Citizen Scientist Monitoring of Nature-based Coastal Resiliency and Restoration Projects

A Guidance Manual

New Jersey Department of Environmental Protection
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Introduction
With the Raritan Bay and Hudson River to the North, Barnegat Bay and Atlantic Ocean to the East, and the Delaware River and Bay to the West and South, New Jersey forms a kind of peninsula, making it a truly “coastal state”. The oceans, rivers and bays of New Jersey are hallmark features of the State and draw visitors from all over the world to enjoy the beaches, boardwalks and other recreational activities. It is little wonder why so many New Jersey residents live by the coast. But in recent years it has become increasing clear that living by the coast is not without its dangers. The most obvious dangers are storms, like Superstorm Sandy, that can pound the shore and cause major flooding and damage to property. While not as fierce as Sandy, the slow and constant creep of sea levels threatens to cause permanent flooding in areas that were once dry. Unlike Sandy’s storm surge, rising sea levels won’t retreat, which threatens to drown marshes and beaches; and to flood towns. Even before that happens, gradual sea level rise will make it easier for water to be carried by a storm and forced onto communities. One reason that Sandy so devastating was that it struck during a high tide. Rising sea levels will create a “constant high tide”. Coastal erosion is another hazard that threatens people and properties. The constant movement of water along marshes or beaches carries away sediment, wearing down the shoreline and allowing the water to get closer and closer to homes. New Jersey is a coastal state, which provides wonderful opportunities, but it comes with risks.

Traditionally, large scale engineering projects like coastal armor ing (i.e. seawalls and bulkheads) have tried to reduce the risk to coastal communities. Unfortunately, these hardened structures sever the delicate and important connection between land and sea. As anyone who has ever strolled the beach, kayaked through saltmarsh, or simply enjoyed the scenic views of the coast know, a true shoreline is one where land and sea meet. Natural shorelines receive the tide and the sediments that it carries to help keep pace with rising sea levels, something that armored shorelines can’t do. Natural shorelines also support a delicate ecology that benefits humans in many ways.

What is needed now is a new way to restore and enhance shorelines to provide protection to people and property, that also keeps the shoreline natural and able to function as nature intended. New Jersey has a solution, but we need your help! The New Jersey Department of Environmental Protection and our partner organizations are developing and implementing a new generation of coastal restoration projects designed to provide protection and work with nature. Because these kinds of projects are new, we need people out there to help us monitor them. We want to be sure that the projects are working and meeting their goals. This manual is intended to train you and your fellow “Citizen Scientists” on how to properly monitor these coastal restoration projects. We are counting on you to help keep New Jersey a wonderful and successful coastal state!
The Importance of Natural Shorelines
Whether it is tourists strolling the boardwalks with ice cream cones, surfers enjoying a ride on a wave, or fishermen hauling in the day’s catch, the New Jersey coast has something for everyone. No weekend is complete without a trip to the shore to relax and have fun. The dollars spent from visitors spending a summer week at the beach boost local economies and provide a host of job opportunities to residents. The coast of New Jersey is also important to another type of visitor that takes a different kind of “summer rental”. These, of course, are migratory birds, such as red knots, that use these coastal areas to rest along their long migratory route from South America to the Arctic. Red knots feed on the eggs of horseshoe crabs that clamor along the shore of the Delaware Bay in droves to mate and spawn. This ecological web and the dependence on one species for the success of another exists all along New Jersey’s coast. Our success, as well, is dependent on the ecology and environmental quality of the coasts, much like the red knots. Much of the seafood we eat depends on healthy estuaries, like the Delaware and Barnegat Bay. These estuaries (transition areas were freshwater rivers meet with the salty brine of the sea) provide a sheltered and relatively safe nursery for larval and juvenile fish and shellfish to grow up in. If these coastal ecosystems are degraded or lost, we would lose a great source of food. Nurseries are one example of the many ecosystem services that estuaries and other coastal environments provide.

**Ecosystem Services** – processes that an ecosystem provides (chemical, biological, physical, etc.) that directly benefit the surrounding flora or fauna community (including humans).

**Photosynthesis** – The process of producing sugars and oxygen from carbon dioxide, using sunlight as an energy source. The sugars serve as the basis for most ecosystem food-webs.

**Phytoplankton** – Any kind of microscopic, single-celled plant found free floating in the ocean. Phytoplankton are the main photosynthesizers in the ocean.
Ecosystem Services

One of the most important ecosystem services world-wide (on both land and sea) is **photosynthesis**. On land, however, forests only contribute 29% of the Earth’s oxygen. In the open waters of the oceans, lack of nutrients prevent **phytoplankton** growth and thus, limit photosynthesis. But along the coasts, high concentrations of nutrients support large populations of phytoplankton. In these coastal waters, like those in New Jersey, phytoplankton produce huge amounts of oxygen. It has been estimated that photosynthesis in the ocean provides as much as 85% Earth’s oxygen! That means when you take a breath, thank phytoplankton and the coasts that support them!

Coastal habitats, particularly saltmarshes, do a great job at protecting water quality. When it rains, stormwater in the street will flow into gutters and eventually empty out onto the coasts, carrying with it whatever trash happened to be laying on the curb. When that trash laden stormwater eventually finds its way to the coast, the debris often gets trapped in the thick vegetation that make up saltmarshes. The wide swaths of vegetation that buffer coastal waters can be thought of as filters that strain the water of debris and other pollutants. This helps maintain healthy water quality and prevents fish and other animals from getting ensnared or mistaking debris for food.

Fun Fact: Marshes are the “kidneys” of coastal systems.
While saltmarsh vegetation can filter out large debris, shellfish like oysters and mussels can filter out lots of the microscopic particles in the water that contribute to poor water quality. These kinds of animals are known as “filter feeders” because they feed by straining out the water to eat plankton and algae. Besides filtering the water for food, they also remove excess nutrients from fertilized lawns, suspended sediment and other particles carried into the water by stormwater runoff. If left unchecked, excess nutrients can make the water eutrophic, causing an explosion in algae populations that are often called harmful algal blooms or HABs. Ultimately, when the algal bloom dies, microbes decompose the algae, consuming oxygen in the process (Wouldn’t you be breathing heavily too if you had that much to eat?) If the bloom is big enough, this could result in a decrease in the amount of available oxygen (hypoxia) or create a condition where there is no oxygen at all (anoxia), killing fish and other animals. In addition, HABs make it difficult for sunlight to penetrate through the water, preventing seagrass from growing on the bottom. By filtering out algae and suspended sediments from the water column, shellfish can reduce turbidity which helps seagrass meadows, and the animals that depend on them, to flourish. Shellfish convert the nutrients that they take in to an organic form that can be used by other organisms. These natural filters are mutually beneficial for humans, animals and habitat alike.

Coastal waters are important ecosystems for a variety of marine life. As shellfish feed and grow, they can form extensive three dimensional reefs which are utilized by other animals,
such as fish and crabs, for habitat and predation. These reefs and other coastal water habitats provide nursery grounds for vital fisheries. These habitats help to provide the great local seafood that you experience while visiting the shore.

One of the most important ecosystem services that coasts provide is their ability to buffer communities from storms and flooding. When a storm moves along the coast, a surge of water will flow through the saltmarsh vegetation. If the vegetation is dense, healthy, and intact, the water will lose energy and abate before causing damage to infrastructure and property (think of how a ball slows down when it is rolled over a thick carpet). Similarly, a wide beach with sand dunes can absorb wave energy and block storm surge from flooding the communities behind them. These coastal ecosystems increase the resilience of surrounding communities by providing natural defenses and the ability to absorb and recover from environmental disturbances.

**Issues Facing the Coast**

With a growing population along the coast and the inevitable development and infrastructure that goes along with it, the defenses that coastal ecosystems provide is more important now than ever. Unfortunately, development is degrading the very ecosystems that can protect it. Waterfront homeowners often armor the shoreline with bulkheads, revetments or sea walls to prevent erosion and to provide access to deep water for boat docks. While preventing and preserving land in front of a property or infrastructure is necessary, too much shoreline armoring can be very detrimental to coastal ecosystems. Shoreline erosion is a natural process, with some areas eroding sediment and other areas accreting it. The result is a dynamic environment that is constantly changing. This was not an issue before people began moving to coastal areas, but as soon as homes were built in this previously dynamic environment property owners wanted to be sure that their homes stayed put. However, by severing the connection between the land and water, armoring can destroy intertidal habitats that would normally be occupied by vegetation, fish, shellfish and other invertebrates (Lawless

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**Resilience** – the ability for a system to absorb and withstand a disturbance by bending (rather than breaking) and bouncing back to recovery.

**Eutrophic** – describes a body of water that has excessive amounts of nutrients, most commonly nitrogen and phosphorous.

**HAB** – or “Harmful Algal Bloom”, occurs when algae populations spike due to an influx nutrients into coastal waters, usually from runoff of human sources.

**Hypoxia** – describes low oxygen concentrations in water.

**Anoxia** – describes water that is completely depleted in oxygen.

**Turbidity** – describes the clarity of water based on the amount of sediments and other material suspended in it.
Shoreline armoring can also trap sediment, preventing it from entering the water and flowing to other shorelines to replenish them. This “sediment starvation” prevents saltmarshes from gaining elevation to keep pace with sea level rise and from accreting along the shoreline, resulting in a dwindling marsh. Armoring and other coastal structures can also alter the flow of currents and prevent sandy beaches and dunes from accreting. Thus, armored shorelines are not able to respond to nature in the same way that natural shorelines can. When a natural shoreline is covered by the tide sediment in the water settles out and allows the shoreline to accrete, both horizontally and vertically. Armored shorelines, however, hold the water back and are not subject to tidal inundation. These engineered shorelines are not able to respond and adapt to environmental changes. Shoreline armoring can also facilitate erosion on nearby shorelines. When a wave suddenly hits a vertical wall the wave energy is redirected and can hit unprotected shorelines with full force. Conversely, waves along a natural shoreline will slow down and break as they move along the sloping shore and encounter shallow water (like a wave breaking on a beach) making wave energy less destructive.

What is New Jersey Doing About It?

We now understand that resiliency projects relying heavily on armoring or engineered materials are not the only ways forward. Instead of engineered projects that often work against nature, new kinds of projects called natural and nature-based solutions (NNBS) are being used that work with nature to increase coastal resiliency. In addition to controlling erosion, reducing flooding, and absorbing wave energy, NNBS can also create habitat, improve water quality, and help maintain other ecosystem services.

Examples of Natural and Nature-based Solutions:

Living Shorelines – A form of shoreline stabilization that can be used in lieu of bulkheads in areas with relatively low wave energy. Unlike bulkheads that sever the connection between the land and water, living shorelines mimic natural shorelines by creating a sloping intertidal zone. Living shorelines rely on the use of natural materials to create, restore, enhance or protect vegetated shoreline habitats. These projects can also serve as a natural means to protect coastal infrastructure, such as boat ramps, and can be used to help reduce tidal flooding and low amounts of wave energy. Living shorelines are often categorized by the level of engineering needed: Natural, Hybrid and Structural.
Natural – These living shorelines are characterized by the simple use of marsh vegetation planting (which helps bind sediment together through the roots), submerged aquatic vegetation (which can help reduce wave energy and provides vital habitat), sand fill (to elevate or regrade the shoreline) and biodegradable organic materials, such as coconut fiber coir logs (which can trap sediment behind them as the tide comes in. Natural living shorelines are best used in areas that experience low to moderate wave energy.

Hybrid – These living shorelines may consist of everything mentioned above, but also utilize low-profile sills or breakwaters to attenuate wave energy in more exposed environments. These structures are often made from stone and may be seeded with shellfish to provide another ecological element.

Structural – These living shorelines are intended for areas with relatively high degrees of wave energy where simple sills and breakwaters are not adequate in protecting the shoreline. Structural living shorelines include revetments, larger breakwaters and groins that are designed to provide ecological elements (such as being interspersed with vegetation or shellfish, or having crevices to provide habitat) and maintain ecosystem services (more so than traditional engineered structures).
Vegetated Embankments – Large earthen barriers that run along the shoreline in order to prevent tidal waters, strong wave action and storm surge from washing water up onto properties, roadways and other infrastructure. Compared to armored seawalls, vegetated embankments provide habitat and additional green space.

Beach Re-nourishment – Wide sandy beaches, especially along barrier islands, can help take the brunt of storms and heavy wave action, protecting adjacent homes. At the same time, waves wash sand off beaches, requiring some beaches to be re-nourished with new sources of sand. This technique allows beaches to remain in place and provide protection against storms as well as preserving habitat for shorebirds and other wildlife.

Dune Creation – The barrier formed by vegetated dunes at the back of the beach stand as the last line of defense to storm surge. Like beaches, however, dunes can dwindle over time through winds and other forces. One technique is to increase their size with heavy machinery or build new ones in areas where they aren’t naturally forming. The newly created dunes are then planted with vegetation so that their roots hold the sand in place. Dunes are important nesting habitat for shorebirds and other wildlife. Make sure never to disrupt dunes by walking over them.

Beneficial Reuse – This technique refers to the “beneficial reuse” of dredged material for coastal restoration / resiliency purposes. When a channel or marina shoals from sediment settling to the bottom, it makes the water difficult to navigate. Dredging involves sucking up the sediment on the bottom, deepening the waterway. Typically, the dredged sediment would be dumped offshore in a designated area where it would remain. Beneficial Reuse is a variety of techniques that utilize the dredged material for restoration/ resiliency projects, instead of disposing of it. Some of these techniques include “Thin Layer Placement” where the dredged sediment is sprayed up onto the saltmarsh platform’s surface to a precise height to help it gain elevation and keep pace with sea level rise. Another technique is to place the dredged material along the shoreline edge in conjunction with a living shoreline to help slow erosion.

Current Pilot Projects

The New Jersey Department of Environmental Protection, along with our partners, is busy planning NNBS projects across the State. To start, we are implementing four pilot projects through a grant from the Department of the Interior and administered through the National Fish and Wildlife Foundation. These projects will help guide us in determining what methods work and how we can design and implement new NNBS projects that restore natural habitats.
and help communities strengthen their resiliency. The locations of the four pilot projects can be found here. Below is a more detailed description of each project:

**Atlantic City Living Shoreline** – This project is to enhance a shoreline along Gardener’s Basin, a historic area of Atlantic City, by stabilizing the shoreline, creating habitat for fish and invertebrates, and providing tidal flood mitigation to the surrounding area. Currently, the debris strewn site is a 100 ft. long gap in an otherwise bulkheaded lagoon. Once the debris is removed, the shoreline will be protected by two overlapping stone sills off-shore. The area between the sills and the shore will then be filled with sand. The area will be planted with saltmarsh cordgrass to create a vegetated shoreline. At the top of the sloping shoreline (the area furthest from the water) a vegetated embankment will be made to provide further tidal flood mitigation and habitat creation.

![The Atlantic City Living Shoreline before and after construction.](image1.jpg)

*Photo by: Evan Sherer (NJDEP)*

**Brigantine Vegetated Embankments** – This project is a series of vegetated embankments at three municipal-owned street right-of-ways on the southeastern side of Brigantine Blvd. These unprotected lots experience stormwater flooding during rain storms from water running off of Brigantine Blvd. In addition, tidal and storm surge flooding from the lagoon side causes problems. The project will consist of building vegetated embankments across the shoreline edge of the lots, rising above the existing bulkheads on either side. A drainage trench will be built on the landward side of the embankment which will channel water into a pipe and carry it underneath the embankment, letting it drain onto the shoreline. The elevated embankments will also mitigate tidal and storm surge flooding. In the future, when adjacent bulkheads need to be repaired or replaced, they will be required to be raised to the same height as the berms, creating a uniform defense.
Secaucus Drainage Ditch – During Hurricane Sandy floodwaters deposited sediment into three drainage ditches along the Hackensack River. The sediment clogged the stormwater drainage pipes in the ditches, impeding flow. This project will restore proper drainage and improve stormwater management by dredging out the ditches and refitting the pipes to prevent sediment build up. Vegetation plantings and coconut fiber erosion control matting will be placed within the ditches to help prevent further sedimentation.
Upper Township Living Shoreline – This living shoreline will be placed at the end of Bayview Drive, on both the east and west sides of the re-built boat ramp. The living shoreline will provide shoreline stabilization, habitat creation for shellfish, crabs and other estuarine animals, and tidal flooding mitigation. The removal of existing debris and the planting of marsh vegetation will increase the ecological value and function of this area. To the west of the boat ramp, six 30 ft. long coconut fiber coir logs will be placed in two rows. Behind each row, organic sediment will be filled in, creating a tiered marsh surface. The filled areas will also be planted with marsh vegetation. On the east side of the boat ramp, one 30ft coconut fiber coir log will be placed and filled behind it and planted.

The Upper Township Living shoreline before and after construction.
Photo by: Evan Sherer
The Importance of Monitoring
We Need Your Help!

Coastal areas are extremely important, not just for plants and animals, but the humans that live near them. The NNBS projects that are underway are designed to work with nature to restore and enhance these areas. These projects can improve water quality, wildlife use, recreational opportunities, and coastal resiliency, to name a few.

There will be many more projects in the future, this is just the start! Before we get there, however, we need to be sure that these pilot projects are working correctly and achieving their goals. New Jersey NBBS projects are in their infancy and we are still determining what works and what needs tweaking. A lot is at stake, so we want to make sure we are on the right track! That’s where you come in! You and your fellow “Citizen Scientists” will be our “eyes” and “ears” by checking on and monitoring the projects to see if they are working. Is the project preventing erosion? Is it helping to mitigate flooding? Is it being used as habitat? By collecting data and making observations you can help us figure out how well the projects are working. If they are successful, we can recreate the projects in other locations. If they are not successful, we can figure out why and step in to see how we can fix the problem.

But don’t worry, we will be there to help you. NJDEP, along with our partners, the Partnership for the Delaware Estuary and Barnegat Bay Partnership, will be out at the projects over the course of this year to teach you how to monitor and become a Citizen Scientist. As you work side-by-side with professional scientists in the field, you will be able to ask questions about coastal habitats, resiliency, and marine science. As a Citizen Scientist, you will take part in important work that will help us understand how we can protect our coastline.

Most of the guidance will take place out in the field with our partners, but this manual will serve as a primer to help get you started as a Citizen Scientist.

Monitoring 101

Monitoring is all about paying attention to the small things that, when put together, can tell a larger story. Think of yourself as a detective at a crime scene. Be observant. Notice if some of the vegetation is dying, look to see if there is evidence of animals using the site. Is there evidence of flooding landward of the project? Are you going out to monitor during the same tidal stage each time? The next chapter will go through specific monitoring procedures, but here we will discuss the basic things to keep in mind when monitoring a project.
Repeatability and Standardization

Monitoring is all about seeing how a site changes over time, for instance a living shoreline changing from a sparsely vegetated eroded shoreline to a lush verdant saltmarsh edge. To do this, a Citizen Scientist must be careful and take the time to make sure each measurement and observation they make is performed in the same way it was performed last time. Each time a Citizen Scientist visits a site, they are collecting information that can be thought of as a “page” in a “flipbook”. If all the pages were made the same way, it will be relatively easy to see how the project is advancing as you flip through the book. If each page was made in a different way, for instance, you didn’t measure the same stand of vegetation the same way, or you forgot to record the presence of shellfish, or you take photographs differently each time, you would wind up with a flipbook that is rather incoherent and doesn’t tell you what you need to know. It is very important to follow procedures so that you can make consistent observations over time.

Careful Observation, Measurement and Recording

Assessing a site can be both qualitative and quantitative, observing to see if the vegetation is growing in nice and lush, in general, but also by how much is it growing. The former can be done through taking pictures and careful observations, the latter can be done through careful measurement and recording. When the measurements you take, such as vegetation heights, are analyzed they will begin to tell a story of how the project is fairing. It is useful to think of each number, each measurement, that you put down as a letter that goes into writing that story. That is why it is important to take the time to make sure you are measuring and recording your observations correctly. You want to make sure that your measurements are both accurate and precise. Often these two words are thought of as synonyms, but they, in fact, have different definitions. Accuracy refers to the closeness of a measured value to a known value. For example, if you weighed a free weight at the gym that was labeled “15lbs” and your measurement showed that it weighed 15lbs, it would be an accurate measurement. If
your measurement result was 25lbs, then clearly something went wrong! Precision refers to how close multiple measurements are to one another. In the previous example, if you made several measurements of the 15lbs weight and each time your results showed 25lbs, your measurements are very precise (albeit not accurate). If your measurements are scattered anywhere from 5lbs to 30lbs, then your measurements are not precise (and maybe science just isn’t for you!).

Concerns over accuracy and precision arise when several different Citizen Scientists measure things different ways. That is why it is important to take the time to be consistent and careful. That way, there can be confidence that a measurement of vegetation height made by one person during one outing is comparable to the same measurement made by a different person in a subsequent outing.

<table>
<thead>
<tr>
<th>High Accuracy</th>
<th>Low Accuracy</th>
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<tbody>
<tr>
<td><img src="image1" alt="High Accuracy Diagram" /></td>
<td><img src="image2" alt="Low Accuracy Diagram" /></td>
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When monitoring, it is important to take the time to make precise and accurate measurements. This is especially important when data from multiple Citizen Scientists will be pooled together to make decisions. By taking the time to ensure that each measurement was taken correctly we will have greater confidence in the data and our ability to make decisions.

Safety

The most important thing to keep in mind while monitoring is your safety! Always bring a buddy, never go monitoring alone. Only go out to monitor when you are feeling well. Before going to a site make sure to look up the weather forecast. If the forecast predicts bad weather, do not go out monitoring. If the weather turns bad while you are visiting a site, especially if you hear thunder, leave the site immediately. Your safety is more important than monitoring. During the summer make sure that you bring plenty of water, wear lightweight clothing, sunscreen and insect repellant (while sunscreen and bug repellant will be provided at each site, it is always a good idea to bring extra). During the colder months, make sure you bring enough layers to keep you warm. Remember, even though it may seem warm when you leave the house, there may be a cold wind blowing along the shoreline. Always wear close toed shoes or
boots when visiting a site. Be careful while walking at a site as the ground could be rocky or unstable. Avoid walking over vegetation and going into the water, particularly near areas where shellfish are growing. If you do get injured, first aid kits will be available at each site. If you are cut by a shellfish, be sure to clean the area thoroughly and disinfect it. Shellfish can carry lots of bacteria, so keep an eye on it. If the cut becomes infected, see a doctor.
Monitoring Methods
After reading this manual you now understand why these nature-based projects are so important, and why we need to monitor them. By now you probably want to get out there and start working, but take the time to consider a few things:

- Do you have a group or partner to go out with?
- Have you checked the weather forecast?
- Have you told others where you will be?
- Do you have your cell phone?
- Are you dressed for the weather?
- Do you know where you are going? Click a project below to bring up a Google Map:
  - Atlantic City
  - Brigantine: Cherokee Blvd, Hydrangea Way, Harbor Beach
  - Secaucus: Ditch 1, Ditch 2, Ditch 3
  - Upper Township (both sides of the boat ramp)

- Are you going at low tide? Make sure to come during, or up to two hours before, low tide. You can check the tides here. Just click on the tide station near the project you are going to monitor.

Now that you are prepared, you are ready to start monitoring. Below is a list of the materials that you will need. They will be provided at the site:

- Site Diagram and Instructions
- Pencils
- Clipboards
- Measuring Tapes (2)
- Meter Sticks (8)
- Data Sheets

You will also need to bring:

- Your smartphone to take pictures.
- Rubber boots so you can get to the water’s edge
- And a watch to keep accurate time

Ok, let’s get started!
Fixed Photo Observations

One of the most effective (and easiest) ways to monitor a site is to take pictures of it over time. Fixed Photos must be taken from the same location each time (hence Fixed Photo). If the photograph is taken at the same location, and each photo is captured the same way, we can get a general idea of how the project is maturing (remember the flip book analogy from before). Each site has several Fixed Photo Points which are marked with a PVC pipe with blue bands along the length. The Fixed Photo Points are also indicated on the site map.

Method:

1. Locate the Fixed Photo Point on the site map. Each point will have a specific label. When walking to a Fixed Photo marker, walk between the rows of vegetation. Try to avoid trampling the vegetation as much as possible.

2. The Fixed Photo Point will have a small horizontal surface to help you align your shot. Place your camera on the horizontal surface so that the lens is on the upper left side and that the left side of the smart phone is in line with the left edge of the horizontal surface of the Fixed Photo Point. (see the diagram on the following page).

3. Each Fixed Photo Point will have a designated object to focus on. The monitoring instructions at each site will include original “Master Photos” for each of the Fixed Photo Points and will identify where the camera should focus. When taking a photo, try to duplicate that fixed point’s Master Photo.

4. After taking the photo record the time that the photo was taken and the Photo ID # in section 1 of the datasheet (“Fixed Photo Observations”). By recording the time that the photo was taken you will be able to match it with the photo’s time stamp. This will help you later, in case you can’t remember which picture is from which Fixed Photo Point.
   a. The Photo ID # will consist of:
      i. The name of the photo point (ex. AC.FP1)
      ii. The date taken (ex. 5_18_17)
      iii. The first and last initials of the photographer (ex. ES)
   b. The Photo ID # would read like this: AC.FP1_5_18_17_ES
a.) Make sure that the lens is on the top left side and that the end of the camera is in line with the end of the top of the marker.

b.) When aiming the camera, do your best to duplicate the original “Master Photo”. c.) Master photos for each Fixed Photo Point will be included in the monitoring instructions at each site.
Vegetation Community Zones

You will see that each site has an array of PVC markers arranged in lines (usually two or three lines per site). These lines, called “transects”, are used to mark the linear area to be monitored. Each transect contains three to four PVC markers starting at the water’s edge (marked with blue tape at the top) and running up towards the land (marked with red tape at the top). Each PVC marker is named according to which transect it is a part of and its location within that transect.

For this group of methods, you will be measuring the width of vegetation zones along the transects. These coastal projects provide habitat for several plant species, depending on elevation and water supply. We want to know if the width of the vegetation zones change over time. Smooth cordgrass (*Spartina alterniflora*) is very common along the water’s edge. When you think of marsh vegetation, you probably picture *S. alterniflora*. For most of the sites, this species will be the first zone you encounter along the edge. Common reed (*Phragmites australis*) or just “phrag” is a reedy plant that can grow thick and often dominate a shoreline. For the sites that have it, phrag will be the second zone that is encountered. Other projects may feature Salt hay (*Spartina patens*) further landward. Unlike its taller cousin, *S. alterniflora*, *S. patens* is shorter and prefers higher elevations and drier conditions. Photos of these plants will be provided at each site to make identification easier.
You will first measure where the *S. alterniflora* zone begins at the water’s edge. This measurement can also be called the “shoreline change measurement” because it measures if the shoreline edge moves over time. Next, you will measure the end or *landward* side of the *S. alterniflora* zone. Finally, you will measure the beginning and ending (or *waterward* side and *landward* side) of the phrag or *S. patens* zone. If the project contains a third vegetation zone, you will measure the waterward and landward side of that one as well.

**Waterward *Spartina alterniflora* Zone Measurement (Shoreline Change Measurement)**

While shoreline erosion is a natural process, too much erosion can threaten property and infrastructure, and facilitate flooding in certain areas. A key goal of these nature-based projects is to stabilize shorelines and allow them to accrete land. As the tide rises it carries suspended sediments. When the water moves past breakwaters or thick vegetation, wave energy slows down allowing sediments to settle on the shoreline. Think of making a powdered drink. When you add the powder and stir, the powder gets suspended in the liquid. When you stop stirring the liquid slows down, resulting in some of that powder settling on the bottom of the glass. Sediment accumulates on shorelines in much the same way. The accreting shoreline will act to buffer coastal hazards as well as provide new habitats for plants and animals. This procedure will help us determine if and by how much the shoreline is accreting.
Methods:

1. Attach the zip tie loop at the end of the measuring tape to the top of the first transect marker in the water (marked with blue tape at the top). This must be done during low tide. To do this most effectively, have someone stand on shore with the measuring tape reel while you walk out to the PVC marker with the tape in your hand, unreeling as you go. Make sure to take your smartphone with you. You’ll need it for the next step.
   a. Have your partner unreel the measuring tape as they walk up the length of the transect to the last landward PVC marker. **Be sure to walk to the left of the PVC posts to avoid stepping on the vegetation that you will be monitoring**

With a partner standing on the shore holding the measuring tape reel, walk out to the PVC marker in the water and secure the end of the tape.

2. Stand over the transect marker and take a vertical photograph of the entire transect looking towards the shore. In addition to marking the transects, the blue PVC pipes in the water serve as Fixed Photo Points. Record the time each photo was taken along with the proper Photo ID (as described in the Fixed Photo Observations methodology).
3. Starting from where the tape measure is secured to the PVC marker, run your fingers between the tape, keeping it taut so that it doesn’t droop, and walk toward the shoreline edge. Stop where you see vegetation growing on the shoreline. Standing over the tape measure, read off the distance, in meters, between the PVC marker and the vegetation to your partner.
   a. Record this measurement in the “Waterward” column of the *S. alterniflora* Vegetation Community Zone in Section 3 of the datasheet.

a.) Hold the measuring tape taut as you walk landward.  b.) Stop when you have reached vegetation on the shoreline edge.  c.) Stand over the measuring tape and look straight down and estimate where the vegetation begins. In this example, vegetation begins at 1.9m.
b. If there is a gap between areas of vegetation, measure to the closest section of continuously vegetated edge. See examples:

![Diagram showing measurement technique]

c. If there is vegetation extending beyond the attachment point (i.e., waterward of the blue marked PVC pipe), make note of it in the comments section.

**Measuring the Rest of the Vegetation Community Zones**

After measuring the “waterward” extent of *S. alterniflora* / shoreline change you will now measure the rest of the vegetation zones.

**Methods:**

1. With the measuring tape still held between your fingers, walk up onto the shore and follow the transect until you reach the landward edge of the *S. alterniflora* zone.
   
   a. Make sure to walk to the left of the transect tape. Also, remember to hold the measuring tape taut.

2. Stop when you reach the last remaining growth of *S. alterniflora* and record the measurement (in meters) in the “Landward” column of Section 3.
3. Next, continue along the transect and measure the beginning (waterward) and end (landward) of the next vegetation community zone.

a.) Walk up the transect towards the land. b.) Stop when you notice the last growth of S.
Vegetation Measurements

Along each transect you will be setting up 2 to 3 temporary vegetation plots. At each plot you will take three measurements (percent vegetative cover, vegetation plot photo observations, and blade height measurements) to assess the status of the vegetation community.

Percent Vegetative Cover

Thick robust vegetation is one of the hallmarks of a healthy shoreline. As newly planted vegetation takes root, we want to monitor how well it is growing. Thick vegetation will help trap sediment and stabilize shorelines. You will record the percentage that vegetation occupies within $1m^2$ plots along each transect. Over time we will be able to see how well the vegetation is growing in.

Method:

1. For each red PVC marker along the transect, you will set up a plot. The PVC marker will serve as a corner for each plot. Look at the site map to locate the position of each plot.
2. Lay 3 meter sticks out in a square, as illustrated on the map. The transect tape serves as one of the sides.
   a. Avoid stepping in the plot area to minimize vegetation disturbance.
3. Estimate the percentage of area that vegetation occupies within the plot.
   a. Percent cover should reflect the total area of the plot that is being covered by vegetation. Note: vegetative cover may not be continuous within the plot. See examples:

   ![Vegetation Cover Examples]

   b. This is a subjective measurement, so use your best judgment. If there is a disagreement with your partners, reach a consensus.
4. Record the observation in section 2c of the datasheet (“Percent Vegetative Cover and Blade Height Measurements”) in the “% Cover” row.
Vegetation Plot Photo Observations

We would like to see how the vegetation in the plots are growing and photos are the best way to do that!

Method:

1. Stand a few feet behind the measurement tape side of the plot. Have your partner hold an upright meter stick in the center of the plot. With your camera centered about 1.5m above the plot, take a photograph of the entire plot. Make sure that the top of the meter stick is visible in the photograph.
2. Record the time the photo was taken and the Photo ID# in section 2b of the datasheet (“Vegetation Plot Photo Observations”).
   a. Like the Fixed Photo Points, the Photo ID # for the plot photos will consist of:
      i. The name of the plot (ex. AC.T1C)
      ii. The date taken (ex. 5_18_17)
      iii. The first and last initials of the photographer (ex. ES)
   b. The Photo ID # would read like this: AC.T1C_5_18_17_ES

As an optional step, you may try to identify plant species within the plot. Use a plant guide to correctly identify plants. Record your observations in section 2a of the datasheet (“Species Composition”). If a plant is unknown, you may photograph it. Please name these photos the same as above, but add “_plant_id” to the end (ex. AC.T1C_5_18_17_ES_plant_id).

Blade Height Measurement

Now that we have assessed the whole site via photographs and estimated how thick the vegetation is growing in at each plot, let’s get a little more specific and measure the height of individual plants.

Method:

1. At each plot randomly select 20 blades and measure their height in cm.
   a. Using a meter stick, measure from the bottom where the stem meets the ground to the top of the blade. Randomly select blades from across the plot being careful not to measure the same blade twice.
   b. If the blade is more than a meter tall use your finger to mark where the meter stick stopped on the blade. Then move the meter stick up to your fingers and measure the rest of the blade.
   c. If the plot has less than 20 blades, measure the number available.
2. Record stem height in centimeters in section 2c of the datasheet (“Percent Vegetative Cover and Blade Height Measurements”).
3. Repeat the Vegetation Measurement procedures for each plot along the transect.
a. Move to the next transect and repeat all of the **Vegetation Community Zone** and **Vegetation Measurements** procedures

**Additional Comments**

1. Some additional observations that may be considered include:
   a. What additional plant species exist outside of vegetation plots?
   b. Is debris present? If yes: what kind, how much?
   c. Are shellfish present? If yes: mussels, oysters, or both?
   d. Is water ponding on the landward side of the project (i.e on the backside of the Brigantine berms)?

**What to do After Completion**

When you have completed monitoring the site:

1. Make sure to put all of the supplies back into the lockbox and secure it.
2. Decide who will be responsible for sending the data collected to NJDEP. Make sure that person has the photos and datasheet before you leave the site.
   a. When that person gets home:
      i. Move the photos you have taken to your computer. Rename the Fixed Photo Observations and the Vegetation Plot Observation photos (and optional plant ID photos, if you have them) as described above.
      ii. You will have an Excel template of the datasheet saved on your computer. Input the data that you collected from the paper datasheet to the one on the computer. Name the datasheet on your computer with:
         1. The name of the site (ex. AC)
         2. The date you monitored (5_18_17)
         3. Your first initial and last initial (ES)
         4. The name of the datasheet on the computer should now look like this: **AC._5_18_17_ES**
      iii. Take a picture of the original paper datasheet and name it: **AC._5_18_17_ES_original**
   b. Make sure that everything is named correctly (Fixed Photo Observation and Vegetation Plot Observation photos, optional plant ID photos, the photo of the original datasheet, and the Excel version of the datasheet) and send them in one email to **evan.sherer@dep.nj.gov**.

   Please include in the subject line the site name, date monitored and your first initial and last name (ex. **AC._5_18_17_ES**).
Citations
