Statewide Coastal Restoration Guide with Living Shoreline Chapter

Implementation and Quality Assurance Plan

Florida Department of Environmental Protection
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INTRODUCTION

On behalf of the Florida Department of Environmental Protection's (FDEP) Office of Resilience and Coastal Protection, the University of Central Florida (UCF) has been contracted to develop a Statewide Coastal Restoration Guide (SCRG) including a Living Shoreline Chapter. The purpose of the SCRG is to provide a comprehensive guide and scalable model that can be used to identify suitable shoreline restoration and/or enhancement projects throughout the state. To accomplish this goal, FDEP has identified several key tasks necessary to leverage the existing resources within the state and evaluate the body of work that has been completed across the state. These steps include:

1. Establishing a Florida Estuarine Restoration Team (FLERT) Steering Committee that will serve as subject matter experts to assist in the development of the SCRG.
2. Establishing a meta-analysis team that will provide guidance and oversight with the development of a living shoreline suitability model meta-analysis along Florida's coasts.
3. Identifying the body of work completed across the state in relation to living shoreline restoration applications.
4. Developing an Implementation and Quality Assurance Plan.
5. Execution of a statewide Living Shoreline Suitability Meta-Analysis.
6. Conducting pilot studies and selection of the appropriate model(s).
7. Developing the Statewide Coastal Restoration Guide with a specific Living Shoreline chapter.

The FLERT Steering Committee (the Committee) has been assembled and was approved by FDEP on February 1, 2024. The Committee is comprised of representatives from the existing ERTs, universities, regulatory agencies, and non-profit organizations (**Appendix A**). The Committee provides input and guidance in support of this project through a series of planned quarterly meetings designed to help identify available data and study information, guide and support the meta-analysis and model selection, support the development and review of the pilot studies, and guide the development of the final planning guidance document.

This Implementation and Quality Assurance Plan (IQAP) has been developed to support the Living Shoreline Suitability Meta-Analysis task. This IQAP includes:

- A description of the research objectives.
- An evaluation of the existing research and data related to shoreline restoration.
- A preliminary summary of insufficiencies or gaps within the body of data.
- A summary of the existing living shoreline suitability models appropriate for this analysis.
- A description of the quality assurance measures.

RESEARCH OBJECTIVES

The meta-analysis will achieve the following objectives:

1. Identify primary predictor variables related to coastal habitats in Florida.
2. Evaluate accuracy of published living shoreline models in predicting success of existing living shoreline projects.

LITERATURE AND DATA EVALUATION

CHALLENGES TO EVALUATION

Evaluating available shoreline restoration studies related outcomes can be challenging due to several factors including:

- Heterogeneity of Studies: Shoreline restoration studies can vary widely in terms of study design, restoration methods, geographical location, and ecosystem types, making it challenging to compare and synthesize their outcomes.
- Data Availability and Quality: Data on shoreline restoration outcomes may be limited, incomplete, or of varying quality, which can affect the reliability and robustness of the evaluation.

- Temporal and Spatial Scales: Shoreline restoration outcomes may manifest over long time periods and large spatial scales, requiring long-term monitoring and analysis to accurately assess their effectiveness.
- Complexity of Ecosystem Responses: Ecosystem responses to shoreline restoration can be complex and multifaceted, involving interactions between physical, chemical, and biological processes that are difficult to quantify and predict.
- Lack of Standardized Metrics: There is often a lack of standardized metrics for evaluating shoreline restoration outcomes, making it challenging to compare studies and draw generalizable conclusions.
- Unforeseen Factors: Unforeseen factors such as natural disasters, climate change, and human activities can influence shoreline restoration outcomes, making it difficult to isolate the effects of restoration efforts.
- Publication Bias: There may be a bias towards publishing positive results in shoreline restoration studies, leading to an overestimation of the effectiveness of restoration efforts.
- Policy and Management Factors: Shoreline restoration outcomes can be influenced by policy and management decisions, which may vary between studies and affect the interpretation of results.

Addressing these challenges requires a careful and systematic approach that considers the complexities of shoreline ecosystems, utilizes robust study designs, and methodologies, and integrates data from multiple sources to provide a comprehensive evaluation of shoreline restoration outcomes.

LITERATURE SEARCH

A comprehensive literature search was performed to identify the body of work completed across the state of Florida in relation to shoreline restoration applications relevant to the scope of the research objectives. This search included available databases from regulatory, non-governmental, and other relevant organizations, search engines, and relevant journal publications. The search terms used relevant keywords related to the research question topic and overall project themes, including but not limited to shoreline restoration, living shorelines, shoreline stabilization, coastal habitat restoration, and living shoreline model.

Additionally, the literature search will incorporate recommendations provided by the Committee members during all project related quarterly meetings and associated correspondence.

STUDY SELECTION

The study selection approach will define and apply inclusion and exclusion criteria to the identified studies. These criteria included:

- Study design type.
- Publication type and date.
- Relevance to the meta-analysis objectives.
- Geographic locations.

The study search included refinement using search filters and advanced search options, including publication date (limited to publications between 2014-2024), peer-reviewed journals or published technical reports, and accessibility. Publications included a variety of study designs, including experimental, observational, and modelling, and literature reviews. Book chapters, survey papers, theses, and dissertations were not included. Studies with site-specific living shoreline evaluations were limited to Florida or neighboring coastlines (i.e. Mobile Bay, AL) for relevance to our study area and removal of site-specific characteristics not applicable in Florida (i.e. ice scouring). Living shoreline model studies and general information on living shorelines were included for all US geographic regions to provide overall context. Final studies selected provided information on different types of living shoreline methods, field-based evaluations of living shoreline performance, field or lab studies investigating environmental characteristics affecting living shoreline success, modelling studies related to characteristics of living shoreline success, general recommendations, guidelines for living shoreline design and implementation, and published living shoreline models.

Table 1. Summary of Selected Studies

Study	Publication Type	Relevance
Balasubramanyam, V. & Howard, K. (2019). New Hampshire Living Shoreline Site Suitability Assessment: Technical Report. R-WD-19-19. Portsmouth, NH: Prepared for the New Hampshire Department of Environmental Services Coastal Program. 81 pg.	Technical Report	Living shoreline suitability model
Berman, M. & Rudnicky, T. (2008). The Living Shoreline Suitability Model Worcester County, Maryland. Technical Report submitted to Coastal Zone Management Program Maryland Department of Natural Resources Annapolis, Maryland. 52 pg.	Technical Report	Living shoreline suitability model
Bilkovic, D. M., Mitchell, M., Mason, P., & Duhring, K. (2016). The role of living shorelines as estuarine habitat conservation strategies. *Coastal Management*, *44*(3), 161-174.	Peer-Reviewed Journal Article	Background and importance of living shorelines
Boland, C.D., and K. O'Keife. 2018. Living Shoreline Suitability Model for Tampa Bay: A GIS Approach. Final Report to the Gulf of Mexico Alliance, Habitat Resources Priority Issue Team. Florida Fish and Wildlife Conservation Commission, Saint Petersburg, FL, USA. 49 pages including appendices	Technical Report	Living shoreline suitability model
Cannon, D., Kibler, K., Donnelly, M., McClenachan, G., Walters, L., Roddenberry, A., & Phagan, J. (2020). Hydrodynamic habitat thresholds for mangrove vegetation on the shorelines of a microtidal estuarine lagoon. *Ecological Engineering*, *158*, 106070.	Peer-Reviewed Journal Article	Modelling study on hydrodynamic limits of mangroves
Dobbs, B. N., Volk, M. I., & Nawari, N. O. (2017). Living Shoreline Treatment Suitability Analysis: A Study on Coastal Protection Opportunities for Sarasota County. *Journal of Sustainable Development*, *10*(1).	Peer-Reviewed Journal Article	Living shoreline model
Donnelly, M., Shaffer, M., Connor, S., Sacks, P., & Walters, L. (2017). Using mangroves to stabilize coastal historic sites: deployment success versus natural recruitment. *Hydrobiologia*, *803*, 389-401.	Peer-Reviewed Journal Article	Post-stabilization monitoring of living shoreline
Donnelly, M., Kibber, K., Walters, L. (2020). Developing a Shoreline Habitat Restoration and Management Plan for Brevard County – Phase I. Indian River Lagoon National Estuaries Program Report.	Technical Report	Living shoreline suitability model
Dutta, S., Biber, P. D., & Boyd, C. A. (2021). Nearshore sediment comparisons among natural, living, and armored shorelines in Mobile Bay, Alabama. *Southeastern Naturalist*, *20*(1), 135-151.	Peer-Reviewed Journal Article	Evaluation of living shorelines
Fillyaw, R. M., Donnelly, M. J., Litwak, J. W., Rifenberg, J. L., & Walters, L. J. (2021). Strategies for successful mangrove living shoreline stabilizations in shallow water subtropical estuaries. *Sustainability*, *13*(21), 11704.	Peer-Reviewed Journal Article	Evaluation of living shorelines
Herbert, D., E. Astrom, A. C. Bersoza, A. Batzer, P. McGovern, C. Angelini, S. Wasman, N. Dix, & A. Sheremet. 2018. Mitigating erosional effects Induced by boat wakes with living shorelines. *Sustainability,* 10(2): 436.	Peer-Reviewed Journal Article	Evaluation of living shorelines

Study	Publication Type	Relevance
Kibler, K. M., M. Donnelly, D. Cannon, J. Phagan, L. Walters, G. McClenachan, and A. Roddenberry, (2020). Developing a Shoreline Restoration Suitability Model for North Indian River and Mosquito Lagoon, Phase II. Indian River Lagoon National Estuaries Program Report IRL2018-017. https://stars.library.ucf.edu/shorelines/	Technical Report	Living shoreline suitability model
Kibler, K. M., Kitsikoudis, V., Donnelly, M., Spiering, D. W., & Walters, L. (2019). Flow–vegetation interaction in a living shoreline restoration and potential effect to mangrove recruitment. *Sustainability*, *11*(11), 3215.	Peer-Reviewed Journal Article	Evaluation of living shorelines
Kyzar, T., I. Safak, J. Cebrian, M. W. Clark,N. Dix, K. Dietz, R. K. Gittman, J. Jaeger, K. R. Radabaugh, A. Roddenberry, C. S. Smith, E. L. Sparks, B. Stone, G. Sundin, M. Taubler, & C. Angelini. 2021. Challenges and opportunities for sustaining coastal wetlands and oyster reefs in the southeastern United States. *Journal of Environmental Management*, 296: 113178.	Peer-Reviewed Journal Article	Identification of driving factors affecting coastal wetlands and oyster reefs
Looby, A., Reynolds, L. K., McDonald, A. M., Barry, S. C., Clark, M., & Martin, C. W. (2024). Intertidal Soundscapes of Hardened and Living Shorelines: A Case Study of Habitat Enhancement. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *34*(3), e4118.	Peer-Reviewed Journal Article	Evaluation of living shorelines
Manis, J. E., Garvis, S. K., Jachec, S. M., & Walters, L. J. (2015). Wave attenuation experiments over living shorelines over time: a wave tank study to assess recreational boating pressures. *Journal of coastal conservation*, *19*, 1-11.	Peer-Reviewed Journal Article	Evaluation of living shoreline methods on wave attenuation
Martin, S., Temple, N., Palino, G., Cebrian, J., & Sparks, E. (2021). The effects of large-scale breakwaters on shoreline vegetation. *Ecological Engineering*, *169*, 106319.	Peer-Reviewed Journal Article	Evaluation of living shorelines
McClenachan, G. M., Donnelly, M. J., Shaffer, M. N., Sacks, P. E., & Walters, L. J. (2020). Does size matter? Quantifying the cumulative impact of small-scale living shoreline and oyster reef restoration projects on shoreline erosion. *Restoration Ecology*, *28*(6), 1365-1371.	Peer-Reviewed Journal Article	Evaluation of living shorelines
Miller, J.K., Rella, A., Williams, A. & Sproule, E. (2015). Living Shorelines Engineering Guidelines. Prepared for New Jersey Department of Environmental Protection. 102 pg.	Technical Report	Living shoreline suitability model
Mitsova, D. & Bergh, C. (2016). Suitability Analysis for Living Shorelines Development in Southeast Florida's Estuarine Systems Technical Report. 102 pg.	Technical Report	Living shoreline suitability model
Mitsova, D., Bergh, C., Guannel, G., Lustic, C., Renda, M., Byrne, J., ... & Reed, S. (2018). Spatial decision support for nature-based shoreline stabilization options in subtropical estuarine environments. *Journal of environmental planning and management*, *61*(14), 2468-2490.	Peer-Reviewed Journal Article	Living shoreline suitability model
Moosavi, S. (2017). Ecological coastal protection: pathways to living shorelines. *Procedia Engineering*, *196*, 930-938.	Peer-Reviewed Journal Article	Synthesis of coastal stabilization strategies

Study	Publication Type	Relevance
Morris, R. L., Bilkovic, D. M., Boswell, M. K., Bushek, D., Cebrian, J., Goff, J., ... & Swearer, S. E. (2019). The application of oyster reefs in shoreline protection: Are we over-engineering for an ecosystem engineer?. *Journal of Applied Ecology*, *56*(7), 1703-1711.	Peer-Reviewed Journal Article	Oyster-based living shoreline evaluation and recommendations for design
Morris, R. L., La Peyre, M. K., Webb, B. M., Marshall, D. A., Bilkovic, D. M., Cebrian, J., ... & Swearer, S. E. (2021). Large-scale variation in wave attenuation of oyster reef living shorelines and the influence of inundation duration. *Ecological Applications*, *31*(6), e02382.	Peer-Reviewed Journal Article	Oyster-based living shoreline evaluation
National Oceanic & Atmospheric Administration. (2015). National Guidance for Considering the Use of Living Shorelines. 36 pg.	Technical Report	General information about living shorelines and framework for use of living shorelines, including site evaluation guidelines
Nunez, K., Rudnicky, T., Mason, P., Tombleson, C., & Berman, M. (2022). A geospatial modeling approach to assess site suitability of living shorelines and emphasize best shoreline management practices. *Ecological Engineering*, 179, 106617.	Peer-Reviewed Journal Article	Living shoreline model with field observations as validation
Safak, I., C. Angelini, & A. Sheremet. 2021. Boat wake effects on sediment transport in intertidal waterways. *Continental Shelf Research*, 222: 104433.	Peer-Reviewed Journal Article	Hydrodynamic and sediment processes in area of high boat traffic on ICW
Safak, I., P. L. Norby, N. Dix, R. Grizzle, M. Southwell, J. J. Veenstra, A. Acevedo, T. Cooper-Kolb, L. Massey, A. Sheremet, & C. Angelini. 2020. Coupling breakwalls with oyster restoration structures enhances living shoreline performance along energetic shorelines. *Ecological Engineering,* 158: 106071.	Peer-Reviewed Journal Article	Evaluation of living shorelines
Safak, I., C. Angelini, P.L. Norby, N. Dix, A. Roddenberry, D. Herbert, E. Astrom, & A. Sheremet. 2020. Wave transmission through living shorelines. *Continental Shelf Research,* 211: 104268.	Peer-Reviewed Journal Article	Evaluation of living shorelines
Saintilan, N., Kovalenko, K.E., Guntenspergen, G., Rogers, K., Lynch, J.C., Cahoon, D.R., Lovelock, C.E., Friess, D.A., Ashe, E., Krauss, K.W. and Cormier, N., 2022. Constraints on the adjustment of tidal marshes to accelerating sea level rise. *Science*, *377*(6605), pp.523-527.	Peer-Reviewed Journal Article	Limitations of coastal marshes to respond to sea level rise
Smith, C. S., Rudd, M. E., Gittman, R. K., Melvin, E. C., Patterson, V. S., Renzi, J. J., ... & Silliman, B. R. (2020). Coming to terms with living shorelines: a scoping review of novel restoration strategies for shoreline protection. *Frontiers in Marine Science*, *7*, 434.	Peer-Reviewed Journal Article	Review of living shorelines methods
Spiering, D. W., Kibler, K. M., Kitsikoudis, V., Donnelly, M. J., & Walters, L. J. (2021). Detecting hydrodynamic changes after living shoreline restoration and through an extreme event using a Before-After-Control-Impact experiment. *Ecological engineering*, *169*, 106306.	Peer-Reviewed Journal Article	Evaluation of living shorelines

Study	Publication Type	Relevance
Verutes, G. M., Yang, P. F., Eastman, S. F., Doughty, C. L., Adgie, T. E., Dietz, K., ... & Chapman, S. K. (2024). Using vulnerability assessment to characterize coastal protection benefits provided by estuarine habitats of a dynamic intracoastal waterway. *PeerJ*, *12*, e16738.	Peer-Reviewed Journal Article	Hydrodynamic and sediment processes in area of high boat traffic on ICW
Weaver, R. J., Stehno, A., Bonanno, N., Sager, A., Kenny, A., Zehnder, J. A., ... & Allen, A. (2017). Scale model design of oyster reef structures as part of a showcase living shoreline project. *Shore Beach*, *85*(4), 41-54.	Peer-Reviewed Journal Article	Design parameters for hybrid living shorelines
Young, A., Runting, R. K., Kujala, H., Konlechner, T. M., Strain, E. M., & Morris, R. L. (2023). Identifying opportunities for living shorelines using a multi-criteria suitability analysis. *Regional Studies in Marine Science*, *61*, 102857.	Peer-Reviewed Journal Article	Living shoreline model

DATA TYPES AND SOURCES

Suitability analysis for living shoreline development requires the consideration of a wide range of data and those data can have variable degrees of impact depending on geographic location, existing shoreline conditions, scale, and the proposed outcome. For example, data collected in relation to wave energy, historical species occurrence, land cover, water quality, sea level rise, as well as other hydrologic, geomorphologic, and vegetative conditions can be critical to assessing suitability, as well as measuring success. A summary of the data types recommended by the Committee and identified through on-line resources for this evaluation is summarized in **Table 2**. Data suggested by the Committee and not found through on-line data searches are included in the next section (Data Gaps).

Table 2. Summary of Environmental Data Types and Data Sources

Data Type	Data Source(s)	Spatial Scale	Relevant Information
Coastal Habitats Occurrence and Extent (past, present)	Seagrass Integrated Mapping and Monitoring (SIMM) http://myfwc.com/research/habitat/seagrasses/projects/active/simm/	Statewide	Maps of seagrass area, monitoring results
	Coastal Habitat Integrated Mapping and Monitoring Program (CHIMMP) https://myfwc.com/research/habitat/coastal-wetlands/projects/chimmp/	Statewide	Maps of coastal wetland area, monitoring results
	Oyster Integrated Mapping and Monitoring Program (OIMMP) https://myfwc.com/research/habitat/coastal-wetlands/projects/oimmp/	Statewide	Maps of oyster area, monitoring results
	NASA Enhanced Vegetation Index (EVI: MOD13Q1 16-day 250-meter) https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/products/MOD13Q1	Statewide	Vegetation maps
	NOAA Coastal Ecosystems Maps https://www.ncei.noaa.gov/products/coastal-ecosystem-maps-gulf-mexico	Gulf of Mexico	Habitat and species occurrences, physical conditions, environmental quality

Data Type	Data Source(s)	Spatial Scale	Relevant Information
Coastal Habitats Occurrence and Extent (past, present) (cont.)	Florida Natural Areas Inventory database https://www.fnai.org/	Statewide	Conservation land maps, conservation needs assessment, critical lands and waters
	National Wetlands Inventory Wetlands Mapper https://www.fws.gov/wetlands/Data/Mapper.html	Statewide	Current and historic wetland maps, locations of wetland restoration projects
	National Estuarine Research Reserve System https://cdmo.baruch.sc.edu	Florida NEERS	Habitat maps, water quality, weather conditions
	National Wetlands Conditions Assessment https://www.epa.gov/national-aquatic-resource-surveys/nwca#:~:text=The%20National%20Wetland%20Condition%20Assessment,used%20and%20widely%20accepted%20indicators	Statewide	Biological, chemical, and physical data from sampled locations throughout Florida
	Mangrove Cover Maps https://mangrovescience.earthengine.app/view/mangrove-dataset-selector	Statewide	Maps of mangrove area
Land Use and Land Cover	Cooperative Land Cover (v3.7 Nov. 2023) https://myfwc.com/research/gis/wildlife/cooperative-land-cover/	Statewide	Land cover maps
Water Levels, Currents, and Tide Range	NOAA Ocean Altimetry https://podaac.jpl.nasa.gov/Altimetric_Data_Information	Statewide	Sea level, sea surface height, wave height
	NOAA tidal datums https://tidesandcurrents.noaa.gov/stations.html?type=Datums	Statewide	Site specific water levels, tide ranges
	NOAA Ocean Currents https://www.ncei.noaa.gov/access/global-ocean-currents-database/category.html	Statewide	Surface current characteristics
Shoreline Characteristics	UCF Shoreline Characterization https://stars.library.ucf.edu/shorelines/	North Indian River Lagoon and Mosquito Lagoon (Brevard and Volusia Counties)	Shoreline habitats, intertidal wide and slope, erosion severity, wave heights
	FWC Shoreline Characterization	Duval County to Volusia County	Shoreline habitats, intertidal wide and slope, erosion severity, wave heights
	Palm Beach County Shoreline Characterization	Lake Worth Lagoon	Shoreline habitats, intertidal wide and slope, erosion severity, wave heights

Data Type	Data Source(s)	Spatial Scale	Relevant Information
Sea Level Rise Trends	Coastal Dynamics of Sea Level Rise: Hydro-MEM model by NOAA https://noaa.maps.arcgis.com/apps/MapJournal/index.html?appid=85242c8a228945f3b943f3ec7f01e035	Apalachicola Bay	Sea level rise predictions, changes in saltmarsh extent
	NOAA Sea Level Rise Viewer https://coast.noaa.gov/digitalcoast/tools/slr.html	Statewide	Sea level rise predictions
Elevation and Bathymetry	NASA ASTER Global Digital Elevation Model v3 (15-meter) https://asterweb.jpl.nasa.gov/gdem.asp	Statewide	Elevation maps
	Bathymetry Data (FWC) https://geodata.myfwc.com/datasets/0f0270271a7f4ab0b2c43c8e8bd984c3_2/explore?location=28.817850%2C-80.756922%2C11.00	Statewide	Bathymetry maps
	NOAA's Digital Coast Database https://coast.noaa.gov/digitalcoast/	Statewide	Elevation maps and lidar
Sediment Characteristics	USGS usSEABED https://www.usgs.gov/programs/cmhrp/science/accessing-usseabed	Statewide	Sediment types
Water quality	Florida Water Resource Monitoring Catalog https://water-cat.usf.edu/	Statewide	Locations of water quality monitoring stations, links to data
	Indian River Lagoon Observatory Network (IRLON) https://www.irlon.org/?health=Off&quality=On&units=Metric&duration=3%20days&maps=storm_tracks&legend=Off&forecast=Point&hti=&nhc=undefined&sst=&current=&datum=MLLW&windPrediction=wind%20speed%20prediction&region=&bbox=-82.42492675781251,26.07652055985697,-78.26110839843751,28.99372720461893&iframe=null&mode=home&skipState=true	Indian River Lagoon	Variable by station, water quality stations can include nutrient levels, chlorophyll, dissolved oxygen, turbidity, water temperature, salinity, current speed and direction, also includes weather stations (air temperature, wind direction and speed, PAR)
Monitoring Data	Choctawhatchee Basin Alliance Living Shorelines Oyster Reef Monitoring https://data.florida-seacar.org/programs/details/537	Choctawhatchee Basin	Water quality data and oyster reef condition after oyster-based living shoreline installation
	Rookery Bay National Estuarine Research Reserve Shoreline Monitoring https://data.florida-seacar.org/programs/details/625	Rookery Bay National Estuarine Research Reserve	Changes in shoreline extent within the NEER

Data Type	Data Source(s)	Spatial Scale	Relevant Information
Monitoring Data (cont.)	Apalachicola Emergent Marsh Vegetation Monitoring https://data.florida-seacar.org/programs/details/5009	Apalachicola Bay National Estuarine Research Reserve	Change in emergent and submerged vegetation over time, including species composition, % cover, blade length, density, canopy height
	Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR); Link: https://floridadep.gov/SEACAR	Statewide	Seagrass, mangrove, and wetland monitoring data
	UCF Living Shoreline Monitoring Data from De Soto National Memorial https://stars.library.ucf.edu/ceelab-researchdata/3	De Soto National Memorial	Change in vegetation cover and erosion after living shoreline stabilization
	UCF Living Shoreline Monitoring Data from Northeast Florida	Canaveral National Seashore, Tomoka State Park, Gamble Rogers Memorial State Recreation Area, North Peninsula State Park, Washington Oaks Gardens State Park	Change in vegetation cover and erosion after living shoreline stabilization
	SOIRL Brevard County Living Shoreline Monitoring Data	Brevard County	Change in oyster density and size, plant survival after living shoreline stabilization and oyster reef restoration
	Florida Coastal Everglades Long Term Ecological Research Network https://fcelter.fiu.edu/data/index.html	South Florida	Monitoring data from coastal habitats in LTER

ADDITIONAL SOURCES OF INFORMATION

Management plans provide an overview of estuarine conditions, conservation and management priorities, and restoration plans. These sources can support development of end-user tools to address priorities of managed lands in Florida. The following management plans were selected to help inform model development and support the development of the overall guide:

- Indian River Lagoon National Estuarine Program (NEP) Comprehensive Conservation and Management Plan (CCMP) (https://onelagoon.org/wp-content/uploads/IRLNEP_CCMP-Looking-Ahead-to-2030_eBook.pdf)
- Tampa Bay NEP CCMP (https://indd.adobe.com/view/cf7b3c48-d2b2-4713-921c-c2a0d4466632)
- Sarasota Bay NEP CCMP (https://drive.google.com/file/d/1PwMtAe4YZyKG-TZmnv59OkVswD3Rfyy_/view)
- Coastal and Heartland National Estuary Partnership (https://www.epa.gov/sites/default/files/2018-01/documents/charlotte_harbor_ccmp-committing_to_our_future.pdf)
- Rookery Bay National Estuarine Research Reserve (https://rookerybay.org/wp-content/uploads/Rookery-Bay-NERR-Management-Plan-2022-1.pdf)

- Apalachicola National Estuarine Research Reserve (https://floridadep.gov/rcp/nerr-apalachicola/documents/apalachicola-nerr-management-plan)
- Guana Tolomato Matanzas National Estuarine Research Reserve (https://publicfiles.dep.state.fl.us/cama/plans/aquatic/GTM-NERR-Management-Plan-2009.pdf)
- Coastal Habitat Integrated Mapping and Monitoring Program Report (https://myfwc.com/media/12072/chimmp-report-2017.pdf)

EVALUATION OF EXISTING DATA GAPS

Identifying data gaps is crucial for shoreline restoration models to ensure that decision-making is based on the best available information. By addressing data gaps, shoreline restoration models can provide more reliable predictions and recommendations, leading to more effective and sustainable restoration projects. Evaluating data gaps involves:

- Highlighting Key Variables: Identify the most critical variables for the model(s) and prioritize data collection efforts for these variables.
- Assessing Data Availability: Determine which data are currently available for the study and which data are missing or incomplete. Assign a score of availability from 1 to 5, with 5 being the most available and 1 being the least available. (Availability scoring matrix: 1 = Very Limited availability or Not available in most areas, 2 = Limited availability in most areas, 3 = Moderate availability in most areas, 4 = Good availability in most areas; 5 = Availability in all areas).
- Quantifying Uncertainty: Estimate the impact of data gaps on model outputs and decision-making to understand the level of uncertainty associated with the results. (Uncertainty impact scoring matrix: 1 = Very high impact, 2 = High impact, 3 = Moderate impact, 4 = Low impact; 5 = No impact).
- Recommending Data Collection: Suggest specific data collection efforts or studies to fill the identified gaps and improve the model's accuracy and reliability. The next quarterly meeting of the Committee will focus on identified data gaps, discuss methods for addressing (i.e. identification of individuals with data that is not published or publicly available), and identify pilot projects needed to collect necessary data.

Table 3. Summary of Data Gaps

Key Variable	Availability Score	Impact of Uncertainty Score	Comments
Coastal Habitats Occurrence and Extent (past, present)	5	5	Statewide coverage reduces data gaps for this characteristic
Water Levels, Currents, and Tide Range	5	5	Statewide coverage reduces data gaps for this characteristic
Shoreline Characteristics	2	2	Availability of this data limited to specific regions and introduces geographical bias into analysis
Sea Level Rise Trends	5	3	Committee members emphasized the need for future sea level rise to be incorporated into model predictions, need to identify best rates of sea level rise for inclusion
Elevation and Bathymetry	5	5	Statewide coverage reduces data gaps for this characteristic
Land use/Land cover	5	5	Statewide coverage reduces data gaps for this characteristic
Water quality	4	5	Statewide coverage reduces data gaps for this characteristic

Key Variable	Availability Score	Impact of Uncertainty Score	Comments
Monitoring Data	2	2	Limited amount of monitoring data on living shoreline project outcomes influences methods and success evaluations, availability of this data limited to specific regions and introduces geographical bias into analysis, monitoring results often only reported for "good" projects and introduces bias into analysis because lacks comparison to unsuccessful projects
Erosion and Accretion Rates*	1	2	Availability of this data limited to few projects and geographical locations
Sediment Budgets*	1	3	Availability of this data limited to few projects and geographical locations
Status of Armored Structures*	1	3	Availability of this data limited to few projects and geographical locations
Recovery Profile of High Trophic Level Species*	1	5	Availability of this data limited to few projects and geographical locations
Species Community Data (microbial, nekton, birds, inverts)*	1	5	Availability of this data limited to few projects and geographical locations and not consistent across different groups

*Data recommended by Committee but may not be useable because of limited availability

The primary data gaps identified at this stage were variations in availability of data from different regions of Florida at the local scale for both environmental predictor variables (site-specific shoreline characteristics) and response variables indicating effectiveness of living shorelines methods on abiotic and biotic conditions of shorelines. In addition, there is a bias towards reporting positive results of living shoreline projects, limiting the analysis to identify conditions where living shoreline stabilization methods did not achieve project goals and guide identification of areas where specific methods are or are not appropriate.

EVALUATION OF SUITABILITY MODELS

A summary of the existing living shoreline suitability models is provided in **Table 4**. The list includes living shoreline suitability or design models identified from peer-review publications and technical reports. The search initially focused on those developed for Florida, however, review of these models found 6 of 11 models identified were applications of the Virginia Institute of Marine Science Shoreline Suitability Model and utilized similar characteristics for models. The search was expanded to include living shoreline models developed for the US Atlantic and Gulf of Mexico regions to increase variation in model characteristics for comparison.

Table 4. Summary of Existing Living Shoreline Suitability Models

Model Name	Link	Publisher	Relevant Model Characteristics
Living Shoreline Suitability Model for Cedar Key	https://www.arcgis.com/home/item.html?id=810b2083d2924a779b3e2e9cd3e87f47	Virginia Institute of Marine Science (VIMS)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry
Choctawatchee Bay Living Shoreline Model	https://www.arcgis.com/home/webmap/viewer.html?webmap=9b2ef272b1af429fa38e67134ac49da3	Choctawhatchee Basin Alliance (CBA) (applied VIMS model)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry

Model Name	Link	Publisher	Relevant Model Characteristics
Perdido Bay, Florida Living Shoreline Suitability Model	https://troygeoamtics.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=137316ecf2594d51b1e6b12e1ae63715	Troy University (applied VIMS model)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry
Pensacola Bay Living Shoreline Suitability Model	https://troygeoamtics.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=e9eee63681694840a5a7d8ee41f19eb6	Troy University (applied VIMS model)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry
Shoreline Restoration Suitability Model for North Indian River and Mosquito Lagoon	Living Shoreline Suitability Models (arcgis.com)	University of Central Florida	Wave height, Edge type (hardened, vegetated, bare), Erosion severity, Slope
Perdido Bay Ono Island, AL Shore Best Managem ent Practice Viewer Vers ion 5.1.	https://www.gsa.state.al.us/apps/CASIS/index.html	Geological Survey of Alabama (applied VIMS model)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry
Shoreline Habitat Restoration and Management Plan for Brevard County	https://stars.library.ucf.edu/ceelab-researchdata/2/	University of Central Florida	Wave height, Edge type (hardened, vegetated, bare), Erosion
Future Shorelines Project: Living Shoreline Site Assessment Tool for Indian River Lagoon	https://futureshorelines.fiu.edu	Florida International University	Shoreline characteristics (slope, intertidal width, shoreline structure), Sea level rise predications
Living Shoreline Suitability Model for Tampa Bay	https://myfwc.com/research/gis/fisheries/living-shorelines/	Florida Fish and Wildlife Research Institute (applied VIMS model)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry
Suitability Analysis for Living Shorelines Development in Southeast Florida's Estuarine Systems	https://maps.coastalresilience.org/seflorida/methods/Living_Shorelines_Final_Report_05_06_16.pdf	The Nature Conservancy	Wind/wave action, Boat wakes, Storm surge, Tidal influence, Vessel clustering, Nearshore slope, Presence of habitat
Living Shoreline Treatment Suitability Analysis for Sarasota County	https://www.ccsenet.org/journal/index.php/jsd/article/view/64068	University of Florida	Bathymetry Slope, Shoreline type, Biological productivity, Wave energy, Tree canopy, Fetch, Land Use, Land value, Population (human)
Virginia Institute of Marine Science (VIMS) Shoreline Management Model	https://www.vims.edu/ccrm/advisory/ccrmp/bmp/smm/	Virginia Institute of Marine Science (VIMS)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry
Living Shoreline Explorer for North Carolina	https://coastalresilience.org/project/living-shoreline-explorer/	The Nature Conservancy	Wave energy

Model Name	Link	Publisher	Relevant Model Characteristics
Living Shoreline Suitability Model- Maryland	https://www.vims.edu/ccrm/advisory/ccrmp/bmp/smm/maryland/	Virginia Institute of Marine Science (VIMS)	Bank height, Presence of hard-armoring, Presence of shoreline vegetation (mangroves, saltmarsh, seagrass), Nearshore bathymetry
Texas Living Shoreline Site Suitability Tool	https://storymaps.arcgis.com/stories/d6989e741253424584c06ead83078c5d	The Texas General Land Office	Shoreline type, Water depth, Nearshore slope, Erosion rate, Fetch, Wave energy, Distance to channel
Maine- Living Shoreline Support Tool	https://www.maine.gov/dacf/mgs/hazards/living_shoreline/	Maine Department of Agriculture, Conservation, and Forestry	Fetch, Nearshore bathymetry, Shoreline type, Slope
New Hampshire Living Shoreline Site Suitability Assessment	https://prepestuaries.org/living-shorelines-site-suitability-mapping-tool-technical-report/	NH Department of Environmental Services Coastal Program	Habitat type, Aspect, Eelgrass extent, Potential for marsh migration, Northwest fetch (as a proxy for ice shoving), Tidal crossings, Navigation channels, Shoreline type, Seaward slope, Soils erodibility, sociopolitical model for final predication
New Jersey's Living Shoreline Engineering Guide	https://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf	New Jersey Department of Environmental Protection	Erosion history, Tide range, Sea level rise, Wind, waves and boat wakes, Fetch, Slope, Currents, Bathymetry, Water quality, Sediment type, Sunlight

Based on recommendations provided by the Committee, key characteristics that may be used to guide model selection and development should include:

- Project goals: The model should allow for a scaled or tiered approach based on the specific project goals. This will help keep the project design anchored to the goals of the project and avoid excessive engineering.
- Local scale characteristics: The selected model(s) should be flexible in terms of local vs regional scale, allowing for incorporation of local ecosystem characteristics where possible.
- Design life: When evaluating living shoreline installations, the design life should be considered a primary factor when considering model inputs.
- Measures of success: Various measures of success can help ensure that shoreline restoration projects are effective in achieving their intended goals and may include ecological health, water quality, sediment retention, carbon sequestration, resilience to climate change, cost effectiveness, and community engagement.
- Flexibility: The model should be flexible in terms of functionality and regulatory constraints and should allow for implementation of adaptive management to adjust restoration strategies based on monitoring results and changing conditions, such as sea level rise or invasive species problems.
- Identifying data gaps: Identify the most critical variables for the model and prioritize data collection efforts. Ensure that decision making is based on the best available data.
- Adaptable over time: The model should be adaptable over time, allowing for the incorporation of new data and research findings to improve the model's accuracy and relevance.

Examples of existing living shoreline tools and web-based applications to support model building and final products are listed in **Table 5**.

Table 5. Summary of Existing On-Line Living Shoreline Tools

Resource Name	Link	Publisher	Relevant Information
Habitat Resiliency to Climate Change: Coastal & Heartland National Estuary Program	https://storymaps.arcgis.com/stories/dff06f74bc3c4011a5e29078714b498b	CHNEP Wateratlas	Sea Level Rise Predications and Habitat Changes
Florida Living Shorelines	http://floridalivingshorelines.com/	Florida Fish and Wildlife Conservation Commission	Types of Living Shorelines, Locations and Description of Living Shoreline Projects in Florida
Adaptation of Coastal Urban and Natural Ecosystems (ACUNE) tool for Collier County	https://storymaps.arcgis.com/stories/aad4c97c78234b5fae02ef3b90176ead https://restoreactscienceprogram.noaa.gov/projects/local-coastal-tool	National Oceanic & Atmospheric Administration	Sea Level Rise Predications and Habitat Changes
Resilient Florida Program Living Shorelines	https://floridadep.gov/rcp/resilient-florida-program/content/resilient-florida-program-living-shorelines	Florida Department of Environmental Protection	Locations and Descriptions of Living Shoreline Projects in Florida
Habitat Blueprint for Living Shorelines	https://www.habitatblueprint.noaa.gov/living-shorelines/	National Oceanic & Atmospheric Administration	Guidance for Living Shorelines, Examples of Locations of Living Shorelines
Chesapeake Bay Living Shorelines	https://www.cbf.org/about-cbf/locations/virginia/issues/living-shorelines/six-steps-to-create-your-living-shoreline.html	Chesapeake Bay Foundation	Types of Living Shorelines, Guidelines for Homeowners
Chesapeake Bay Living Shorelines with Oysters	https://www.cbf.org/about-cbf/locations/virginia/issues/living-shorelines/are-oysters-an-option-for-your-living-shoreline.html	Chesapeake Bay Foundation	Habitat suitability guidelines for oyster as part of living shoreline design
Virginia Institute of Marine Science (VIMS) Shoreline Decision Support Tool	https://cmap2.vims.edu/LivingShoreline/DecisionSupportTool/index.html	Virginia Institute of Marine Science (VIMS)	Shoreline stabilization techniques based on site characteristics

PEER REVIEW

A peer review of the proposed study selections will be performed by the approved meta-analysis team (**Appendix B**) to validate the selections using the established criteria and ensure that all relevant studies have been included. The meta-analysis team may propose changes to the list if needed. For example, the meta-analysis team may be aware of more recent work performed that was not identified in the original proposed list of studies. Proposed changes to the list will be evaluated using the same criteria described in the study selection section.

The meta-analysis final report deliverable will include appropriate information detailing the literature search process, including summaries of the literature sources, key terms used in the search, filters used to refine the search parameters, and a final recommended list of studies selected for inclusion in the meta-analysis. The meta-analysis final report will also be used to refine this IQAP for future use.

UPDATES

Perform periodic reviews of information sources to incorporate new studies and literature on shoreline restoration. This may include:

- Subscribing to publication alerts from relevant journals or databases to receive notifications of new articles and studies in the field.
- Engaging with the Committee members, meta-analysis team, and organizations working in shoreline restoration to exchange information, share updates, and collaborate on projects.
- Attending conferences, workshops, and seminars related to shoreline restoration to stay updated on the latest research, trends, and practices in the field.
- Using online platforms, databases, and websites dedicated to shoreline restoration to access and share information, such as project reports, case studies, and best management practices.

Updates will be shared with the Committee members and meta-analysis team for review and approval.

DATA MANAGEMENT AND ANALYSIS

Once the final study selection has been approved, the next step is to extract and analyze the relevant information from the identified body of work. The following sections describe this process.

DATA EXTRACTION

Relevant data will be extracted from the selected body of work using the following variables:

- study characteristics (publication year, study location, study design, and duration),
- Type of shoreline restoration method, and
- outcomes measure

Data from each study was extracted and systematically recorded in a secured database including columns for each variable extracted. Review the extracted data for accuracy. Standardize the extracted data to ensure consistency across studies. For example, convert all measurements to the same units, and ensure that variables are named consistently.

DATA SYNTHESIS

Once the data extraction process has been completed, use statistical techniques to synthesize the extracted data for meta-analysis. This may include:

- Calculating effect sizes.
- Pooling data across studies.
- Conducting statistical analyses to determine the overall effect of shoreline restoration on the outcome of interest.
- Conducting subgroup analyses if applicable.

Calculating effect sizes for each study will depend on the outcome measure used in each study (mean difference, standardized mean difference, odds ratio, etc.). Pool effect sizes will be determined using available software tools to pool the effect sizes across studies. The choice of statistical method will depend on the study design and outcome measure. Common methods include fixed-effects models and random-effects models. R package 'glmer' can fit mixed-effect models with both continuous and binary response variables, while R package 'ordinal' can fit mixed-effect models with ordinal response variables. (Also, see the CRAN Task View on mixed, multilevel, and hierarchical models in R: https://cran.r-project.org/web/views/MixedModels.html). Finally, R package 'metafor' can fit meta-analytic (and mixed-effect) regressions to individual study estimates and predictions. The conventional mixed-effect models referenced above can combine multiple studies with the same response variables (or response variables that are on the same scale), while meta-analytic regression can more broadly combine multiple studies with response variables that are only similar under a link-function transformation.

ASSESSMENT OF HETEROGENEITY

Assess heterogeneity among the studies using statistical methods. In the context of our meta-analysis, heterogeneity is the variability in the true individual-study model coefficients and, therefore, variability in individual-study responses to equivalent predictor values. Standard measures of heterogeneity, such as I^2, are returned by the 'metafor' R package. High heterogeneity indicates that the meta-analytic model will not be predictive for new studies (and unstudied systems). If significant heterogeneity is present, explore potential sources of heterogeneity through subgroup analyses and further meta-analytic regression. Subgroups could be based on study characteristics (study design, location, publication year). Use identified sources of heterogeneity to construct new candidate meta-analytic models.

PUBLICATION BIAS ASSESSMENT

Assess for publication bias in restoration success data, which is the tendency for studies with positive results to be published more frequently than studies with negative results. Publication bias in response variables can result in overly optimistic model predictions. Use methods such as funnel plots and cross validation to detect and adjust for publication bias, if necessary.

SENSITIVITY ANALYSIS

Conduct sensitivity analysis to assess the robustness of the meta-analysis results. This may involve excluding studies one by one to see if the overall results change significantly.

RESULTS

INTERPRETATION OF RESULTS

The results of the meta-analysis will be interpreted in the context of the research question, including the implications of the findings and any limitations of the study. Interpreting the results of a meta-analysis involves understanding the overall effect of shoreline restoration on a specific outcome, as well as considering the variability and quality of the included studies. A general approach to interpreting the results is provided as follows:

- Pooled Effect Size: Examine the pooled effect size, which represents the average effect of shoreline restoration across all included studies. This could be a mean difference, standardized mean difference, odds ratio, or another measure depending on the outcome variable.
- Confidence Intervals: Look at the confidence interval (CI) around the pooled effect size. The CI provides a range within which the true effect size is likely to fall. A wider CI indicates more uncertainty in the estimate.
- Statistical Significance: Determine if the pooled effect size is statistically significant. This is typically indicated by a p-value less than 0.05. However, it's important to consider the clinical or practical significance of the effect size as well.
- Heterogeneity: Assess the degree of heterogeneity among the included studies using the I^2 statistic. High heterogeneity ($I^2 > 50\%$) suggests substantial variability in effect sizes across studies, which may limit the reliability of the pooled estimate.
- Subgroup Analysis: If applicable, examine the results of subgroup analyses to explore sources of heterogeneity. Subgroups could be based on study characteristics, participant demographics, or other factors.
- Sensitivity Analysis: Consider the results of sensitivity analyses to assess the robustness of the findings to different assumptions or methodological choices. A consistent effect size across different analyses increases confidence in the results.
- Publication Bias: Evaluate the possibility of publication bias, which occurs when studies with positive results are more likely to be published. Funnel plots and statistical tests can help assess for publication bias.
- Quality of Evidence: Consider the overall quality of the evidence based on the included studies. Higher-quality studies with rigorous methodologies provide more reliable evidence than lower-quality studies.
- Implications: Discuss the implications of the meta-analysis findings for practice, policy, or future research. Consider how the results contribute to the understanding of shoreline restoration effects and what further research is needed.

Interpretation of the results of a meta-analysis requires careful consideration of the statistical findings, the quality of the included studies, and the broader implications on shoreline restoration work.

REPORTING

Prepare a comprehensive report of the meta-analysis following established guidelines, such as the most recent Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Include details of the study selection process, data extraction, data synthesis methods, results, and any supplemental materials (tables, figures, etc.). Reporting structure should include at a minimum, a clearly stated title, abstract, introduction, methods, results, discussion, and conclusions. A list of references cited in the report should also be included.

QUALITY ASSURANCE PLAN

The purpose of this quality assurance plan is to ensure the accuracy, reliability, and validity of the meta-analysis process and its results.

STANDARDIZATION

Define standardized procedures for conducting the meta-analysis, including data collection, data synthesis, and statistical analysis, to minimize bias, and ensure consistency across studies.

METHODOLOGY REVIEW

The meta-analysis approach will be developed and conducted in accordance with best practices in meta-analytic research, including transparent reporting, appropriate statistical methods, and thorough sensitivity analyses.

DATA QUALITY

Verify the quality of the included studies, including the validity and reliability of the data extracted. Use a clear criterion for assessing the quality of studies/data such as study design, sample size, methodological rigor, and risk of biased assessment. Independent assessments by at least two or more reviewers should be completed.

PUBLICATION BIAS

Address publication bias by using appropriate statistical methods and discussing its potential impact on the results. Consider factors such as selection bias, performance bias, detection bias, attrition bias, and reporting bias.

TRANSPARENCY

Ensure that the methods, data, and results of the meta-analysis are transparent and can be replicated by other researchers.

CONFLICT OF INTEREST

Declare any potential conflicts of interest that may have influenced the conduct or reporting of the meta-analysis.

ETHICAL CONSIDERATIONS

Ensure that the meta-analysis adheres to ethical guidelines, including the protection of participant confidentiality and the responsible use of data.

PEER REVIEW / FEEDBACK MECHANISM

The information and methods used to perform the meta-analysis should be reviewed by the Meta-Analysis Team to ensure the quality and validity of the methods and results. This includes reviewing the data, data sources, relevant suitability models used, data and model selection approach, as well as the analytical methods used in the meta-analysis and associated results. The review process should be iterative and occur as needed throughout the meta-analysis process. The peer review process will inform the meta-analysis approach, with review comments discussed and addressed during the scheduled meta-analysis team meetings and associated correspondence. Feedback will be recorded in the meeting minutes for each scheduled meta-analysis team meeting. A review log (**Appendix C**) will be provided with the meeting minutes for each meeting. The review log will summarize the comments or issues highlighted, along with any proposed changes or corrective measures implemented or proposed.

CONTINUOUS IMPROVEMENT

Identify opportunities for continuous improvement in the meta-analysis process, including updating the analysis as new evidence/studies becomes available.

DOCUMENTATION

Maintain thorough documentation of the meta-analysis process, including any deviations from the original plan and the rationale for those deviations. A template table to track deviations proposed/implemented is provided in **Table 6**.

Table 6. Summary of Proposed Meta-Analysis Changes

Meta-Analysis Comment	Description of Proposed Change	Meta-Analysis Team Approval (Yes/No)	Change Comments

APPENDIX A

Statewide Coastal Restoration Plan with Living Shoreline Chapter					
Task 1: Establish the Florida Estuarine Restoration Team (FLERT) and Identify and Invite Additional Relevant Academic Staff					
ERT REGION	**NAME**	**ERT POSITION**	**ORGANIZATION POSITION**	**ORGANIZATION**	**EMAIL**
Panhandle (PERT)	Kim Miller	Chair	Northwest Regional Aquatic Preserve Manager	Florida Department of Environmental Protection	kim.miller@floridadep.gov
	Melody Ray-Culp	West Panhandle Lead	Coastal Program Coordinator, Florida Panhandle	U.S. Fish and Wildlife Service	melody_ray-culp@fws.gov
	Zach Schang	Member	Northwest Florida Aquatics Preserve Manager	Florida Department of Environmental Protection	zachary.schang@floridadep.gov
	Chris Boyd	Relevant Academic Staff	Assistant Professor of Restoration Ecology	Troy University	boydc@troy.edu
Northeast (NERT)	Ron Brockmeyer	Chair	Environmental Scientist V	St. Johns River Water Management District	rbrockmeyer@sjrwmd.com
	Katie Conrad	North Regional Lead	Northeast Florida Coastal Coordinator	U.S. Fish and Wildlife Service	katie_conrad@fws.gov
	Annie Roddenberry	South Regional Lead	Biological Scientist III	Florida Fish and Wildlife Conservation Commissio	annie.roddenberry@myfwc.com
	Scott Eastman	Member	Program Administrator	Florida Department of Environmental Protection	scott.eastman@floridadep.gov
Big Bend (BigBERT)	Tiffany Lane	Co-chair	Coastal Program Coordinator, Tampa Bay and Big Benc	U.S. Fish and Wildlife Service	tiffany_lane@fws.gov
	Anna Laws	Co-chair	Biological Scientist III	Florida Fish and Wildlife Conservation Commission	anna.laws@myfwc.com
	Savanna Barry	Relevant Academic Staff	Regional Specialized Extension Agent	University of Florida and Florida Sea Grant	savanna.barry@ufl.edu
East Central (ECERT)	Irene Arpayoglou	Chair	Regional Aquatic Preserves Manager	Florida Department of Environmental Protection	irene.arpayoglou@floridadep.gov
	Vincent Encomio	Relevant Academic Staff	Extension Agent	University of Florida and Florida Sea Grant	vencomio@ufl.edu
Southwest (SWERT)	Mindy Brown	Co-chair	Southwest Regional Aquatic Preserves	Florida Department of Environmental Protection	melynda.a.brown@floridadep.gov
	Kathy Worley	Member	Director of Science	Conservation of Southwest Florida	kathyw@conservancy.org
Statewide	Kent Smith	Member	Biological Administrator III Marine/Estuarine SubSection	Florida Fish and Wildlife Conservation Commission	kenneth.smith@myfwc.com
	Albert R. Wynn III	Relevant Academic Staff	Associate Director Wakulla Environmental Institute	Tallahassee Community College	albert.wynn@tcc.fl.edu
West Central and Southwest	Cameron Ainsworth	Relevant Academic Staff	Associate Professor, Physical Oceanography	University of South Florida	ainsworth@usf.edu
Southeast	James Murley	Unafilliated	Chief Resilience Officer	Miami-Dade County	james.murley@miamidade.gov
NERT and ECERT	Jessy Wayles	Member	Community Engagement Coordinator & Habitat Restoration Specialist	Indian River Lagoon National Estuary Program	Wayles@irlcouncil.org
	Randall W. Parkinson	Relevant Academic Staff	Associate Professor, Registered Professional Geologist	Florida International University	rparkins@fiu.edu

APPENDIX B

Statewide Coastal Restoration Plan with Living Shoreline Chapter								
Task 3: Assemble Meta-Analysis Project Team								
ERT REGION	NAME	ERT POSITION	ORGANIZATION POSITION	RELEVANT QUALIFICATIONS			ORGANIZATION	EMAIL
				Education	Years of Experience	Experience Summary		
Panhandle (PERT)	Alison McDowell	Member	Executive Director and Marine Scientist	M.S. Environmental Science	17	Recommended by two of the PERT chairs; Extensive experience developing, installing, and monitoring of living shorelines.	Choctawhatchee Basin Alliance	mcdowel2@nwfsc.edu
	Chris Boyd	Relevant Academic Staff	Assistant Professor of Restoration Ecology	Ph.D. Fisheries and Allied Aquacultures	18	Working with the Pensacola Bay, Perdido Bay, and Choctawhatchee Basin Alliance, Dr. Boyd has created living shoreline suitability models for Florida estuaries: Boyd, Chris, and Xutong Niu. "Development, Implementation, and Availability of the Gulf of Mexico Living Shoreline Management Models and Decision Support Tool." AGU Fall Meeting Abstracts. Vol. 2021. 2021.	Troy University	boydc@troy.edu
Northeast (NERT)	Scott Eastman	Member	Program Administrator	M.S. Interdisciplinary Ecology	20	Specializes in the collection and use of shoreline characterization data in Florida, project management and application, and provides end-user guidance for model development.	Florida Department of Environmental Protection	scott.eastman@floridadep.gov
	Rene Baumstark	Member	GIS Lead	Ph.D. GeoScience	10	Recommended by NERT and the biological administrator for FWC; Experience with suitability modeling and developing GIS tools for living shoreline work and other related projects.	Florida Fish and Wildlife Conservation Commission	rene.baumstark@myfwc.com
Big Bend (BigBERT)	Anna Laws	Co-chair	Biological Scientist III	Unavailable	Unavailable	Extensive project management experience on living shoreline projects, provides end-user guidance for model development.	Florida Fish and Wildlife Conservation Commission	anna.laws@myfwc.com
East Central (ECERT)	Irene Arpayoglou	Chair	Regional Aquatic Preserves Manager	M.S. Marine Biology and Coastal Zone Management	15	As a manager in the aquatic preserve she has led, evaluated, and overseen many different restoration projects and has insight into the application of the model for management purposes. Current co-PI on NOAA funded research to create living shoreline suitability model for southern Indian River Lagoon.	Florida Department of Environmental Protection	irene.arpayoglou@floridadep.gov
	Lorae Simpson	Member	Director of Research	Ph.D. Soil and Water Sciences	13	Extensive project management and research experience on estuarine habitat projects, including mangroves, seagrass, and oysters. Experience with large-scale data reviews: Simpson, Loraé T., et al. "Do global change variables alter mangrove decomposition? A systematic review." Global Ecology and Biogeography 32.11 (2023): 1874-1892.	Florida Oceanographic Society	lsimpson@floridaocean.org
	Vincent Encomio	Relevant Academic Staff	Extension Agent	Ph.D.	15	Extensive project management and research experience on estuarine habitat projects, including mangroves, seagrass, and oysters. Current co-PI on NOAA funded research to create living shoreline suitability model for southern Indian River Lagoon.	University of Florida and Florida Sea Grant	vencomio@ufl.edu
Southwest (SWERT)	Kathy Worley	Member	Director of Science	Unavailable	15	Contributes significantly to environmental research and conservaton within Southwest Florida: leading mangrove research, water quality studies, and serves as the Conservancy's GIS specialist.	Conservation of Southwest Florida	kathyw@conservancy.org
Statewide	Albert R. Wynn III	Relevant Academic Staff	Associate Director Wakulla Environmental Institute	M.S. Physics	25	Instructor for living shoreline and aquaculture courses; Experience leading oyster dome restoration efforts and has extensive experience rehabing oyster populations in Florida.	Tallahassee Community College	albert.wynn@tcc.fl.edu
	Alberto Canestrelli	Relevant Academic Staff	Assistant Professor, Coastal Ecosystem Dynamics	Ph.D.	15	Extensive research and modeling experience related to coastal hydrology and geomorhology: Canestrelli, Alberto, et al. "Well-balanced high-order centred schemes for non-conservative hyperbolic systems. Applications to shallow water equations with fixed and mobile bed." Advances in Water Resources 32.6 (2009): 834-844.	University of Florida	alberto.canestrelli@essie.ufl.edu
	Kara Radabaugh	Member	Research Scientist	Ph.D. Marine Biology and Biological Oceanography	20	Leads FWRI Monitoring and Mapping networks for coastal habitats, including wetlands, oysters, and seagrass. CHIMMP Report: https://myfwc.com/media/12072/chimmp-report-2017.pdf	Florida Fish and Wildlife Conservation Commission	kara.radabaugh@myfwc.com
West Central and Southwest	Cameron Ainsworth	Relevant Academic Staff	Associate Professor, Physical Oceanography	Ph.D. Resource Management and Environmental Studies	16	Exensive research and modelling experience of coastal habitats and response of fish communties: Ainsworth, Cameron H., et al. "Impacts of the Deepwater Horizon oil spill evaluated using an end-to-end ecosystem model." PloS one 13.1 (2018): e0190840.	University of South Florida	ainsworth@usf.edu
NERT and ECERT	Randall W. Parkinson	Relevant Academic Staff	Associate Professor, Registered Professional Geologist	Ph.D. Marine Geology and Geophysics	26	Extensive research and modeling experience related to coastal habitat responses to sea level rise and living shoreline suitability models: Link to most recent model- https://futureshorelines.fiu.edu	Florida International University	rparkins@fiu.edu

APPENDIX C

Meta-Analysis Team Review Log

Meeting Date:

Reviewer Name	Secton	Review Comment	Response to Comment	Resolution Details