Planning and Funding Natural Infrastructure Along Connecticut's Coast

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Table of Contents

Introduction

As the climate crisis worsens, there is greater recognition that in addition to energy-focused solutions, nature-based solutions play a critical role in climate mitigation and adaptation efforts. This semester our team was tasked with working with Audubon Connecticut and the Connecticut Association of Conservation District to help them apply for United States Department of Agriculture funding through the Natural Resource Conservation Services to implement green and grey infrastructure upgrades along the Connecticut coastline with a focus on protecting shellfish beds from stormwater runoff and restoring natural habitats in vulnerable communities. The purpose of the project is to support Audubon CT and the Connecticut Association of Conservation Districts (CACD) in their application for an NRCS PL-566 (Watershed Protection and Flood Prevention) grant for roughly $10 million. The aim of this grant is to help Connecticut create an ecologically thriving and resilient coast, while protecting the commercial and hobby shellfish industry.

Connecticut is a coastal state where some of the most sensitive ecosystems have been compromised and severely degraded due to continued development along the coast. Water quality is a major concern, particularly as it impacts salt marshes, shellfish beds, recreation, and vulnerable communities. Stormwater runoff is a significant source of pollution in coastal areas. Some shellfish beds along the coast are often closed for extensive periods during the year because of poor water quality due to stormwater runoff. Maintaining good water quality through improved stormwater management near the many approved, open shellfish beds found throughout Connecticut is a priority. Salt marsh degradation and shellfish habitat degradation are also significant concerns which the CACD and Audubon CT project seeks to address.

Audubon CT is a leader in habitat conservation and restoration for birds, nature and people throughout the state. Connecticut's Conservation Districts are local non-profit organizations, set up under state statute, to provide technical assistance and education on soil and water conservation to farmers, municipalities, and land owners. A major part of their efforts to secure funding for infrastructure investments (both green and grey) along CT's coasts is the development of a Watershed Protection and Flood Prevention Act (PL-566) Watershed Operations Plan for Coastal Connecticut. The PL-566 Program provides the necessary resources to prevent erosion, floodwater and sediment damage, to further the conservation development, use and disposal of water; and to further the conservation and proper use of land in authorized watersheds. USDA's Natural Resources Conservation Service (NRCS) offers financial and technical assistance through this program for erosion and sediment control, watershed protection and fish and wildlife habitat enhancement.

Using the Cape Cod Water Resources Restoration Project as a guide, our team recommended projects to include in the plan, with a focus on protecting shellfish beds, restoring salt marshes, and improving water quality in vulnerable communities. As part of our project vetting, we included various data points needed to evaluate projects, including proximity to shellfish beds

and vulnerable communities. In this final report, we also did a deeper dive into one of the proposed projects.

Throughout the semester, we learned about the shellfish and salt marsh habitats along the Connecticut coast, the impacts of sedimentation on oyster health; and the negative impact of fecal coliform on the shellfishing industry due to public health concerns. We were also able to further our understanding of stormwater runoff as the leading source for sediment and fecal coliform, and the significance of erosion and sea level rise as big concerns for salt marsh habitat and vulnerable communities. We also discovered that shellfish and salt marsh habitats are often co-located, and various recommended projects benefit both.

Methodology

Our work this semester focused on identifying impactful and relevant projects for inclusion in the USDA PL-566 grant application. We were able to identify 22 projects for inclusion in the PL-566 Grant, which provides funding for watershed improvement projects. The focus of these projects was improving water quality, shellfish habitat, and salt marsh habitat. We also included projects that help vulnerable communities and provide coastal resilience.

Over the course of the semester we worked with Audubon CT and CACD to gather data and compile proposed projects after reading through various reports and townships plans that were shared by local non-profit and governmental organizations. We then collected additional background information from project partners and other local sources to add to the list of projects we proposed for restoring Connecticut's coast. The primary resources we used were various Community Coastal Resilience Plans, 319 Watershed Plans (Nonpoint Source Pollution), Climate Resilience Proposals from TNC, Audubon, and Save the Sound, CIRCA Resilient Connecticut Online Tool and the CT ECO Aquaculture Mapping Atlas. From these resources, we began selecting and evaluating projects. We also completed a thorough literature review to see if there were any new and innovative practices that may have been missed by the partner organizations.

We qualified projects based on our client goals (e.g. proximity to vulnerable communities) and academic/scientific literature (e.g. what researchers/academics say about the best way to restore shellfish beds and salt marshes). We also took into account project location relative to various site features, which were mapped in GIS. Specifically, we wanted to assess if projects fell along the coastal region, were proximal to vulnerable communities, had potential for aquaculture production, and further climate change resilience along the coast. We analyzed over 180 proposed projects collected from various nonprofits, rated each project against the established criteria, researched the feasibility and timeline of each, and found 23 projects that can satisfy the PL-566 grant application. We were also able to write a more complete analysis of one project (see Appendix IV).

The Criteria we used for determining project's impacts are as follows:

- Presence of Shellfish and Saltmarsh Habitat
- Presence of Vulnerable Communities
- Location (coastal region)
- Coastal Resilience
- Water Quality

Projects were vetted and solidified based on project status, funding status, maintenance status, and Infrastructure type, and areas of impact. Once we had criteria established, we began to evaluate and qualify projects, which after sorting through over 180 projects, we developed four project types, as follows:

- Living Shorelines
- Dune Restoration + Beach Nourishment
- Stormwater retrofits
- Tidal Flow Restoration

To view our vetting sheet with examples, click here.

Final Project Selection

We analyzed over 180 projects and developed a binary rating system to help us sort through which projects would satisfy the requirements for the USDA PL-566 (Watershed Protection and Flood Prevention) grant based on the benefits each project site provided. We rated each project site's impacts as either being a "Primary" Benefit, "Secondary" Benefit, or no benefit provided.

Living shorelines use elements of native vegetation to improve a coastal location's ability to withstand hurricanes and heavy storms from the water. These are an alternative to concrete or metal bulkheads and research suggests these solutions provide better protection, are naturally regenerative requiring less maintenance and can better withstand storm impacts. They are living structures that will be home to wildlife.

Beach nourishment & dune enhancement are popular projects that must be carefully designed to maximize their longevity and long term viability. Beach and dunes have been moving and migrating for thousands of years. Attempts to keep dunes in one location fortified with hard structures most often lead to structural failures and unsightly remaining debris. One limitation of this approach is the frequent need to re-nourish beach and dune sand supply after future storms.

Stormwater retrofits refer to the implementation of stormwater best management practices, which include new installations or upgrades to existing stormwater systems to provide additional stormwater treatment and improve downstream water quality. In the coastal

watershed, stormwater retrofits can reduce nutrient and sediment runoff into the Long Island Sound.

Tidal Flow Restoration involves the successful effort to restore tidal flow (e.g., culvert enlargement, fill removal) and return native plants to the site (planting, invasive plant species removal). Wetland restoration involves returning the natural functions of former or degraded wetlands. The main causes of tidal wetland degradation are activities such as draining, filling, impounding water, and placement of undersized culverts, which reduce tidal flow into and out of the wetland. Restoration efforts consist of reconnecting wetlands to estuarine embayments through the removal of tide gates, installation of larger culverts, and removal of fill, thus putting them back on ttack to be self-sustaining.

Project List*

Proposed Project	**Project Type**
Stratford Long Beach	Beach Nourishment Projects
Penfield Beach	Beach Nourishment Projects
Fairfield Beach	Beach Nourishment Projects
Chittenden Beach	Living Shoreline
Grass Island	Living Shoreline
Long Cove Tidal Marsh	Living Shoreline
Stony Creek Beach	Living Shoreline
Sandy Point, New Haven Harbor	Living Shoreline
Stratford Point Bank	Living Shoreline
Stratford Russian Beach Bank Protection	Living Shoreline
Long Wharf Erosion Mitigation and Living Shoreline	Living Shoreline
Johnson Creek	Living Shoreline
West Haven High School	Stormwater Retrofit
Live Oaks Elementary School	Stormwater Retrofit
Branford High School	Stormwater Retrofit
Foote Park	Stormwater Retrofit

Clinton Town Hall	Stormwater Retrofit
Cox Elementary School	Stormwater Retrofit
Cove River Tide Gate Relocation and Replacement	Tidal Flow Restoration
Mill River Tidal Flow Restoration	Tidal Flow Restoration
Fort Nathan Hale Tidal Reconnection	Tidal Flow Restoration
Hammock River	Tidal Flow Restoration

*For more details on the selected projects, such as estimated cost, see our project spreadsheet here.

Next Steps and Recommendations

This report represents the official handoff of project work to Audubon CT and CACD. Audubon CT and CACD will continue collecting and evaluating projects, and will hold public meetings to receive input from communities and key stakeholders. We look forward to the completion of the PL-566 plan, and are hopeful that Audubon CT, CACD, and their partners will receive funding for their watershed improvement projects.

In addition to finding new projects, each final project will likely require a deep-dive analysis and description. We provide one example of a full project deep dive (see Section IV of the Appendix). Each final project will require a deep-dive analogous to this example. The deep-dive provided in the appendix begins with its project 1-pager, and then follows with a section with greater details and narrative of the project's history, context, and benefits.

Based on our experience compiling an initial list of projects, we recommend that Audubon CT and CACD pursue the following next steps:

1. Collect additional projects for inclusion in the PL-566 application
This report recommends 22 projects for inclusion in the PL-566 program (see appendix for 1-pagers). There are many other projects across Connecticut that did not make it into this report due to timing and information gaps. For example, SeaGrant shared 4 projects that we think should be included but were not submitted in time. There are also many projects that were included in the 319 watershed plans, but did not make it into our final list of projects. Our team went through all the plans and included some projects in our final recommendations; however, many of the reports were relatively old, making it difficult to vet them. For a list of these projects and others that were not included, please see "Additional Projects" in the appendix.

There are likely also many projects that are unknown to the writers of this report. We recommend that Audubon CT and CACD hold public outreach meetings along the Connecticut coast, focusing on areas with vulnerable communities and nearby salt marsh and shellfish habitat. The authors of this report feel this is especially important in areas where no projects have been proposed. Based on our map, the following areas would be good candidates for further outreach:

1. New Canaan
2. Norwalk - Veterans Park Area
3. Stratford/Shelton along the Housatonic River
4. East Haven
5. Westbrook
6. Essex, South-east of Beacon Hill
7. East Lyme & Niantic River Estuary
8. Thames Estuary

2. Establish a simple process and key contact for inbound project submission

In addition to finding projects through outbound efforts, we recommend that Audubon CT and CACD set up a system for inbound project or site recommendations. Some recommended steps are:

1. **Set up a page with a description of the PL-566.** This can be a Google doc hosted online that borrows language and material from the outreach presentation.
2. **Include a link to an online form for project submission.** The online form can be a Google form that asks for information similar to that included in our one-page template. For example, has the project already started? Has it already been funded? What is the project's impact on shellfish, if any? Does the project impact vulnerable communities? What are the main project costs? Does project scoping material already exist? Etc.
3. **Disseminate this page and form through various channels.** This might include linking to it from the homepage of the CACD and Audubon CT websites, and sharing it out to the conservation districts and other conservation partners.
4. **Establish a point person for inbound project requests.** On both the webpage and other communications, establish a point person who is responsible for receiving and responding to project requests. As noted in our final presentation, watershed work is currently being done by disparate groups in a very start-stop fashion, and coordination is a challenge. Collecting all project requests in a central location should help with organization.

We feel this process may be especially useful for collecting updated nonpoint source water quality improvement projects from conservation districts and town managers.

3. Consider potential adverse impacts of projects on coastal ecology

Our project evaluations focused largely on a comparison of benefits. In part, this is because green infrastructure projects are generally known to work with nature, rather than against it. That

said, for final project selection, the sponsors of the project should evaluate the potential negative consequences.

Preliminary research on the topic did not raise any immediate ecological concerns for our teams. In fact, most scientific research shows that shellfish, salt marsh, and eel grass have mutually beneficial relationships (Chowdhury et al. 2019[1], Groner et al. 2018[2]). For living shorelines, the biggest concern is whether the solution is long-lasting in the face of more powerful storms since not all living shoreline projects are successful at reducing erosion (Polk & Eulie 2018[3]). The longevity and effectiveness of living shoreline projects is worth interrogating in final project selection. For stormwater retrofits, we did not find any research to indicate that biofiltration systems would negatively impact coastal ecosystems. Finally, the tidal flow restoration projects may have a range of ecological impacts that are tied to changing levels of salinity and hydrologic regimes. For example, woody vegetation may not be tolerant to increased salinity.[4] Therefore, tidal flow restoration projects should be examined for their impacts on existing ecosystems. The original project sponsor is a good starting point, though it may be necessary to bring in coastal ecologists for a second opinion.

Acknowledgements

We are extremely grateful to Denise Savageau and Rob LaFrance, our clients and mentors for this capstone clinic. Their insight and knowledge were invaluable to us as we researched, gathered, and vetted projects. We would like to acknowledge Tessa Getchis, Juliana Barett, Alyssa Dragon, Chris Sullivan, Cary Chadwick, Michael Zuber, Harry Yamalis, Kevin O'Brien, Judy Rondeau, Dan Mullins, Chris Tomicheck, Michael Dietz, Adam Whelchel, Bill Lucey, and our other partners at Save the Sound, CT DEEP, The Nature Conservancy, UConn and SeaGrant, the Bureau of Aquaculture, the Eastern Connecticut Conservation District, for their help collecting projects and their advice. Lastly, we would like to extend our sincere thanks to Brad Gentry and Chris DeFiore for their mentorship and helpful feedback throughout the semester.

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[1] Chowdhury, M. S. N., Walles, B., Sharifuzzaman, S. M., Shahadat Hossain, M., Ysebaert, T., & Smaal, A. C. (2019). Oyster breakwater reefs promote adjacent mudflat stability and salt marsh growth in a monsoon dominated subtropical coast. Scientific Reports, 9(1), 8549. https://doi.org/10.1038/s41598-019-44925-6

[2] Groner, M. L., Burge, C. A., Cox, R., Rivlin, N. D., Turner, M., Van Alstyne, K. L., Wyllie-Echeverria, S., Bucci, J., Staudigel, P., & Friedman, C. S. (2018). Oysters and eelgrass: Potential partners in a high pCO2 ocean. Ecology, 99(8), 1802–1814. https://doi.org/10.1002/ecy.2393

[3] Polk, M. A., & Eulie, D. O. (2018). Effectiveness of living shorelines as an erosion control method in north carolina. Estuaries and Coasts, 41(8), 2212–2222. https://doi.org/10.1007/s12237-018-0439-y

[4] Woods Hole Sea Grant Program. (2008). Introduction to Tidal Flow Restoration. National Sea Grant Library. https://nsgl.gso.uri.edu/whoi/whoig08003.pdf

Appendix

1. Summary of Final Deliverables

All of our final deliverables live in a publicly accessible **google drive folder**. That folder contains this final report, and:

A folder of our project **One-pagers**:
- The one-pager template
- All the 1-pagers. This is a repeat of what exists in our appendix

A folder of our **GIS data and map**:
- A zipped file which contains our final map with formatting and layers included
- A folder full of the map layers

A folder of 2 key **Project spreadsheets**:
- The file "vetting spreadsheets" is a spreadsheet that we used to vet projects. It contains the final list of projects that we considered including, and more importantly it shows our vetting methodology and can be used for vetting future projects.
- The file "PL-566 Projects" is a spreadsheet with multiple lists of projects, including our full list pre-vetting, our final list post-vetting, and 2 lists of projects that we were not able to vet and thus should still be vetted.

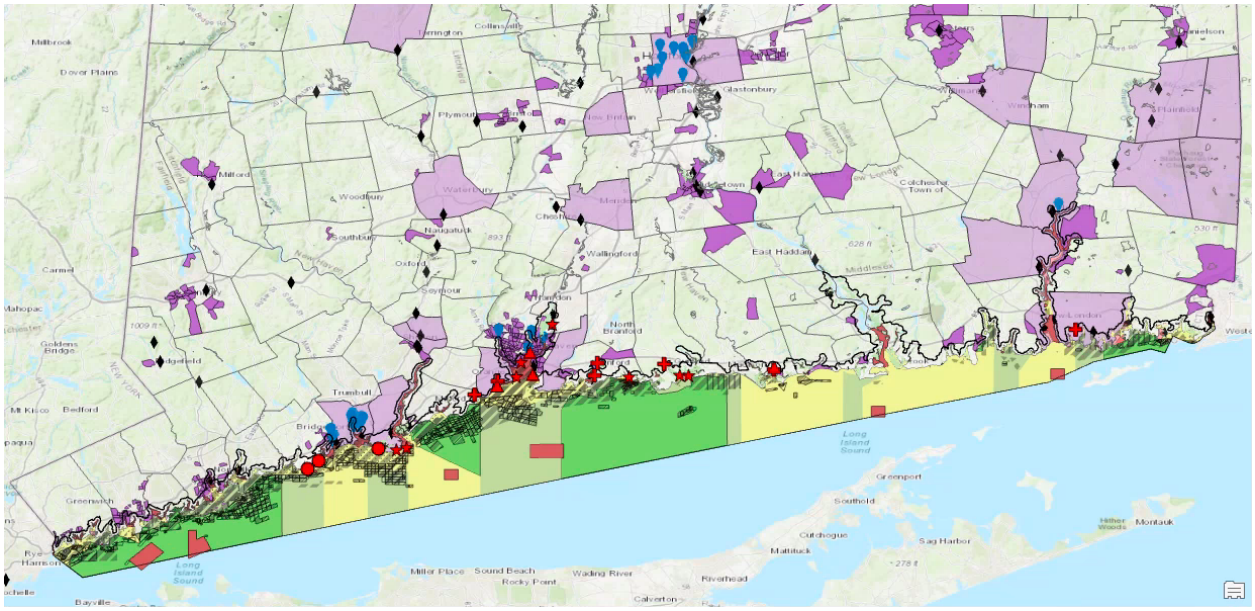
A folder of presentations for external communications:
- **Final Presentation** delivered December 9, 2021 (with editing access)
- **Outreach Presentation** (with editing access)

2. Map

For qualifying projects, we relied on a GIS map made up of the following layers:

- CT Townships
- Eelgrass Beds
- CT Coastal Boundary
- Coastal Access Guide
- Shellfish Area Classification Set
- State Managed Shellfish Beds
- Town Managed Shellfish Beds
- CT Natural Shellfish Beds
- CT Recreational Beds
- CSO Events
- Critical Habitats
- Erosion Susceptibility
- EJ Block Groups
- EPA % Minority
- WasteWater Treatment Plants

The full map and project layers can be found in this folder here.



To add new projects to the map, simply upload a spreadsheet with points, following the format laid out here. Note: It is essential to have the coordinates.

Project Name	Town	Location Coordinates	Latitude Coordinate Y	Longitude Coordinate X	Type of Project	Subtype	Lead Partner	Project status	Funding status
West Haven High School	West Haven	41.2595589483	41.2595589483	-72.9586367172	Stormwater Retrofits	Rain Garden	UConn CLEAR	Not started	Not funded
Live Oaks Elementary School	Milford	41.23833513907	41.23833513907	-72.9950305154	Stormwater Retrofits	Rain Garden	UConn CLEAR	Not started	Not funded
Branford High School	Branford	41.28783896017	41.28783896017	-72.8014907749	Stormwater Retrofits	Rain Garden, Tre	UConn CLEAR	Not started	Not funded
Foote Park	Branford	41.26847618937	41.26847618937	-72.8062154172	Stormwater Retrofits	Rain Garden, Tre	UConn CLEAR	Not started	Not funded
Clinton Town Hall	Clinton	41.27776979374	41.27776979374	-72.5235858712	Stormwater Retrofits	Rain Garden	UConn CLEAR	Not started	Not funded
Cox Elementary School	Guilford	41.2865673898	41.2865673898	-72.6964205098	Stormwater Retrofits	Rain Garden	UConn CLEAR	Not started	Not funded
Chittenden Beach	Guilford	41.26908972367	41.26908972367	-72.67173368861	Living Shoreline	Dune restoration	Save the Sound	Not started	Not funded
Grass Island	Guilford	41.26835866612	41.26835866612	-72.65768016318	Living Shoreline	Marsh Restoratio	Save the Sound	Not started	Not funded
Long Cove Tidal Marsh	Guilford	41.34934760954	41.34934760954	-72.87263162418	Living Shoreline	Marsh restoratio	Save the Sound	Not started	Not funded
Stony Creek Beach	Branford	41.2663893389	41.2663893389	-72.75170664495	Living Shoreline	Planting tidal veg	Save the Sound	Started	Not funded
Sandy Point, New Haven Harbor	West Haven	41.26646561299	41.26646561299	-72.9291999851	Living Shoreline	Enhancing beach	Save the Sound	Not started	Not funded
Stratford Point Bank	Stratford	41.15478989350	41.15478989350	-73.10218284790	Living Shoreline	Oyster Ball Reefs	Save the Sound	Started	Not funded
Stratford Long Beach	Stratford	41.152691014191	41.152691014191	-73.14668301247	Beach Nourishment	Re-nourishing th	Save the Sound	Not started	Not funded
Penfield Beach	Fairfield	41.134952851714	41.134952851714	-73.2404885985	Beach Nourishment	Three projects a	Save the Sound	Not started	Unsure
Fairfield Beach	Jennings Beach	41.12215066204	41.12215066204	-73.2574651786	Beach Nourishment	Dune Enhancem	Save the Sound	Not started	Not funded
Stratford Russian Beach Bank Protection	Stratford	41.151482, -73.11	41.151482	-73.118191	Living Shoreline	Living shoreline	TNC	Not started	Unfunded
Long Wharf Erosion Mitigation and Living Shoreline	New Haven	41.289295, -72.92	41.289295	-72.921846	Living Shoreline	Install breakwate	TNC	Not Started	Unfunded
Cove River Tide Gate Relocation and Replacement	West Haven	41.253336, -72.95	41.253336	-72.959647	Tidal Flow Restoration	Tide gate replac	TNC	Not Started	Unfunded
Johnson Creek	Bridgeport	41.183872490943	6, -73.187090178	-73.18709017873	Living Shoreline	Vegetative stabil	City of Bridgeport	Started	Partially Funded
Mill River Tidal Flow Restoration	New Haven	41.30607533786	41.30607533786	-72.90785130181	Tidal Flow Restoration	Tidal Flow Resto	Mill River Watershed A	Started	Partially Funded
Fort Nathan Hale Tidal Reconnection	New Haven	41.27094982745	41.27094982745	-72.9033981622	Tidal Flow Restoration	Tidal Reconnecti	City of New Haven	Started	Not funded
Hammock River	Clinton	41.28221196675	41.28221196675	-72.5227926941	Tidal Flow Restoration	Fix tide gates	CT DEEP	Started	Partially Funded

3. Vetting Spreadsheet

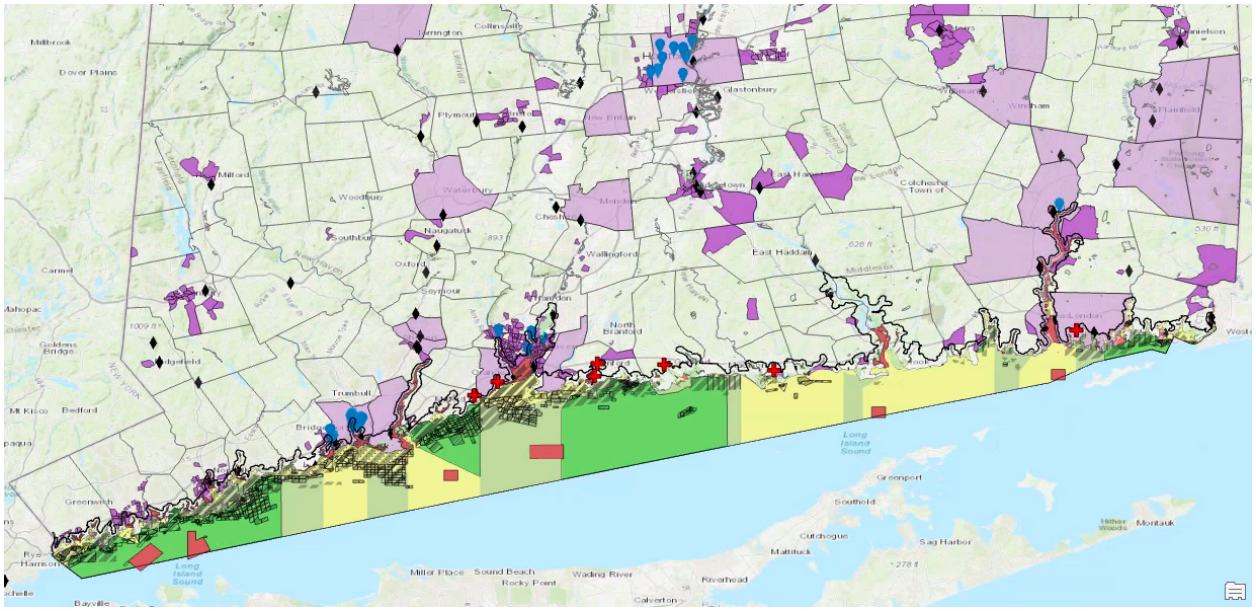
We used the data in our vetting spreadsheet to vet projects according to our vetting process as discussed in the methodology section. For each project and criteria we provided a dropdown list describing how the specific project impacts each of the 5 criteria (e.g. salt marsh habitat improvement). The four elements of the dropdown are: “primary,” “secondary,” “unknown” impact, or or no impact (labeled “none”). Primary and secondary were given 1 point, while unknown and none were given 0 points. The full number of points awarded to a project was then just the sum of five 1’s and 0’s. This rudimentary scoring gave us a rough idea of which projects improved multiple criteria. From there we used our background knowledge of each project to determine which we thought were best fits for the grant and had the most impact.

The vetting spreadsheet can be found here.

4. Project Summary One-pagers

In the following pages, we provide one-page project summaries for the top 22 projects that we recommend including in the grant application. The format across each one is consistent for readability and ease of creation. We also provide a template for the one-pagers here.

Stormwater Retrofit Projects



Project Index:

West Haven High School
Live Oaks Elementary School
Branford High School
Foote Park
Clinton Town Hall
Cox Elementary School

West Haven High School

Stormwater Retrofits

Location: West Haven, Connecticut;
Coordinates: 41.259558948392765, -72.95863671729461
Project Partners: UConn CLEAR
Source of project: UConn CLEAR Stormwater Retrofit Recommendations; Contact michael.dietz@uconn.edu for more information.

Project Description:
Install rain gardens in West Haven High School in order to treat stormwater, while providing an educational opportunity to the school community.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	no impact	primary	secondary

Rationale:
The main goal of this project is to treat stormwater before it runs off into the Long Island Sound. West Haven High School is adjacent to a tidal wetland and directly upstream of restricted-relay shellfish beds, so this project will have secondary benefits to shellfish and salt marsh habitat. West Haven is considered a vulnerable community.

Technical Overview:

- *Area:* Impacts 5,735 sq ft
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
UConn CLEAR estimates that this rain garden will treat 145,852 gallons of water each year. This volume is on the low end when compared to other stormwater retrofit projects on our list; however, it provides a good opportunity for community engagement in a distressed area.

Live Oaks Elementary School

Stormwater Retrofits

Location: Milford, Connecticut;
Coordinates: 41.2383351390776, -72.99503051543891
Project Partners: UConn CLEAR
Source of project: UConn CLEAR Stormwater Retrofit Recommendations; Contact michael.dietz@uconn.edu for more information.

Project Description:
Install rain gardens in Live Oaks Elementary School in order to treat stormwater, while providing an educational opportunity to the school community.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	no impact	primary	secondary

Rationale:
The main goal of this project is to treat stormwater before it runs off into the Long Island Sound. Live Oaks Elementary School is adjacent to a stream with a salt marsh and directly upstream of restricted-relay shellfish beds, so this project will have secondary benefits to shellfish and salt marsh habitat. Milford is not considered a distressed community; however, the stream adjacent to the school feeds directly into West Haven, which is considered a vulnerable community.

Technical Overview:

- *Area:* Impacts 12,374 sq ft
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
UConn CLEAR estimates that this rain garden will treat 314,441 gallons of water each year. This volume would be considered mid-range when compared to other stormwater retrofit projects on our list; however, it provides a good opportunity for community engagement and education that could have larger impacts outside of this specific project.

Branford High School

Stormwater Retrofits

Location: Branford, Connecticut;
Coordinates: 41.287838960176565, -72.80149077496698
Project Partners: UConn CLEAR
Source of project: UConn CLEAR Stormwater Retrofit Recommendations; Contact michael.dietz@uconn.edu for more information.

Project Description:
Install rain gardens and tree filters in Branford High School in order to treat stormwater, while providing an educational opportunity to the school community.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	no impact	primary	secondary

Rationale:
The main goal of this project is to treat stormwater before it runs off into the Long Island Sound. Branford High School is adjacent to a tidal marsh and shellfish beds currently classified as prohibited. Branford High School is located in a Census block group that is considered an Environmental Justice community by Connecticut DEEP.

Technical Overview:

- *Area:* Impacts 32,669 sq ft
- *Estimated Cost:* $15,000-$65,000
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
UConn CLEAR estimates that this rain garden will treat 860,260 gallons of water each year. This volume is on the high end when compared to other stormwater retrofit projects on our list; it also provides a good opportunity for community engagement in a distressed area.

Foote Park

Stormwater Retrofits

Location: Branford, Connecticut;
Coordinates: 41.26847618937097, -72.80621541729435
Project Partners: UConn CLEAR
Source of project: UConn CLEAR Stormwater Retrofit Recommendations; Contact michael.dietz@uconn.edu for more information.

Project Description:
Install rain gardens and tree filters in Foote Park in order to treat stormwater, while providing an educational opportunity in a highly trafficked area.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	no impact	primary	no impact

Rationale:
The main goal of this project is to treat stormwater before it runs off into the Long Island Sound. Foote Park is adjacent to a tidal marsh and shellfish beds currently classified as prohibited. It is not located in a distressed or EJ community (though it is near an EJ census block group).

Technical Overview:

- *Area:* Impacts 106,939 sq ft
- *Estimated Cost:* $27,000-$88,000
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
UConn CLEAR estimates that this rain garden will treat 2,816,085 gallons of water each year. This volume is on the extreme high end when compared to other stormwater retrofit projects on our list. The park provides a high-visibility opportunity to educate Branford about stormwater mitigation projects.

Clinton Town Hall

Stormwater Retrofits

Location: Clinton, Connecticut;
Coordinates: 41.27776979374725, -72.52358587125467
Project Partners: UConn CLEAR
Source of project: UConn CLEAR Stormwater Retrofit Recommendations; Contact michael.dietz@uconn.edu for more information.

Project Description:
Install a rain garden in Clinton Town Hall in order to treat stormwater, while providing an educational opportunity in a highly trafficked area.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	no impact	primary	secondary

Rationale:
The main goal of this project is to treat stormwater before it runs off into the Long Island Sound. Clinton Town Hall is located near a salt marsh and restricted-relay shellfish beds. It is also located in an Environmental Justice Census block group, according to Connecticut DEEP.

Technical Overview:

- *Area:* Impacts 3,485 sq ft
- *Estimated Cost:* $2,000-$9,000
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
UConn CLEAR estimates that this rain garden will treat 91,766 gallons of water each year. This is the smallest stormwater retrofit project on our list. However, it is located in a highly trafficked area providing some stormwater benefits and a great educational opportunity.

Cox Elementary School

Stormwater Retrofits

Location: Guilford, Connecticut;
Coordinates: 41.28656738980979, -72.69642050986855
Project Partners: UConn CLEAR
Source of project: UConn CLEAR Stormwater Retrofit Recommendations; Contact michael.dietz@uconn.edu for more information.

Project Description:
Install a rain garden in Cox Elementary school in order to treat stormwater, while providing an educational opportunity to the school community.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	no impact	primary	no impact

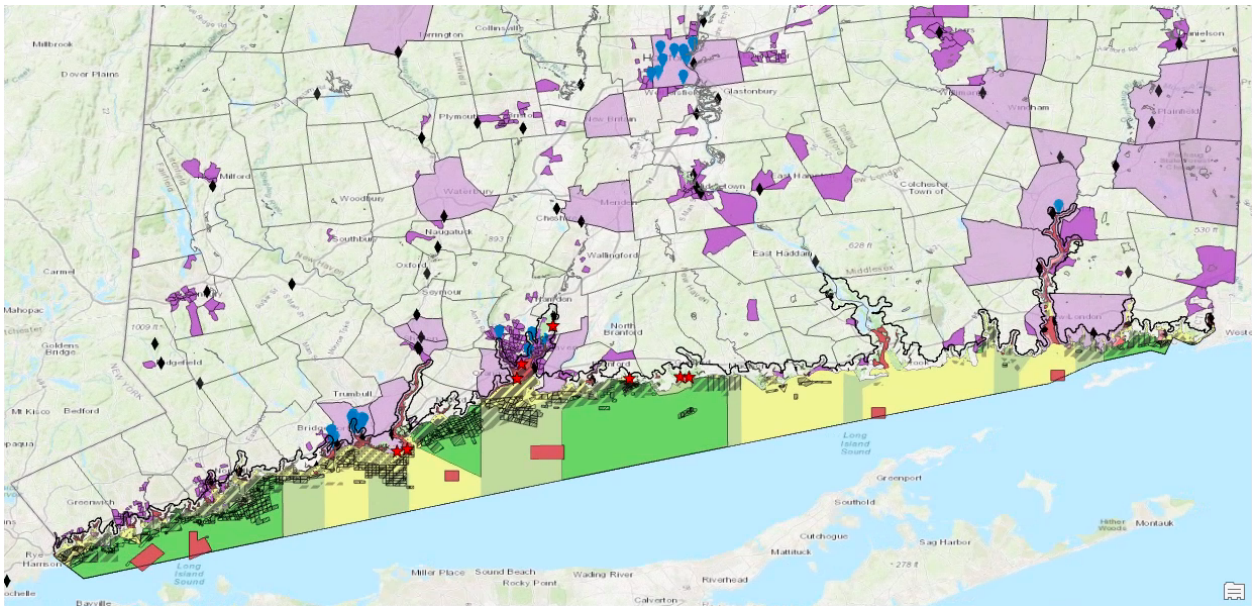
Rationale:
The main goal of this project is to treat stormwater before it runs off into the Long Island Sound. Cox Elementary School is located near a salt marsh and restricted-relay shellfish beds. It is not located in a distressed community or Environmental Justice Census block group, according to Connecticut DEEP.

Technical Overview:

- *Area:* Impacts 21,518 sq ft
- *Estimated Cost:* $8,000-$32,000
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
UConn CLEAR estimates that this rain garden will treat 566,533 gallons of water each year. This volume is on the high end when compared to other stormwater retrofit projects on our list. Given the volume of water treated, it has a competitive cost estimate. It also provides a good educational opportunity.

Living Shoreline Projects



Project Index:

Chittenden Beach
Grass Island
Long Cove Tidal Marsh
Stony Creek Beach
Sandy Point
Stratford Point Bank
Johnson Creek Living Shoreline

Chittenden Beach

Living Shoreline

Location: Guilford, Connecticut;
Coordinates: 41.26908972367386, -72.67173368861386
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
A living shoreline consisting of vegetation and dune construction would protect from further erosion and flooding in the extremely low lying area that lies directly inland.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
None	Primary	Primary	Secondary	None

Rationale:
This region has been devastated by Storm Sandy and more recent storms, leaving a damaged marsh and shoreline. Save the Sound and Guilford are seeking support for design studies and surveys to assess project impact and benefit-cost ratio as the next steps in this project.

Technical Overview:

- *Area:* Impacts 27,000 sq ft
- *Estimated Cost:* $500,000- $2.1 million
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
Currently Save the Sound estimates the cost at $500k for design and $2.1 million for construction.

Grass Island

Living Shoreline

Location: Guilford, Connecticut;
Coordinates: 41.268358666125096, -72.6576801631896
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
Integrated groins, beach enhancement, and a marsh restoration effort east of the harbor would protect this famous landmark location from sea rise and storm surges that threaten the low-lying area.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
Secondary	Primary	Secondary	Secondary	None

Rationale:
Grass Island is home to marsh, dunes and an iconic coastal cottage visual scene.

Technical Overview:

- *Area:* N/A
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
Grass Island lies in a region rich of salt marsh habitat, although does not satisfy vulnerable communities due to isolated location.

Long Wharf Erosion Mitigation and Living Shoreline

Living Shoreline

Location: New Haven, Connecticut
Coordinates: *41.289295, -72.921846*
Project Partners: City of New Haven, Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, TNC
Source of project information: TNC: Southern CT Resilience Plan Doc[5], Resiliency Portfolio Doc[6]

Project Overview:
The project proposes using a combination of rocks and oyster castles to create sills and fortify the area landward of the salt marshes. The project also proposes to plant native plantings along the shore. The goal is to increase the resilience of a public walkway along the water, Long Wharf Drive, and the infrastructure further inland.

Benefits:

Shellfish habitat	Salt marsh habitat	Coastal resilience	Water quality	Vulnerable communities
secondary	secondary	primary	secondary	primary

Rationale:
The primary purpose of the project is to protect critical infrastructure in a vulnerable community. It accomplishes this through planting native plantings and oysters castles, thereby improving shellfish habitat, salt marsh habitat, and water quality as important ancillary benefits.

Technical Overview:

- *Acreage:* Unknown
- *Estimated Cost:* $1,287,000
- *Project status:* Scoped multiple times but not started
- *Funding status:* Unfunded
- *Timeline:* Unknown
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

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[5] See PDF pages 260-263: *Southern Connecticut Regional Framework for Coastal Resilience*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/eq99795if3jqrexz156ry2l4haoqlhew
[6] See PDF page 13: *Southern Connecticut Regional Framework for Coastal Resilience: Community Resilience Building Design Portfolio Edges and Slopes*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/99z5q05pkd4c0dr52a2tousbjj15nqac

Love Cove Tidal Marsh

Living Shoreline

Location: Guilford, Connecticut;
Coordinates: 41.349347609544154, -72.87263162418239
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
This project would involve marsh restoration through removing a blockage in the waterway of the tidal marsh.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
Secondary	Secondary	Primary	Secondary	None

Rationale:
If removed, this would alleviate the consistent flooding problem through the residential neighborhoods along Route 146.

Technical Overview:

- *Area:* N/A
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
Long Cove Tidal Marsh falls in a region rich of salt marsh habitat, although does not satisfy vulnerable communities due to isolated location.

Stony Creek Beach

Living Shoreline

Location: Branford, Connecticut;
Coordinates: 41.26638933890762, -72.75170664499369
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
Although tidal vegetation already exists, planting even more in strategic locations along the walls surrounding the beach would help to mitigate erosion and improve the ecological value of the region.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
Primary	Primary	Primary	Secondary	Secondary

Rationale:
This popular beach location has been battered by storm surges in recent years.

Technical Overview:

- *Area:* N/A
- *Estimated Cost:* N/A
- *Project status:* Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
This popular beach location has been battered by storm surges in recent years.

Sandy Point

Living Shoreline

Location: New Haven, Connecticut;
Coordinates: 41.26646561299507, -72.92919998512733
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
Enhancing Sandy Point's beach structure and the potential of enhancing tidal marsh behind Sandy Point. This material could also help to supply material for marsh and beach structures as part of the Long Wharf and East Shore Park living shoreline projects along the harbor.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
Secondary	Primary	Secondary	Secondary	Secondary

Rationale:
The US Army Corps of Engineers will be completing maintenance navigational channel dredging for the New Haven Harbor to assure its continued commercial use.

Technical Overview:

- *Area:* 800,000 cubic sq. ft
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:
Over 800,000 cubic yards of largely clean dredge materials will be made available through this project. The Corps has identified several potential nature based resilience projects worth exploring that could make use of this material.

Stratford Point Bank

Living Shoreline

Location: Stratford, Connecticut;
Coordinates: 41.15478989350042, -73.10218284790298
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
Hybrid solutions are needed to enhance and expand the protection that a successful pilot artificial reef system is achieving in reducing erosion at the Audubon Center at Stratford Point.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
Primary	Primary	Secondary	Secondary	Secondary

Rationale:
An award winning coastal living shoreline project combining oyster ball reefs and marsh planting can be expanded at this popular Audubon center.

Technical Overview:

- *Area:* N/A
- *Estimated Cost:* N/A
- *Project status:* Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes: Project type can include treating an eroding dune bank.

Stratford Russian Beach Bank Protection

Living Shoreline

Location: Stratford, Connecticut
Coordinates: *41.151482, -73.118191*
Project Partners: City of Stratford, Greater Bridgeport Regional Council, Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, TNC
Source of project information: TNC: Southern CT Resilience Plan Doc[7], Resiliency Portfolio Doc[8]

Project Overview:
The project proposes to replace a degraded, dirt and rock beach with a walking path and thin strip of tidal wetland to stabilize the bank. The bank is currently steep dirt and is eroding. The project will create a more gentle, planted slope and will plant salt marsh vegetation seaward of the bank. It will also create a bioswale to catch runoff nutrients and sediment.

Benefits:

Shellfish habitat	Salt marsh habitat	Coastal resilience	Water quality	Vulnerable communities
none	secondary	primary	secondary	secondary

Rationale:
The primary purpose of the project is to prevent erosion in a vulnerable community. It accomplishes this through planting native grasses, enabling salt marsh migration, and adding bioswales, thereby improving salt marsh habitat and water quality as well.

Technical Overview:

- *Acreage:* Unknown
- *Estimated Cost:* $883,200
- *Project status:* Scoped but not started
- *Funding status:* Unfunded
- *Timeline:* Unknown
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

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[7] See PDF pages 247-263: *Southern Connecticut Regional Framework for Coastal Resilience*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/eq99795if3jqrexz156ry2l4haoqlhew
[8] See PDF page 16: *Southern Connecticut Regional Framework for Coastal Resilience: Community Resilience Building Design Portfolio Edges and Slopes*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/99z5q05pkd4c0dr52a2tousbjj15nqac

Johnson Creek Living Shoreline

Living Shoreline

Location: Bridgeport, Connecticut;
Coordinates: 41.1838724909436, -73.18709017873232
Project Partners: City of Bridgeport, Connecticut Metropolitan Council of Governments (MetroCOG), The Nature Conservancy
Source of project: DEEP

Project Description: The project site is at a low elevation and faces frequent risks of flooding. It has also suffered from disinvestment and is now facing significant erosion. The project's goal is to create a passive recreational trail along the water for public use and restoration using nature-based living shoreline techniques. The design calls for vegetative stabilization and support for potential wetland migration, removal of debris and invasive species for habitat restoration, and improved public access to the waterfront for a low-income and environmentally overburdened community.

Benefits:

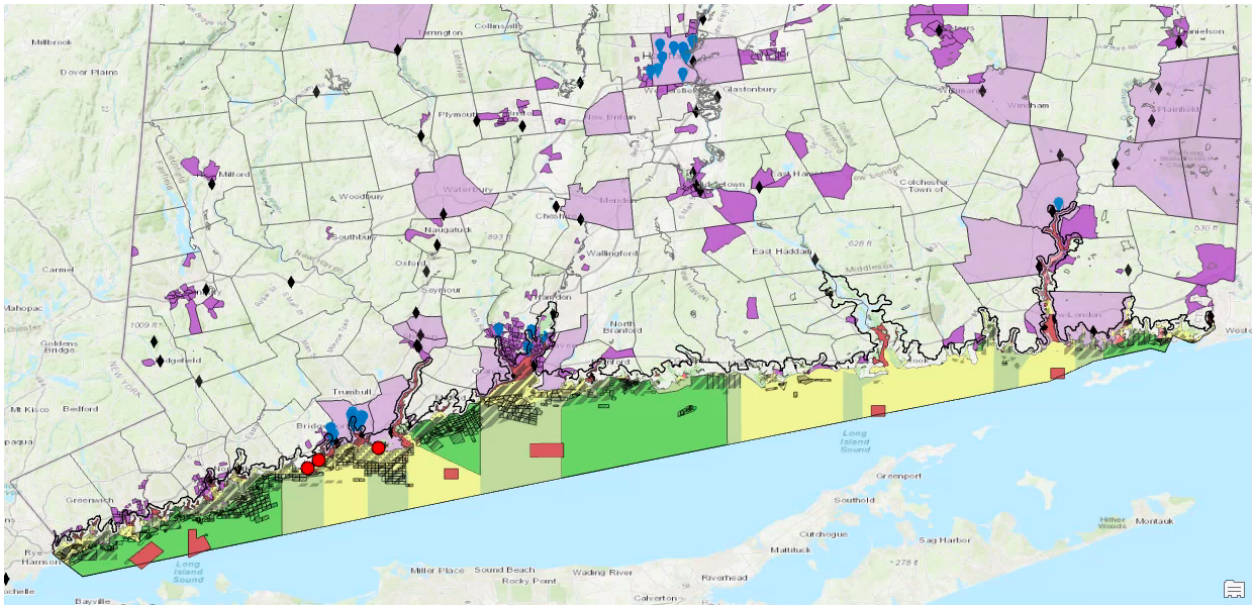
Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	primary	primary	primary	secondary

Rationale:
The Connecticut Metropolitan Council of Governments (MetroCOG), in partnership with the City of Bridgeport and The NatureConservancy (TNC) facilitated the design for a living shoreline project at this location with MMI serving as the design consultant. The project is construction-ready but lacks funding for implementation. The project has been identified as a "high priority" by local stakeholders. As a result of this project, youth and residents will have access to the waterfront, flooding will be mitigated and wetland habitat created.

Technical Overview:

- *Area:* Impacts 1 acre
- *Estimated Cost:* $1,000,000
- *Project status:* Started
- *Funding status:* $75k funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Beach Nourishment Projects



List of Projects:

Stratford Long Beach
Penfield Beach
Fairfield Beach

Stratford Long Beach

Beach Nourishment

Location: Stratford, Connecticut;
Coordinates: 41.15269101419185, -73.14668301247237
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
Re-nourishing this dune structure along with nourishing this beach would provide temporary protection to this important public access point.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
Secondary	Primary	Secondary	Primary	Secondary

Rationale:
Ever since Hurricane Sandy took out a low lying dune, this area has been at risk. This parking facility provides public access to nearly 2 miles of open barrier beach. The low lying dune protecting this facility was washed out during Super storm Sandy.

Technical Overview:

- *Area:* ~ 2 miles
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes: We must accept that these barrier beach systems will continue to migrate and roll inland, and that alternative parking locations may ultimately be part of the solution.

Penfield Beach

Beach Nourishment

Location: Stratford, Connecticut;
Coordinates: 41.13495285171453, -73.24048859894755
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
Three projects are identified in this area to secure inland property from storm surges which sustained heavy damages from hurricane Sandy.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
Secondary	Primary	Secondary	Primary	Secondary

Rationale:
This beach remains a vulnerable location for flooding the nearby area.

Technical Overview:

- *Area:* N/A
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes: Coastal housing is a main priority in regards to protection.

Fairfield Beach

Beach Nourishment

Location: Jennings Beach, Connecticut;
Coordinates: 41.12215066204845, -73.2574651786043
Project Partners: Save the Sound
Source of project: Save the Sound; Contactinfo@savethesound.org for more information.

Project Description:
A comprehensive flood protection project that incorporates dune enhancements should be evaluated to help protect nearby properties.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
None	Primary	Primary	Secondary	Secondary

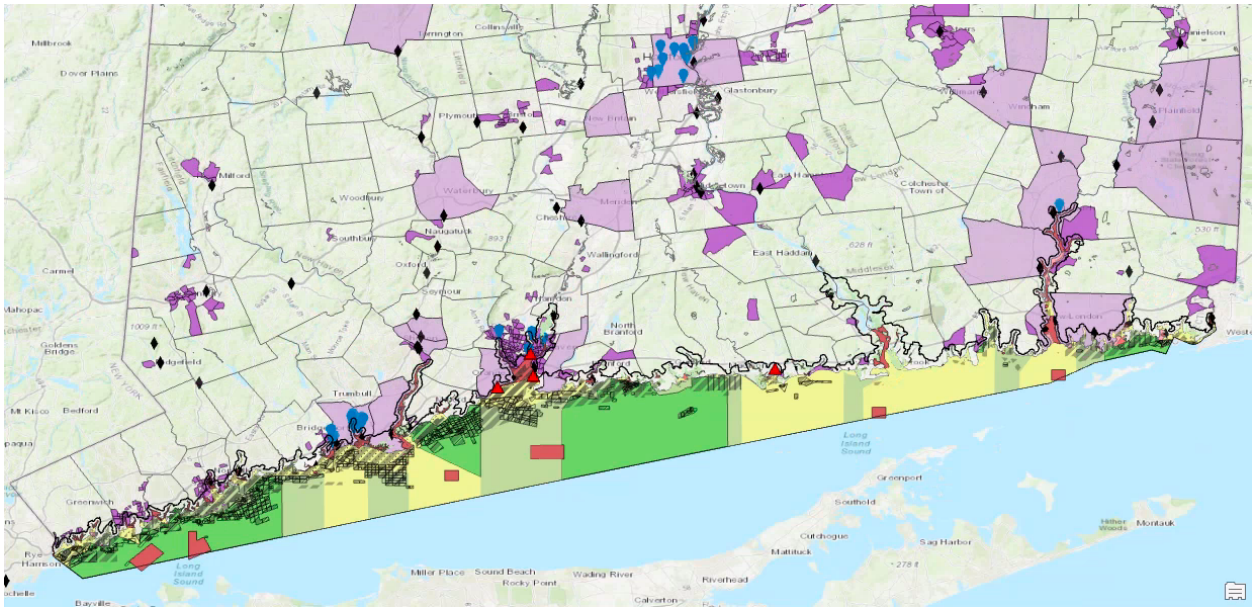
Rationale:
An unstable dune ridge protects some, but not all of its nearby properties. A dune ridge (not a true and stable dune) was put in place here, and it only protects some property.

Technical Overview:

- *Area:* N/A
- *Estimated Cost:* N/A
- *Project status:* Not Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes: An unstable dune ridge protects some, but not all of its nearby properties.

Tidal Flow Projects



Project Index:

Fort Nathan Hale Tidal Reconnection
Hammock River
Mill River Tidal Flow Restoration

Cove River Tide Gate Relocation and Replacement

Tidal Flow Restoration

Location: West Haven, Connecticut
Coordinates: *41.253336, -72.959647*
Project Partners: City of West, Haven, Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, TNC, Milone and MacBroom
Source of project information: TNC: Southern CT Resilience Plan Doc[9]

Project Overview:
"The tide gates are old one-way gates that do not allow sufficient flushing north of the road… The new gates would be placed at the failing pedestrian bridge that is currently closed and the entire bridge would be repaired. This would help increase tidal flushing and control invasive species for this portion of the Cove River as well as reduce flooding upstream."[10]

Benefits:

Shellfish habitat	Salt marsh habitat	Coastal resilience	Water quality	Vulnerable communities
secondary	primary	secondary	unknown	secondary

Rationale:
The purpose of the project is to restore tidal flow while protecting inland infrastructure from coastal flooding. Because of its location, this primarily improves salt marsh habitat, but it will also improve shellfish habitat and coastal resilience within a vulnerable community.

Technical Overview:

- *Acreage:* Unknown
- *Estimated Cost:* Unknown
- *Project status:* Scoped but not started
- *Funding status:* Unfunded
- *Timeline:* Unknown
- *Maintenance requirement:* Low
- *Infrastructure type:* Green/Gray

Notes:

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[9] See PDF pages 79: *Southern Connecticut Regional Framework for Coastal Resilience*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/eq99795if3jgrexz156ry2l4haoqlhew
[10] Ibid.

Fort Nathan Hale Tidal Reconnection

Tidal Flow

Location: New Haven, Connecticut;
Coordinates: 41.27094982745426, -72.90339816223741
Project Partners: City of New Haven, Save the Sound
Source of project: Save the Sound

Project Description: Restore tidal marsh by reconnecting beds of standing water to shoreline; improving access to two parks.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	primary	secondary	secondary	secondary

Rationale:
The site has two distinct parks, separated by a fishing pier– the Fort Nathan Hale-Black Rock Fort, and the Nathan Hale Park. Most of the shoreline is accessible from the park, but there is an obvious lack of tidal connectivity from the Fort Nathan Hale-Black Rock Fort side. Between the parking lot and the shoreline are two canals of standing water, which would benefit from tidal reconnection and restoration. At the same time, the shoreline is designated for recreational purposes, but is difficult to access in its current configuration. This part is near a vulnerable community.

Technical Overview:

- *Area:* Impacts N/A
- *Estimated Cost:* N/A
- *Project status:* Started
- *Funding status:* Not Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:

Hammock River

Tidal Flow

Location: Clinton, Connecticut;
Coordinates: 41.282211966752634, -72.52279269411403
Project Partners: City of Clinton, CT DEEP Wildlife Division
Source of project: CT DEEP

Project Description: The river was tide gated for years, before being chained open to restore tidal flow into the marsh. Enough water enters the marsh during rising tide, but only trickles out at peak low tide. The marsh is saturated as a result. This proposal would keep tide gates fully open when the ride level on the downstream side falls below a threshold elevation. Gates will remain open, allowing for a more complete draining of the system at low tide. The self-regulating tide gates (SRTG) were installed to help increase nesting success of saltmarsh sparrows. They will be adjusted so that they close before rising water levels flood nests.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	primary	secondary	none

Rationale:

This project will benefit tidal marsh habitat directly, and improve tidal flow upstream of shellfish beds in Clinton.

Technical Overview:

- *Area:* N/A
- *Estimated Cost:* $220,000
- *Project status:* Started
- *Funding status:* Partially funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Mixed

Notes:

Mill River Tidal Flow Restoration

Tidal Flow

Location: New Haven, Connecticut;
Coordinates: 41.3060753378688, -72.90785130181189
Project Partners: Mill River Watershed Association, City of New Haven, Save the Sound
Source of project: DEEP

Project Description:
Currently, a dam with 14 tide gates blocks the upstream flow of tidal water and passage of anadromous fish. This project would include installation of self-regulating tide gates in place of manual tide gates on the Mill River, reconnecting upstream habitat to tidal flows and allowing for regular fish passage. This project will also include investments in public access to the Mill River, which is currently the target of EPA Urban Waters Initiative funding and efforts to engage residents of low-income, environmentally overburdened communities in stewardship of the river. The project's scope could also include a passive recreational trail along the water for public use.

Benefits:

Shellfish Habitat	Salt marsh habitat	Coastal resilience	Water Quality	Vulnerable Communities
secondary	secondary	primary	primary	secondary

Rationale:
The project's location features tidal marsh, and is located in a vulnerable community. Restoring this part of the Mill River would have compound benefits on the area and its community.

Technical Overview:

- *Area:* Impacts 26.1 acres
- *Estimated Cost:* N/A
- *Project status:* Started
- *Funding status:* Partially Funded
- *Timeline:* N/A
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Notes:

5. Project deep-dive

Long Wharf Erosion Mitigation and Living Shoreline

Living Shoreline

Location: New Haven, Connecticut
Coordinates: *41.289295, -72.921846*
Project Partners: City of New Haven, Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, TNC
Source of project information: TNC: Southern CT Resilience Plan Doc[11], Resiliency Portfolio Doc[12]

Project Overview:
The project proposes using a combination of rocks and oyster castles to create sills and fortify the area landward of the salt marshes. The project also proposes to plant native plantings along the shore. The goal is to increase the resilience of a public walkway along the water, Long Wharf Drive, and the infrastructure further inland.

Benefits:

Shellfish habitat	Salt marsh habitat	Coastal resilience	Water quality	Vulnerable communities
secondary	secondary	primary	secondary	primary

Rationale:
The primary purpose of the project is to protect critical infrastructure in a vulnerable community. It accomplishes this through planting native plantings and oysters castles, thereby improving shellfish habitat, salt marsh habitat, and water quality as important ancillary benefits.

Technical Overview:

- *Acreage:* unknown
- *Estimated Cost:* $1,287,000
- *Project status:* Scoped multiple times but not started

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[11] See PDF page 260-263: *Southern Connecticut Regional Framework for Coastal Resilience*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/eq99795if3jqrexz156ry2l4haoqlhew
[12] See PDF page 13: *Southern Connecticut Regional Framework for Coastal Resilience: Community Resilience Building Design Portfolio Edges and Slopes*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/99z5q05pkd4c0dr52a2tousbjj15nqac

- *Funding status:* Unfunded
- *Timeline:* Unknown
- *Maintenance requirement:* Low
- *Infrastructure type:* Green

Detailed Project Information

Subjective impact rating: *High overall, but med/low per dollar*
Rating explanation: The impact is high because it protects critical infrastructure while enhancing salt marsh and oyster habitat. However, because its primary goal is coastal resilience, it is a more expensive project than would be necessary if the main goal were solely to increase salt marsh and oyster habitat.

Central problem the project solves: The park has experienced significant erosion in recent years, particularly after Hurricanes Sandy and Irene. Erosion is expected to continue without intervention. Continued erosion will put critical infrastructure at risk, such as Long Wharf Drive, the coastal public park and walkway, and infrastructure further inland. Additionally, continued erosion will decrease the existing salt marsh habitat over time.

Resilience to sea level rise: With 1-2 feet of sea level rise the project should stay functional. Additional work will need to be done to maintain effective resilience with 3 feet or more of sea level rise.

Project history and context setting: This Long Wharf Drive resiliency project has been under consideration for at least six years. While it has been scoped multiple times and has been noted to be a high-value project, it has not yet been implemented.

The City of New Haven commissioned a rock revetment design to win a FEMA hazard mitigation grant obligated to 2015, but the project was canceled in 2016. The city also won a CDBG-DR grant for a planning study of the Long Wharf area, focusing on flood protection and erosion mitigation. This study began in 2015 and was completed in 2016. Lastly, during the planning for the previous iteration of the Southern Connecticut Regional Framework for Coastal Resilience in 2015, municipal staff promoted this project as one of the two most important potential green infrastructure coastal resilience project sites in New Haven.[13]

Not only is Long Wharf Drive in a vulnerable community, it also is where one of Connecticut's largest collections of food trucks, taco trucks in particular, sell their food every day. The

[13] Note that this information comes from the most recent Regional Framework for Coastal Resilience document, completed in 2017. See PDF page 260-263 of: *Southern Connecticut Regional Framework for Coastal Resilience*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017.
https://tnc.box.com/s/eq99795if3jqrexz156ry2l4haoqlhew

confluence of food trucks, popular social space, coastline, and salt marsh habitat make this area a major asset to the social and natural vibrancy of New Haven and Connecticut.

In-depth project description: The primary goal of the project is to reduce erosion and mitigate flood potential through implementing nature-enhancing green infrastructure. As described in the project overview, the project proposes using a combination of rocks and oyster castles to create sills and fortify the area landward of the salt marshes. The project also proposes to plant native plantings along the shore. The goal is to increase the resilience of a public walkway along the water, Long Wharf Drive, and the infrastructure further inland. Specifically, the project will decrease wave energy, decrease erosion, and increase accretion, while simultaneously increasing salt marsh habitat and habitat for oysters and horseshoe crabs. By using spaced-out sills instead of full rock-walls, the wave energy should be mitigated, as opposed to simply moved or even amplified elsewhere. The oysters castles will provide habitat for oysters, while space between the rocks in the sills will provide horseshoe crab habitat. The sills will work to increase sediment accretion, not only mitigating erosion but actually reversing it under most conditions. The sills will be just barely visible in low tide, but generally either unseen or low profile. The native salt marsh grass currently proposed is spartina.

Note that the project will not, nor is it intended to, provide full protection against a base flood (also called “100-year flood”). Additionally, while the park extends beyond Long Wharf Drive, the project proposed by TNC only protects the portion of the park along Long Wharf Drive. Additional work would need to be done to accomplish these more expansive goals.

Summary of Public Comment: [To be filled in when it occurs, or if it has already occurred, once the info has been gathered]

Previous project work done by:
Milone and MacBroom
GEI Consultants
Langan Engineering
City of New Haven
Connecticut Metropolitan Council of Governments
South Central Regional Council of Governments
TNC

Costs Summary:

Construction costs:	$408,000
Rock:	$375,000
Native grasses and restoration work:	$54,000
Oyster Castles	$450,000
Total:	**$1,287,000**

Images and renderings:[14]

Photo of the current conditions of the park along Long Wharf Drive. Healthy salt marsh habitat exists, but it is experiencing erosion.

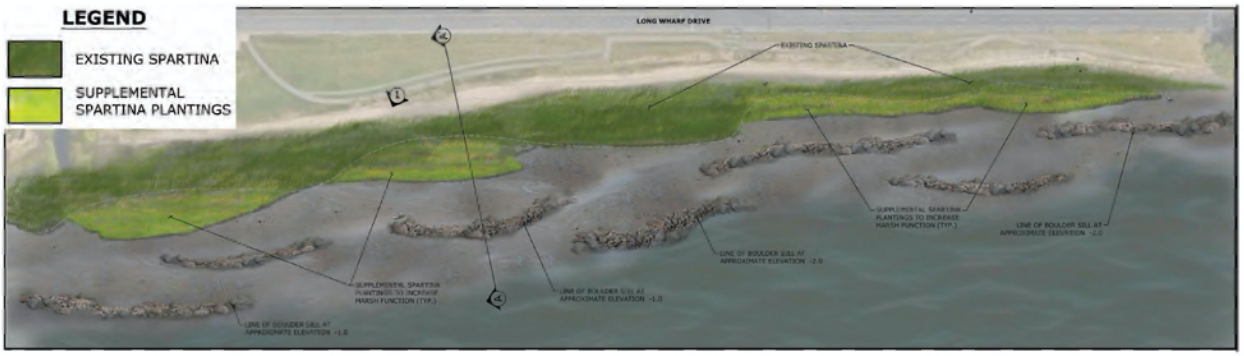
EXISTING

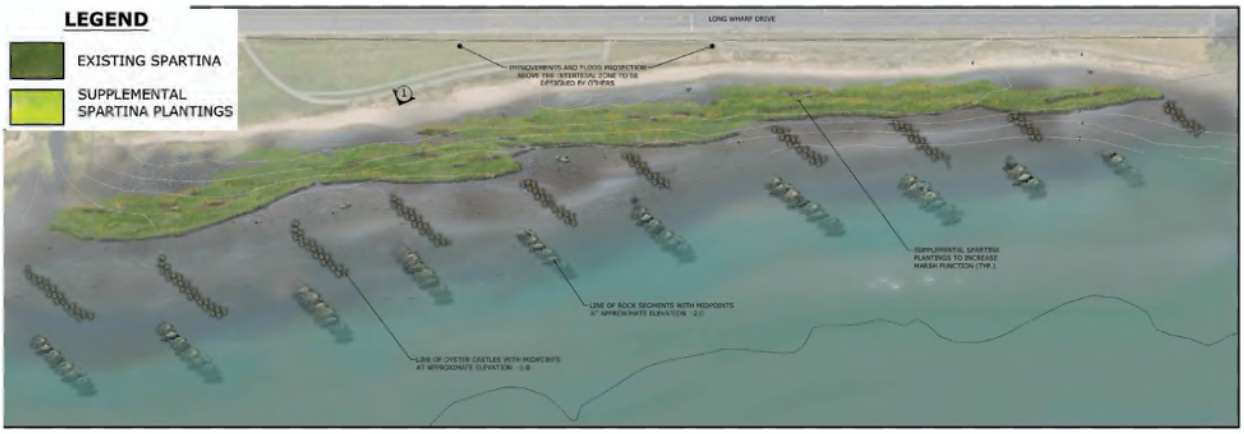
A rendering of the proposed project from a similar vantage as the above photo.

PROPOSED

[14] Source of images: PDF page 260-263 of: *Southern Connecticut Regional Framework for Coastal Resilience*. Connecticut Metropolitan Council of Governments, South Central Regional Council of Governments, and The Nature Conservancy. June, 2017. https://tnc.box.com/s/eq99795if3jgrexz156ry2l4haoqlhew

Proposed potential designs.





6. Additional Projects

In addition to the projects recommended in our final report, we encourage CACD and Audubon CT to look at the following resources for new projects to include in the PL-566 program:

- **Audubon CT Priority Salt Marsh Assessment:** Identifies four priority salt marshes along the Connecticut coast, and a list of associated restoration opportunities.
- **West River Watershed Coalition Plan:** The West River Watershed Coalition is currently working to define priority restoration sites in the West River watershed. The linked jamboard provides a high level overview of priorities. The West River Watershed Management plan can be found.Contact Stephanie Fitzgerald for more information: sfitzgerald1@comcast.net
- **Poquetanuck Cove Conservation Action Plan:** The Eastern Connecticut Conservation District created an action plan to restore the Poquetanuck Cove, an important bird sanctuary and tidal marsh estuary. For an up-to-date list of priority projects, contact Jean Pillo, the ECCD Watershed Conservation Project Manager, at: jean.pillo@comcast.net
- **Watershed Management Plans:** The 319 Watershed Management plans contain many projects that might be suitable for inclusion in the PL-566 grant. This spreadsheet contains some projects that we believe may qualify for the PL-566 program. They were not included in the final list but could make good additions. This list does not include

projects from the Farm River Watershed Plan, which was recently released. As mentioned in our recommendations, we recommend an inbound approach to collecting additional projects from the watershed management plans: towns and conservation districts should vet and prioritize projects that they believe are good candidates for the PL-566 Program.

- **Connecticut Shellfish Restoration Story Map & Recommendations (Sea Grant)**: Sea Grant is finalizing a Shellfish Restoration Map and an accompanying report that identifies four priority sites for shellfish restoration. This accompanying report was not yet published as of December 9, 2021. For more information, please contact Tessa Getchis, aquaculture extension specialist at UConn, at: tessa.getchis@uconn.edu
- **TNC Summary Doc of Coastal Resilience Work in CT**: TNC has done a lot of work with coastal towns throughout CT to build a portfolio of high priority nature-based resiliency projects. This document summarizes the work and provides live links to online PDFs of other comprehensive documents. This document was emailed by TNC's Adam Whelchel in October 2021. For more information please contact Adam Whelcehl at: awhelchel@tnc.org