarine system than a high marsh.</li> </ul>
<b>Seawalls</b>	Solid, vertical structures used to protect backshore areas from heavy wave action, and in lower wave energy environments, to separate land from water. They can be constructed using a range of materials; the most common being poured concrete, steel sheet pile, concrete blocks, gabions, and timber cribs.
<b>Scour</b>	Scour is the removal by hydrodynamic forces of granular bed material in the vicinity of coastal structures.
<b>Sediment Catchment</b>	A function of an ecosystem's geomorphology that captures sediments as they travel through the system.
<b>Shoreline Configuration</b>	The bird's eye spatial profile and cross-sectional view of the shoreline and its components located at the waterfront edge.
<b>Shoreline</b>	Equivalent to the Mean High Highest Waterline.
<b>Sill</b>	Low-profile mounds placed offshore to retain sediment and elevate the nearshore profile. Sills can be constructed of natural or synthetic (e.g. geotextile rolls) materials, and are typically used as a perched beach system or fringe marsh.
<b>Slip</b>	A berth designated between some sort of pile set, pier, or dock structure allowing land access to a vessel.
<b>Slope</b>	Ground that has a natural incline.
<b>Stabilization Techniques</b>	An edge resiliency strategy that uses both hard and soft structures to armor and stabilize the shoreline from erosion forces especially during storm events with high wave action. These techniques can include hardened structures, such as seawalls, bulkheads, revetments, and gabions, as well as softer structures such as dormant post planting, brush mattresses, and vegetated geogrids.

<b>Stepped Pier Apron</b>	A stepped pier apron is the outer edge of a pier or wharf designated for the perimeter pier public access walkway that has a lowered elevation than the center of the pier in order to minimize the appearance of the railing while providing seating opportunities and the security of a railing that is sometimes necessary at the edge.
<b>Storm Surge</b>	Storm surge is a rise in coastal water level associated with a hurricane or other strong coastal storm above the level associated with normal astronomical tides. The storm surge height is the difference between the observed storm tide and the astronomic or normal tide. Surge is produced by a combination of low pressure and the force of winds associated with intense storm systems. When a storm approaches the land, the storm surge “piles up” and leads to coastal flooding. This is distinct from riverine flooding or inland flooding caused by precipitation overwhelming the base flow capacity of a watershed’s rivers and streams.
<b>Stormwater</b>	Surface water from rain or other precipitation.
<b>Stream barbs</b>	Stream barbs are low sitting rock piles that protrude out from the shore and are constructed to redirect the flow of a stream away from the eroding shores. Stream barbs function similarly to river groins; however are typically more modest in nature
<b>Stream Velocity</b>	The speed at which water flows through a stream. The higher the velocity, the greater the erosive force of the stream.
<b>Submerged Aquatic Vegetation</b>	The aquatic plants are known collectively as submerged (or submersed) aquatic vegetation (SAV). SAV generally includes rooted vascular plants that grow up to the water surface but not above it (although a few species have flowers or tufts that may stick a few centimeters above the surface). The definition of SAV usually excludes algae, floating plants, and plants that grow above the water surface.
<b>Tide</b>	The periodic rise and fall of a body of water resulting from gravitational interactions between the sun, moon, and earth; the vertical component of the particulate motion of a tidal wave. Although the accompanying horizontal movement of the water is part of the same phenomenon, it is preferable to designate this motion as tidal current.
<b>Timber Cribbing</b>	Box-like arrangement of interlocking logs or timbers used to form a “crib,” which is then filled with broken rock.
<b>Toxicity</b>	The quality, relative degree, or specific degree of being toxic or poisonous.
<b>Underserved Area</b>	Areas in NYC where the amount of open space per 1000 residents is less than 2.5 acres.
<b>Vegetated Gabions</b>	Rock gabions that incorporate vegetation (such as branches) to increase structural integrity and provide natural habitat along the shoreline edge.
<b>Vegetated Geogrids</b>	A terraced wall consisting of alternating horizontal layers of soil wrapped in synthetic fabric and live branch cuttings.
<b>Vegetated Slopes</b>	Vegetated slopes encompass a range of techniques such as Brush Mattress, Branch Packing, Live Fascines, Reed Clumps, and Dormant Post Planting. A brush mattress is a combination of live stakes, live fascines, and branch cuttings that form a protective

cover on an eroding shoreline that acts to protect the shoreline against oncoming waves, capture sediment during floods, and enhance habitat for vegetation. Branch packing consists of segments of compacted back fill separated by layers of live branches. This approach is a relatively inexpensive technique used to fill in missing areas of the shoreline, which also provides a succession of barriers to prevent further erosion and scouring. Live fascines are cylindrical bundles of branch cuttings that are placed in trenches on sloping shorelines with the purpose of dissipating wave energy at the shoreline. The Latin term for “bundle of sticks” is fascine. Reed clumps are individually wrapped root systems that are placed in trenches and staked down on the water’s edge. These individual plant systems create a root mat that reinforces and retains soil at the shoreline. Dormant post are installed into an eroded bank at or above the waterline. Rootable vegetative material is added to form a permeable revetment along the shoreline.

<b>Water-Dependent Use</b>	Water-dependent uses are uses that can only be conducted on, in, over, or adjacent to the water; each involves, as an integral part of the use, direct access to and use of the water.
<b>Wave Action</b>	Waves have characteristics and effects as they move inland from an ocean, bay, or other large body of water. Large, fast-moving waves can cause extreme erosion and scour, and their impact on buildings can cause severe damage.
<b>Wave Attenuation</b>	Wave attenuation is the reduction in wave energy or wave height that occurs when a wave passes through shallow water areas such as vegetation and structures. The energy of waves, tides, and currents is attenuated via frictional drag introduced by bottom friction in shallow water areas.
<b>Wave Energy</b>	Wave energy is the transport of energy by ocean surface waves.
<b>Wave Height</b>	The vertical distance between the trough and the following crest.
<b>Wave Screens</b>	Offshore structures which reduce wave and current energy at the shoreline. Typically placed perpendicular to the dominant wave direction, these structures consist of horizontal, vertical, and diagonal slats affixed to structural support members. The amount of energy dissipation is directly related to the porosity of the structure.
<b>Wet Floodproofing</b>	See Floodproofing.
<b>Wetland Migration</b>	As the sea rises along gently sloping stretches of undeveloped coastline, the landward migration of wetlands, causing a gradual transition from non-wetland to new wetland.
<b>Wetlands</b>	Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: <ul style="list-style-type: none"> <li>a) at least periodically, the land supports predominantly hydrophytes;</li> <li>b) the substrate is predominately undrained hydric soil; and</li> <li>c) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year. The term system refers to a complex of wetlands and deep water habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors.</li> </ul>
<b>Wharf</b>	See Platform.

**Working Edge**

The Working Edge is designated for edges whose primary focus is accessibility of industrial water-dependent uses such as docking, berthing, mooring, loading, unloading, and other vessel-based activities. Working edges are a vital component of activating the working waterfront in urban cities and heavily employ the use of structural elements in order to accommodate vessels.

GLOSSARY

