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Integrated Living Shoreline Tools and Community Outreach

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Integrated Living Shoreline Tools and Community Outreach

Introduction

Living shorelines are a shoreline management option that provide erosion control while working with nature to restore, create, or protect valuable habitat. The primary types of living shorelines fall into three main categories: soft stabilization, hybrid stabilization, and retrofit stabilization. Soft stabilization uses non-structural techniques, usually involving planting marsh grass along the existing shoreline. Hybrid stabilization places hard structures, generally low-profile or high-profile breakwaters depending on the shoreline characteristics, for additional erosion control while also incorporating soft techniques. Retrofit stabilization uses existing hard structures such as bulkheads or revetments along with soft or hybrid stabilization techniques. The Texas General Land Office has mapped and created a database of 121 living shorelines across the state of Texas (https://www.glo.texas.gov/livingshorelines/). The aim of this project was to inform coastal landowners about the benefits, types, and permitting processes related to implementing living shoreline features along the coast of Texas. To meet this goal, a multipronged approach was taken with three primary tasks, outlined below:

Project Tasks:

- **Living Shoreline Model Analysis and Integration**
    - Integrate the Living Shoreline Site Suitability Model from the Harte Research Institute with the Galveston Bay Foundation Shoreline Protection Model to create a GIS model that recommends living shoreline techniques depending on the characteristics of each section of the Texas coast.
- **Decision Support Tool Development**
    - Create a decision support tool that uses “yes/no” questions to walk users through finding the best recommendation for living shoreline features for their section of coast based on the same characteristics as the GIS model.
- **Community Outreach**
    - Create an educational video to highlight the benefits and uses of living shorelines, conduct stakeholder surveys to better understand the public’s perceptions and

needs regarding living shoreline techniques and permitting processes, and hold stakeholder workshops to educate coastal communities about the tools and resources available to begin implementing living shoreline projects.

<u>Task 1:</u> Living Shoreline Model Analysis and Integration

The original HRI Living Shoreline Suitability Model and the Galveston Bay Foundation (GBF) Shoreline Protection Model were integrated into a single, comprehensive site suitability model for living shoreline techniques that covers all bay shorelines along the coast of Texas. To begin this effort, the two models were compared for similarities and differences with regards to the input variables, data layers and sources used, and outcome recommendations. An advisory team comprised of HRI, GBF, and GLO experts then collaborated on combining the relevant aspects of each model to create a plan for an integrated model that would be appropriate for the entire coast. This process began by compiling a list of input layers and sources, identifying the desired outcome categories, and then creating a decision tree flowchart to conceptualize the model components.

The original HRI model used bathymetry, wave exposure, shoreline type, shoreline change rate, and proximity to shipping channels as inputs that were used to recommend outcomes of (1) Soft Stabilization, (2) Hybrid Stabilization, (3) Retrofit: Hybrid Stabilization, (4) Retrofit: Soft Stabilization, or (5) Not Suitable for Living Shorelines. The GBF model had output options of (1) High Profile Breakwater with Marsh Plantings, (2) Low Profile Breakwater with Marsh Plantings, (3) Marsh Plantings with or without Shoreline Grading, (4) Revetment or Bulkhead with Optional Rock Toe, (5) Beach Nourishment as Needed, (6) No Action Needed, and (7) Stop- Seek Expert Advice. For the integrated model, the input layers, data sources, and output recommendations can be found in Tables 1 and 2.

To create the integrated model, six distinct recommendations were identified and used as the outputs as follows: (1) Soft Stabilization; (2); Hybrid Stabilization; (3) Retrofit Stabilization: Hybrid; (4) Retrofit Stabilization for Existing Bulkhead Structures; (5) Retrofit Stabilization for Existing Revetment Structures; and (6) Stop. Seek Expert Advice. Based on the decision tree created for undefended shorelines, recommendations for shorelines with existing bulkhead features or revetment structures were coded based on the shoreline attributes using a separate decision tree created for defended shorelines. The model is created and run using the Model Builder tool in ESRI's ArcMap 10.8. The model output is a

polyline shapefile with each segment coded for one of the six living shoreline technique recommendations (Figure 1). A technical report with the full methodology and results of the model can be found in Appendix I. The final product will be hosted as a story map on the GLO's Living Shoreline website.

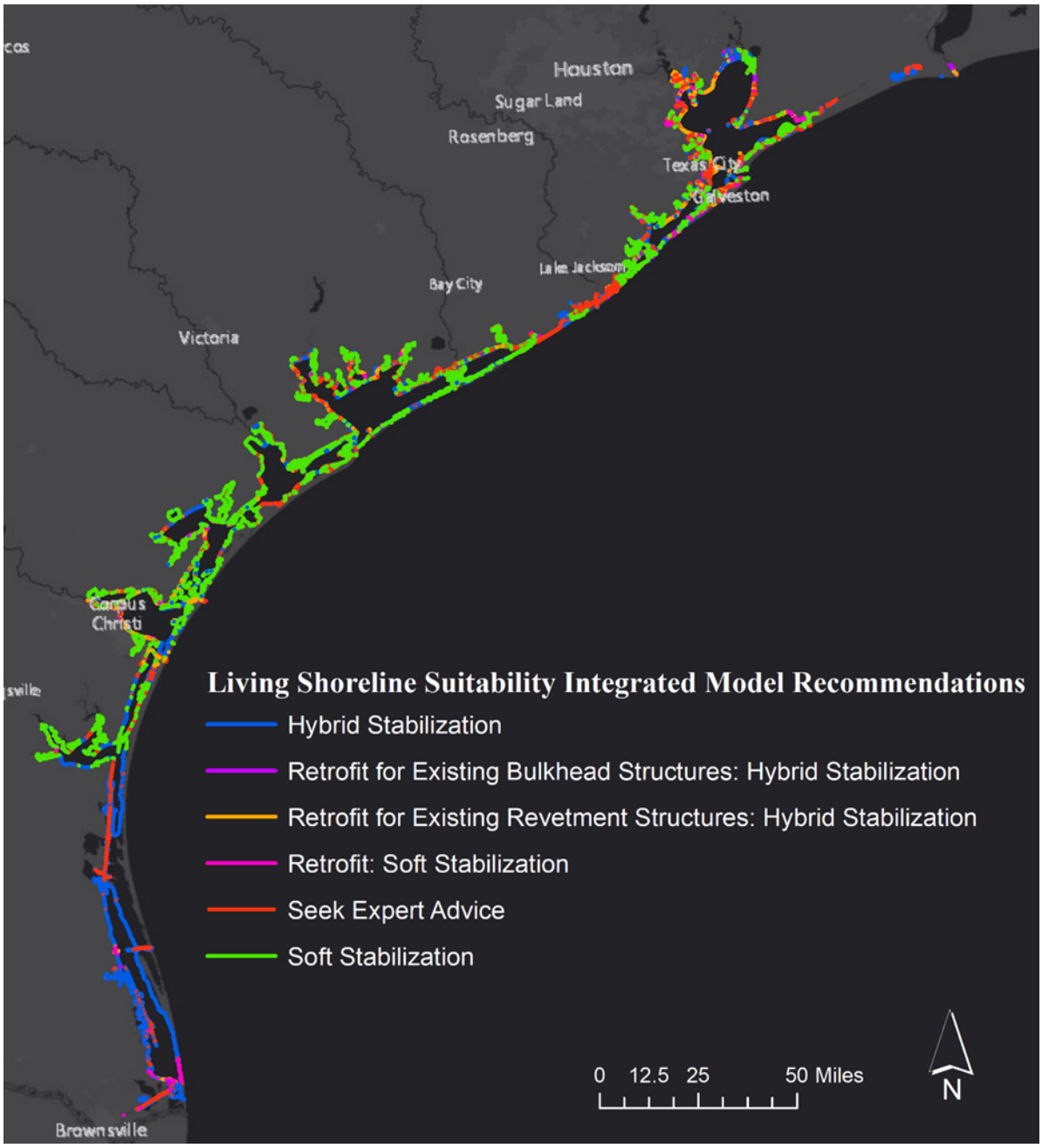


Figure 1 Integrated model outcome showing recommendations for living shoreline techniques along the entire Texas coast.

Task 2: Decision Support Tool Development

Using the same decision trees as used in the site suitability model, a self-guided assessment tool was created to accompany the model tool. This decision support tool employss if- then- else statements to walk users through yes or no questions to arrive at a recommendation for which type of living shoreline technique would be appropriate for their section of the Texas coastline. Each question has an information icon that opens a pop-up window with more information on that specific topic to make the application more accessible to non-expert users. The tool also has a restart option, and the choices can be changed once the user clicks on an option to reroute to a new set of conditions if needed. The outcomes of the tool are the same six recommendations as in the model tool with an accompanying brief description of each recommendation. This decision support tool (Figure 2) will be hosted on the GLO's Living Shoreline website along with the site suitability model.

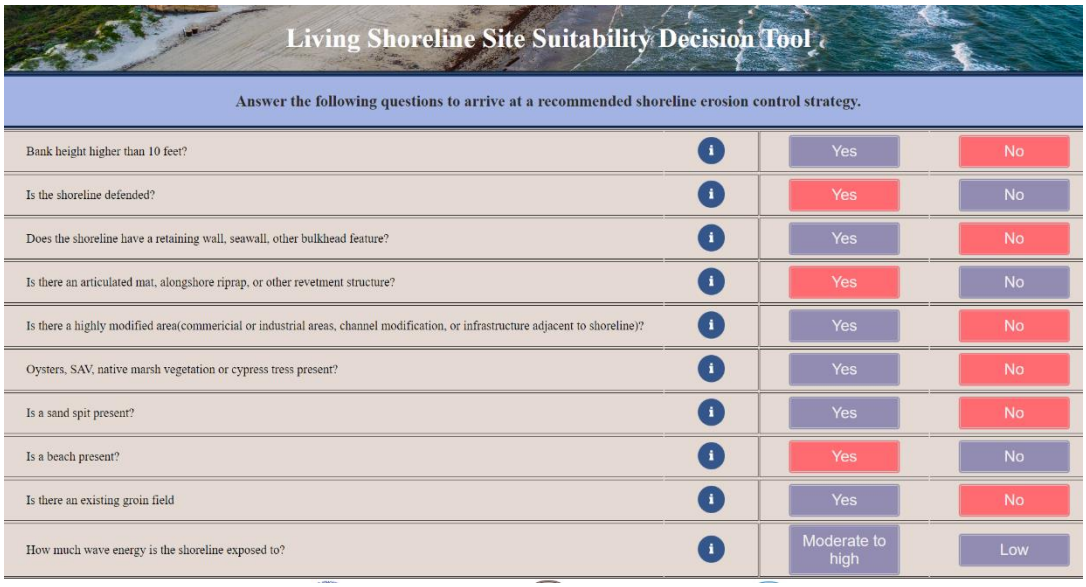


Figure 2 Decision support tool designed to assist coastal landowners in assessing their land for living shoreline techniques.

Task 3: Community Outreach

User Survey – Fall 2021

GBF initiated the community outreach task in September of 2019 by sending a survey to 423 contacts. The survey assessed participants' knowledge of living shorelines, their awareness of the two

living shoreline models, and asked for an assessment of each model. A total of 83 survey responses were received. The majority of survey participants were waterfront property owners (43%) and were "somewhat familiar" (45%) to "very familiar" with living shorelines (41%). Only 14% of participants indicated they had a living shoreline on their waterfront property, and over 33% indicated they would consider implementing one. As shown in Question 6, nearly 68% of participants were not aware either map viewer existed. However, over 46% of participants were interested in utilizing the map viewers. Participants appear to prefer the GBF Map Viewer (21%) over the GLO Map Viewer (8%) but over 36% of participants indicated they like the map viewers about the same. For both map viewers, participants indicated the instructions need improvement as well as the next steps for implementing a living shoreline project. Participants also suggest the level of detail for each shoreline protection recommendation needs improvement. This information was shared with HRI and addressed in the integration of the new Living Shoreline Site Suitability Model and Decision Support Tool. The questions and responses for the User Survey can be found in Appendices II and III.

Living Shoreline Educational Video

To supplement the community workshops, GBF developed an educational video about living shorelines. The video covers what a living shoreline is, why and when this technique should be used, and the tools available to help implement a living shoreline project. Case studies and testimonies were also captured. GBF staff began collecting b-roll footage as well as interviews in the spring of 2021. In April 2022, GBF subcontracted Tumivision Productions to obtain additional footage and produce the video. In May 2022, Tumivision traveled to Corpus Christi to interview GLO and HRI staff and capture b-roll of projects on the lower coast. Additional interview and b-roll footage was filmed in June and August 2022 with GBF and project partners on the upper coast. The final video will be housed on GBF's YouTube channel (https://www.youtube.com/c/GalvestonBayFoundation/) as well as the GLO's Living Shorelines website (https://www.glo.texas.gov/livingshorelines/).

Community Workshops

GBF worked with HRI and GLO to conduct two in-person and one virtual workshop to promote the use of living shorelines and the tools developed by the project team. In an effort to increase attendance and encourage participation during the workshops, the project team designed "Dine and Discuss" events for the two in-person workshops (Figure 3). These events provided attendees with

dinner, a one-hour program, including presentations by the project team, a question-and-answer session, and time to mingle and network. GBF sub-contracted Lee Anne Wilde to manage the Dine and Discuss event logistics and to moderate the program at these events. For those unable to attend the in-person events, a virtual workshop was hosted by the GLO on Zoom. The attendance at each workshop is included in Table 3. The attendees' affiliations are shown in Tables 4-6, indicating a larger presence of bayfront homeowners at the Upper Coast event versus a larger presence of engineers, consultants, and state employees at the Lower Coast event and virtual workshop. Survey questions and results can be found in Appendices IV and V, respectively.

Figure 3 Workshops were held in person and online to educate stakeholders about living shoreline projects, permitting processes, and the tools available to them for implementing green infrastructure projects.

Workshop Survey – Fall 2022

A second survey was developed in September 2022 to assess the workshop attendees' perception of the events in addition to their interest in the new tools and living shorelines in general. The survey was sent to all workshop attendees and registrants, approximately 188 individuals. A total of 54 survey responses were received. Over sixty percent of the survey participants indicated they were "very familiar

with living shorelines." The majority of survey participants were waterfront property owners (19%), followed by environmental consultants (16%). Of the property owners, 33% would consider a living shoreline for their waterfront property. Over 62% of participants responded they were "very likely" to utilize living shorelines in their line of work.

As shown in Question 7, cost appears to be the main obstacle preventing the implementation of living shorelines. However, nearly 18% of participants indicated cost, permitting, and timeframe to implementation were equally challenging obstacles preventing the implementation of living shorelines. Eighty-two percent of participants indicated all the tools were equally valuable. The guidance document, new living shorelines website, and site suitability tool each received 4.44% of the votes, confirming all tools were well received. Question 9 indicates most workshop attendees (53%) were unaware these tools existed prior to the workshops. Both the virtual and in-person workshop attendees indicate the presentation content was most beneficial. However, over 35% of participants indicate the presentation content, Q&A session, and list of tools and resources provided were equally valuable. Seventy-eight percent of participants indicate they would be interested in attending future living shorelines events.

Tables

Table 1: Site Suitability Model Inputs for Integrated Model

	Site Suitability Model Inputs	Data Source
Shoreline Position and Shoreline Type	Shoreline shapefile used as base for model.	ESI
Bank Height	Elevations classified into 5ft elevation bands, converted to polygons. A new field was added to classify elevation into three categories (0-5 ft, 5-10 ft, and >10 ft). Base shoreline offset 25 feet inland and intersected with the bank height polygons.	2m optimized DEM created for TCRMP, includes 2017-2019 lidar
Armoring	Presence/absence of bulkhead, revetments, or breakwaters	ESI
Permanent Structures	Physical structures near the shoreline that would prohibit bank grading. Base shoreline is buffered based on 3 times the maximum height in the bank height category plus 20 feet. Where transportation buffers and shoreline buffers intersect, shoreline should be coded for roads.	ESI and TxDot Roadways
Modified Area	Presence of highly developed upland (e.g. commercial or industrial areas), channel modifications (e.g. canals or shipping lanes), or infrastructure directly adjacent to the shoreline (e.g. roads).	ESI, CCAP, HRI Boat Channels, TxDot Roadways
Riparian Land Use	Land cover. Agriculture, Bare, Cemetery, Coastal Prairie, Commercial/industrial, Extensive marsh, Forested, Grass, Paved, Public land, Railroad, Residential, Scrub/shrub	ESI, CCAP, NWI
Beach/Marsh Presence	Presence of beach or marsh on base shoreline. Beach features coded along tidal marsh shorelines are persistent, sandy features located on the water side of tidal marsh vegetation.	ESI, NWI
Energy/Risk Level	Wind and wave action a shoreline is exposed to. This wave energy index is based on the fetch and typical wind direction and speed for a given area. Fetch is classified as low = 0-0.5 mile, moderate = 0.5-2 miles, and high = > 2 miles.	Energy Index developed for original HRI LS model
Tributaries and Tidal Creeks	Small streams or rivers that are tidally influenced and drain into a major tributary, an estuary like Galveston Bay, or the Ocean. A tidal creek has limited shoreline exposure to fetch > 2 miles.	NWI, ESI, visual inspection
Boat Ramps	Presence of public access boat ramps in Texas.	TPWD dataset
Nearshore Water Depth	Depth of water categorized as shallow (1m contour farther than 10m from shoreline) or deep (1m contour within 10m from shoreline).	ADCIRC mesh
Conservation Areas	Boundaries of lands under conservation protections, including NWRs, national fish hatcheries and other FWS admin sites.	TPWD State Park Boundaries, TPWD Wildlife Management Areas

Oysters	Presence of oysters up to 100ft from shoreline.	TPWD, HRI Oyster Suitability Index
SAV	Presence of SAV up to 100ft from shoreline.	TPWD

Table 2: Integrated Model Output Recommendations

Output Categories for Merged Model	**Specific Recommendation within Category**
Hybrid Stabilization	• High profile breakwater and marsh plantings • Low profile breakwater and marsh plantings
Soft Stabilization	• Marsh planting with or without shoreline grading
Retrofit: Soft Stabilization	• Hybrid stabilization ○ Add high profile breakwater and/or marsh plantings in addition to any existing hardened structures (e.g. breakwaters)
Retrofit: Existing Revetment or Rip Rap	• Hybrid stabilization ○ Add marsh plantings in addition to the existing revetment structures.
Retrofit: Existing Bulkhead or Seawall	• Hybrid stabilization ○ Add marsh plantings in addition to the exiting bulkhead structures.
Seek expert advice	• Land use management • Existing breakwater • Ecological conflicts • Special geomorphic feature • Highly modified area

Table 3: Community Workshops

Date	**Workshop**	**Location**	**Attendance**
8/9/22	Lower Coast Dine & Discuss Living Shorelines	Corpus Christi, TX	49
8/9/23	Upper Coast Dine & Discuss Living Shorelines	Kemah, TX	51
9/14/22	Virtual Living Shorelines Workshop	Zoom	70
	Total Community Members Reached:		**170**

Table 4: Attendee Affiliation at the Lower Coast Dine & Discuss Event

Affiliation	No. of Attendees
State employee	9
Environmental Consultant	9
Engineer	8
Coastal community resident who does NOT own bayfront or oceanfront property	5
NGO employee	4
Bayfront or oceanfront property owner	3
Academic	3
Natural resource manager	2
None of these apply to me	2
No response	2
Federal employee	2
Grand Total	**49**

Table 5: Attendee Affiliation at the Upper Coast Dine & Discuss Event

Affiliation	No. of Attendees
Bayfront or oceanfront property owner	18
No response	5
NGO employee	5
Engineer	4
Environmental Consultant	4
Federal employee	4
State employee	3
None of these apply to me	3
Coastal community resident who does NOT own bayfront or oceanfront property	3
Natural resource manager	2
Grand Total	**51**

Table 6: Attendee Affiliation at Virtual Workshop

Affiliation	No. of Attendees
State employee	13
Federal employee	11
Environmental Consultant	10
Coastal community resident who does NOT own bayfront or oceanfront property	8
Bayfront or oceanfront property owner	7
Engineer	5
NGO employee	5
None of these apply to me	5
No response	2
Academic	2
Natural resource manager	2
Grand Total	**70**

Appendix I: Living Shoreline Site Suitability Integrated Model Technical Report

Living Shoreline Site Suitability Integrated Model

Introduction

The Harte Research Institute (HRI) at Texas A&M Corpus Christi has generated geospatial information on the suitability of applying Living Shoreline (LS) solutions for erosion control and environmental enhancement along bay shorelines of the Texas coast. HRI compiled geospatial and environmental data to build a rule-based model that classifies the suitability of bay shorelines for various living shoreline stabilization techniques. The specific classes and LS types were determined in collaboration with the Texas General Land Office (GLO) and the Galveston Bay Foundation (GBF), which has conducted a similar analysis for Galveston Bay. The original HRI model and the GBF model have been integrated to create one comprehensive LS site suitability model for the entire Texas coastline. The outcomes of the suitability model will be made available as an online viewer to help stakeholders determine where along the coast of Texas LS techniques are viable options as well as recommendations for which type of LS features might be most appropriate. The new data layers regarding LS will also be packaged, documented, and made available for download via a webpage to be hosted by the GLO. HRI has also produced an ArcGIS Story Map to highlight living shoreline types to accommodate varying shoreline conditions along with the model outputs shown on a GIS based map.

Methods

<u>Living Shoreline Suitability Integrated Model</u>

The original HRI Living Shoreline Suitability Model and the Galveston Bay Foundation Living Shoreline Protection Model were integrated into a single, comprehensive site suitability model for living shoreline techniques that covers all bay shorelines along the coast of Texas. To begin this effort, the two models were compared for similarities and differences with regards to the input variables, data layers and sources used, and outcome recommendations. An advisory team comprised of HRI, GBF, and GLO experts then collaborated on the combining the relevant aspects of each model to create a plan for an integrated model that would be appropriate for the entire coast. This process began by compiling a list of input layers and sources, identifying the desired outcome categories, and then creating a decision tree flowchart to conceptualize the model components (Figures 1, 2, and 3).

The original HRI model used bathymetry, wave exposure, shoreline type, shoreline change rate, and proximity to shipping channels as inputs that were used to recommend outcomes of Soft Stabilization, Hybrid Stabilization, Retrofit: Hybrid Stabilization, Retrofit: Soft Stabilization, or Not Suitable for Living Shorelines. The GBF model had output options of High Profile Breakwater with Marsh Plantings, Low Profile Breakwater

with Marsh Plantings, Marsh Plantings with or without Shoreline Grading, Revetment or Bulkhead with Optional Rock Toe, Beach Nourishment as Needed, No Action Needed, and Stop- Seek Expert Advice.

To prepare the integrated model, the first step was to import the Environmental Sensitivity Index shoreline layer (HRI), which classifies the entire coast of Texas based on shoreline type (e.g, sand vs gravel beach, seawall, revetment, marsh). The ESI layer then simplified, processed to split the shoreline into segments of 50 m or less, and classified based on shoreline type (Shoreline = 1 where beach or marsh present; Scarp = 1 where scarp present; Hard = 1 where shoreline is hardened). In addition to scarp presence, bank height was measured for the entire coast using 2m bathymetric LiDAR data collected in 2017-2019 for use in the Texas Coastal Resiliency Master Plan. The bathymetric digital elevation model (DEM) was converted from meters to feet, classified into 5 ft elevation bands and then converted to polygons from its original raster format. A new field was added to its attribute table, and the elevations within this column were classified into three categories: 0-5 ft, 5-10 ft, and >10 ft. A 25 ft buffer was created around the shoreline layer, converted to a polyline, and then intersected with elevation polygon layer. The bathymetry data was also used to classify the nearshore water depth as either shallow or deep by converting the raster layer to 1 m contours. Where the water was measured as 1 m depth more than 10 m from shore (<10% shoreline gradient), the depth was considered shallow. Water depth was classified as deep where it was measured as 1 m deep within 10 m from shore (>10% gradient). For subaquatic vegetation (SAV), a 30 ft buffer was created around the shoreline layer, and the identity tool was used to find where SAV was present within 30 ft of the shoreline. A field was added to the attribute table and calculated for whether or not SAV was present. The tidal creek layer was created by using the riverine classification of the NWI Texas Wetlands layer, which was clipped to the coastal region, merged into a single polyline, intersected with a 100 ft buffer created around the shoreline layer, and then intersected with the shoreline to show tidal creeks within 100 ft of the shoreline. A new field was then added to the attribute table and coded to show whether a tidal creek was present for each segment of the shoreline. As the boat ramp data layer was a point layer, a 100 ft buffer was created around this layer, intersected with the shoreline layer, and then coded for the presence or absence of boat ramps within 100 ft of the shoreline. Conservation areas were a combination of a wildlife management layer and a state parks layer, both from the Texas Parks and Wildlife Department (TPWD). These two layers were merged and then intersected with the shoreline layer and then coded in the attribute table for presence or absence of designated conservation areas. The presence or absence of oysters was coded by using the oyster presence layer from the Oyster Habitat Suitability Index (OSHI v.6) (GLO). The 100 ft buffer was again used to intersect with the oyster polygon layer, the output of which was then intersected with the shoreline and merged to show oyster presence within 100 ft of the shoreline. Since the oyster layer was ranked from not suitable-highest habitat suitability, a new attribute field was created with ranks not suitable – low suitability coded as absence of oysters and moderate – high suitability coded as oysters present. Shipping channels were previously mapped by HRI and were used to classify segments of the shoreline as either bordering (≤ 30 m) or near (≤ 50 m) a shipping channel.

Wave exposure was calculated using the USGS Fetch Model and was coded as either having a fetch suitable for soft stabilization or a fetch suitable for hybrid stabilization. Finally, the shoreline change rates were calculated using Bureau of Economic Geology (BEG) historic shoreline and the Analyzing Moving Boundaries Using R (AMBUR) package. Transects of 500 m were cast every 50 m along the shoreline, spatially joined to the shoreline layer, and then the coded as having erosion rates suitable for either soft or hybrid stabilization techniques. A final shoreline layer with all of the above mentioned attributes was then used as the input layer for the decision support model.

To create the model, six distinct recommendations were identified and used as the outputs: "Soft Stabilization," "Hybrid Stabilization," "Retrofit Stabilization: Hybrid," "Retrofit Stabilization for Existing Bulkhead Structures," "Retrofit Stabilization for Existing Revetment Structures," and "Stop. Seek Expert Advice." Based on the decision trees (Figures 1-3) created for undefended shorelines, shorelines with existing bulkhead features, and shorelines with existing revetment structures, each recommended model outcome was coded based on the shoreline attributes. The required criteria for each recommendation output can be found in Table 1. The model is created and run using the Model Builder tool in ESRI's ArcMap 10.8. Once the model has been run, the final product is a polyline shapefile of the coast of Texas with each segment coded for one of the six living shoreline technique recommendations. For the integrated model, the shoreline characteristics used to define each recommended output can be found in Table 1 of this appendix. Steps needed to run the full model are detailed in the following section.

Steps to run the full Living Shoreline Suitability Integrated Model:

1.) Run the following steps to prepare the shoreline file:

- ESI shoreline type is clipped to the study area and classified based on shoreline type (Shoreline = 1 where beach or marsh present; Scarp = 1 where scarp present; Hard = 1 where shoreline is hardened).
    - ESI shoreline type shapefile used in model has already been split using ET Geowizard into 50 m (or smaller) segments.
- Bathymetry points from ADCIRC Mesh are clipped to study area, a tin is created (using the shoreline as a hard line and the bay polygon as a soft clip), and then contours are derived.
- Shoreline where the 1m contour is at least 10 m away are deemed shallow (Bathy = 1).
- Land/water raster for the fetch model is generated (landwater_c) (will use later in USGS Fetch Model).
- Shoreline segments are classified based on proximity to channels (chan_bord = 1 where channel <=30 m; chan_near = 1 where channel <= 50m).
    - **NOTE:** channels are not categorized into type
- Tributaries are joined to the shoreline using a buffer of 100 ft and coded TidalCreek = 1 where tributaries are present.
- Boat ramps are intersected with a 100 ft buffer on the shoreline and merged with the shoreline layer. Where ramps are present, boatramp = 1.
- Conservation areas are intersected with the shoreline and coded CnsrvArea = 1 where they are present.
- Oyster suitability data is intersected with a 100 ft buffer around the shoreline and merged with the shoreline. Rank of "not suitable" – "low suitability" is coded oysterpres = 0, and rank "moderate suitability" – "high suitability" is coded as oysterpres = 1.

- Subaquatic vegetation is intersected with a 30 ft buffer around the shoreline, and then merged with the shoreline. Where SAV is present, code SAVpres = 1.

2. Simplify the shoreline:

- Is the landmass connected to other landmasses (i.e. part of the mainland)?
- Is the shoreline located on "internal" waters? Is it sheltered by other landmasses?
- If the landmass is an island, is it reasonably large and stable? Is it vegetated or a sand spit? Is there an upland area? Or would a habitat restoration project be more suitable?

3. Derive wave exposure index using the USGS Fetch Model:

- User Guide: https://umesc.usgs.gov/management/dss/wind_fetch_wave/wind_fetch_wave_2012update/wind_wave_2012_update_070814.pdf
- Burrows, M.T., Harvey, R. and Robb, L. (2008). Wave exposure indices from digital coastlines and the prediction of rocky shore community structure. *Marine Ecology Progress Series*, 353, 1-12.
- Create a text file based on the wind rose data for the study area
    - Wind rose data: See excel files in "Input" folder
- Obtain wind speed data from corresponding NOAA buoy for 2007-2017 – calculate the average for each direction (every 22.5 degrees) in knots
- Land/water raster is derived in the above model (landwater_c)
- Add model to toolbox (Waves2012)
- Use Raster Calculator to generate wave exposure index
    - Wind energy = % time of wind in that sector * average wind speed (knots) squared in that sector
    - Wave exposure index is equal to the sum of fetch in each direction * wind energy in each direction
    - Example code: Log10((("fet_022"*0.0608*150) + ("fet_045" * 0.0670 * 164)+ ("fet_067"*0.0415*114.19) + ("fet_090"*0.0614*121) + ("fet_112"*0.1018*116) + ("fet_135"*0.1723*165) + ("fet_157"*0.1989*157) + ("fet_180"*0.077 * 97) + ("fet_202"* 0.0187 * 118) + ("fet_225"*0.018*117) + ("fet_247"*0.0097* 144) + ("fet_270"* 0.0076*154) + ("fet_292"+ 0.0121 * 333) + ("fet_315"* 0.027 * 168) + ("fet_337" * 0.0650 * 238) + ("fet_000"* 0.0666 * 150))*0.001)
        - First number is proportion of wind in that direction; second number is average wind speed (knots) in that direction squared
- Symbolize the raster into 3 categories using quartiles 1st category will be Low (0-25), 2nd will be Moderate (25-75), 3rd will be High (75-100)– compare to wave exposure index for corpus Christi for validation
- Reclassify the raster (first category = 1, etc.)
- Convert the raster into a polygon
- Use spatial join to add the wave exposure index to the shoreline shapefile
- Add Field called "Wave_log" & use Field Calculator with code:

```
def myfunct(GRIDCODE):
  if (GRIDCODE == 1):
    return "Low"
  if (GRIDCODE == 2):
    return "Moderate"
  if (GRIDCODE == 3):
    return "High"
  else:
    return "NA"
```

- Add Field called "Fetch_soft" & use Field Calculator with code:

```
def myfunct(Wave_log):
  if "Low" in Wave_log:
    return 1
  else:
    return 0
```

- Add Field called “Fetch_hybr” & use Field Calculator with code:

```
def myfunct(Wave_log):
  if "Moderate" in Wave_log:
    return 1
  if "High" in Wave_log:
    return 1
  else:
    return 0
```

4. Calculate shoreline change rates:

- Historic shoreline source: http://www.beg.utexas.edu/coastal/zip_shoreline/zone14_up10.htm
  - Merge shoreline type shapefile to historic shoreline shapefile for modern shoreline data (date: 02/01/2012)
  - Used the date “07/01/year” when the exact date for a given year wasn’t given
- Create a baseline and follow AMBUR user guide to format shapefile and calculate shoreline change rates: http://ambur.r-forge.r-project.org/user/ambur%20basic%20user%20guide%201_0a.pdf
  - Cast transects every 50 m with a length of 500 m
  - Excluded 1880 in the analysis
- Use Spatial Join to join envelope_transects_analysis to shoreline shapefile – join field LRR
- Add field called “Erosion” & use Field Calculator with code:

```
def myfunct(LRR):
  if (LRR <= -6.5):
    return "High"
  if (-3.2 >=  LRR > -6.5):
    return "Moderate"
  if (0 >=  LRR > -3.2):
    return "Low"
  if (LR_FT > 0):
    return "Accretion"
  else:
    return "NA"
```

- Select by attributes, Join_count = 0 & use Field Calculator on selection to change Erosion = Unknown
- Add Field called “Erode_soft” & use Field Calculator with code:

```
def myfunct(Erosion):
  if “Low” in Erosion:
    return 1
  if “Accretion” in Erosion:
    return 1
  else:
    return 0
```

- Add Field called “Erode_hybr” & use Field Calculator with code:

```
def myfunct(Erosion)
  if “Moderate” in Erosion:
    return 1
  if “High” in Erosion:
```

```
  return 1
else:
  return 0
```

- Add Field called “Unknown” & use Field Calculator with code:

```
def myfunct(Erosion):
  if “Unknown” in Erosion:
    return 1
  else:
    return 0
```

5.) Use the following codes to classify the final shoreline layer:

Soft Stabilization:
Shoreline = 1 AND Bathy = 1 AND fetch_soft = 1 AND Scarp = 0 AND Erode_soft = 1 AND chan_bord = 0 AND chan_near = 0 AND Hard = 0 AND TidalCreek = 0 AND "BoatRamp" = '0' AND "CnsvtnArea" = '0' AND "OysterPres" = '0' AND "SAV_pres" = 0

Hybrid Stabilization:
("Shoreline" = 1 AND "Bathy" = 1 AND "chan_bord" = 0 AND "Erode_hybr" = 1 AND "Erode_soft" = 0 AND "Fetch_hybr" = 1 AND "OysterPrs1" = 0 AND "SAVpres1" = 0 AND "CnsvtnAr_1" = 0) OR ("Shoreline" = 1 AND "Bathy" = 1 AND "chan_bord" = 0 AND "Erode_soft" = 1 AND "Erode_hybr" = 0 AND "Fetch_soft" = 1 AND "chan_near" = 1 AND "OysterPrs1" = 0 AND "SAVpres1" = 0 AND "CnsvtnAr_1" = 0) OR ("Shoreline" = 1 AND "Bathy" = 1 AND "chan_bord" = 0 AND "Unknown" = 1 AND "OysterPrs1" = 0 AND "SAVpres1" = 0 AND "CnsvtnAr_1" = 0) OR ("Shoreline" = 1 AND "Scarp" = 0 AND "Hard" = 0 AND "Bathy" = 1 AND "chan_bord" = 0 AND "chan_near" = 0 AND "Erode_hybr" = 1 AND "Erode_soft" = 0 AND "Fetch_soft" = 1 AND "OysterPrs1" = 0 AND "SAVpres1" = 0 AND "CnsvtnAr_1" = 0) OR ("Shoreline" = 1 AND "Scarp" = 0 AND "Hard" = 0 AND "Bathy" = 1 AND "chan_bord" = 0 AND "chan_near" = 0 AND ("Erode_hybr" = 0 AND "Erode_soft" = 0) AND "Fetch_soft" = 1 AND "OysterPrs1" = 0 AND "SAVpres1" = 0 AND "CnsvtnAr_1" = 0) OR ("Shoreline" = 1 AND "Scarp" = 0 AND "Hard" = 0 AND "Bathy" = 1 AND "Erode_soft" = 1 AND "Erode_hybr" = 0 AND "Fetch_hybr" = 1 AND "OysterPrs1" = 0 AND "CnsvtnAr_1" = 0)

Retrofit: Soft Stabilization:
"Bathy" = 1 AND "Fetch_soft" = 1 AND "Erode_soft" = 1 AND "Scarp" = 0 AND "chan_bord" = 0 AND "chan_near" = 0 AND "Hard" = 1 AND "BoatRamp1" = 0 AND "CnsvtnAr_1" = 0 AND "OysterPrs1" = 0 AND "SAVpres1" = 0

Retrofit for Existing Bulkhead Structures: Hybrid Stabilization:
("Hard" = 1 AND ("ESI_F" = '1' OR "ESI_F" = '8A') AND "Bathy" = 1 AND "chan_bord" = 0 AND "Erode_soft" = 1 AND "Fetch_hybr" = 1 AND "BoatRamp1" = 0 AND "CnsvtnAr_1" = 0 AND "OysterPrs1" = 0 AND "SAVpres1" = 0) OR ("Hard" = 1 AND ("ESI_F" = '1' OR "ESI_F" = '8A') AND "Bathy" = 1 AND "chan_bord" = 0 AND "Erode_soft" = 1 AND "Fetch_hybr" = 1 AND "chan_near" = 1 AND "BoatRamp1" = 0 AND "CnsvtnAr_1" = 0 AND "OysterPrs1" = 0 AND "SAVpres1" = 0) OR ("Hard" = 1 AND ("ESI_F" = '1' OR "ESI_F" = '8A') AND "Bathy" = 1 AND "chan_bord" = 0 AND "Fetch_hybr" = 1 AND "BoatRamp1" = 0 AND "CnsvtnAr_1" = 0 AND "OysterPrs1" = 0 AND "SAVpres1" = 0)

Retrofit for Existing Revetment Structures: Hybrid Stabilization:
("Hard" = 1 AND ("ESI_F" = '6B' OR "ESI_F" = '8B') AND "Bathy" = 1 AND "chan_bord" = 0 AND "Erode_soft" = 1 AND "Fetch_hybr" = 1 AND "BoatRamp1" = 0 AND "CnsvtnAr_1" = 0 AND "OysterPrs1" = 0 AND "SAVpres1" = 0) OR ("Hard" = 1 AND ("ESI_F" = '6B' OR "ESI_F" = '8B') AND "Bathy" = 1 AND

"chan_bord" = 0 AND "Erode_soft" = 1 AND "Fetch_hybr" = 1 AND "chan_near" = 1 AND "BoatRamp1" = 0 AND "CnsvtnAr_1" = 0 AND "OysterPrs1" = 0 AND "SAVpres1" = 0) OR ("Hard" = 1 AND ("ESI_F" = '6B' OR "ESI_F" = '8B') AND "Bathy" = 1 AND "chan_bord" = 0 AND "Fetch_hybr" = 1 AND "BoatRamp1" = 0 AND "CnsvtnAr_1" = 0 AND "OysterPrs1" = 0 AND "SAVpres1" = 0)

Seek Expert Advice:
Scarp =1 OR Shoreline = 0 OR OysterPres = 1 OR BoatRamp = 1 OR TidalCreek = 1 OR CnstvnArea = 1 OR Bathy = 0 OR TidalCreek = 1 OR SAV_pres = 1

Decision Support Tool

Using the same decision trees as used in the site suitability model, a self-guided assessment tool was created to accompany the model tool. This decision support tool uses if- then- else statements to walk users through yes or no questions to arrive at a recommendation for which type of living shoreline technique would be appropriate for their section of the Texas coastline. Each question has an information icon that opens a pop-up window with more information on that specific topic to make the application more accessible to non-expert users. The tool also has a restart option, and the choices can be changed once the user clicks on an option to reroute to a new set of conditions if needed. The outcomes of the tool are the same six recommendations as in the model tool with an accompanying brief description of each recommendation.

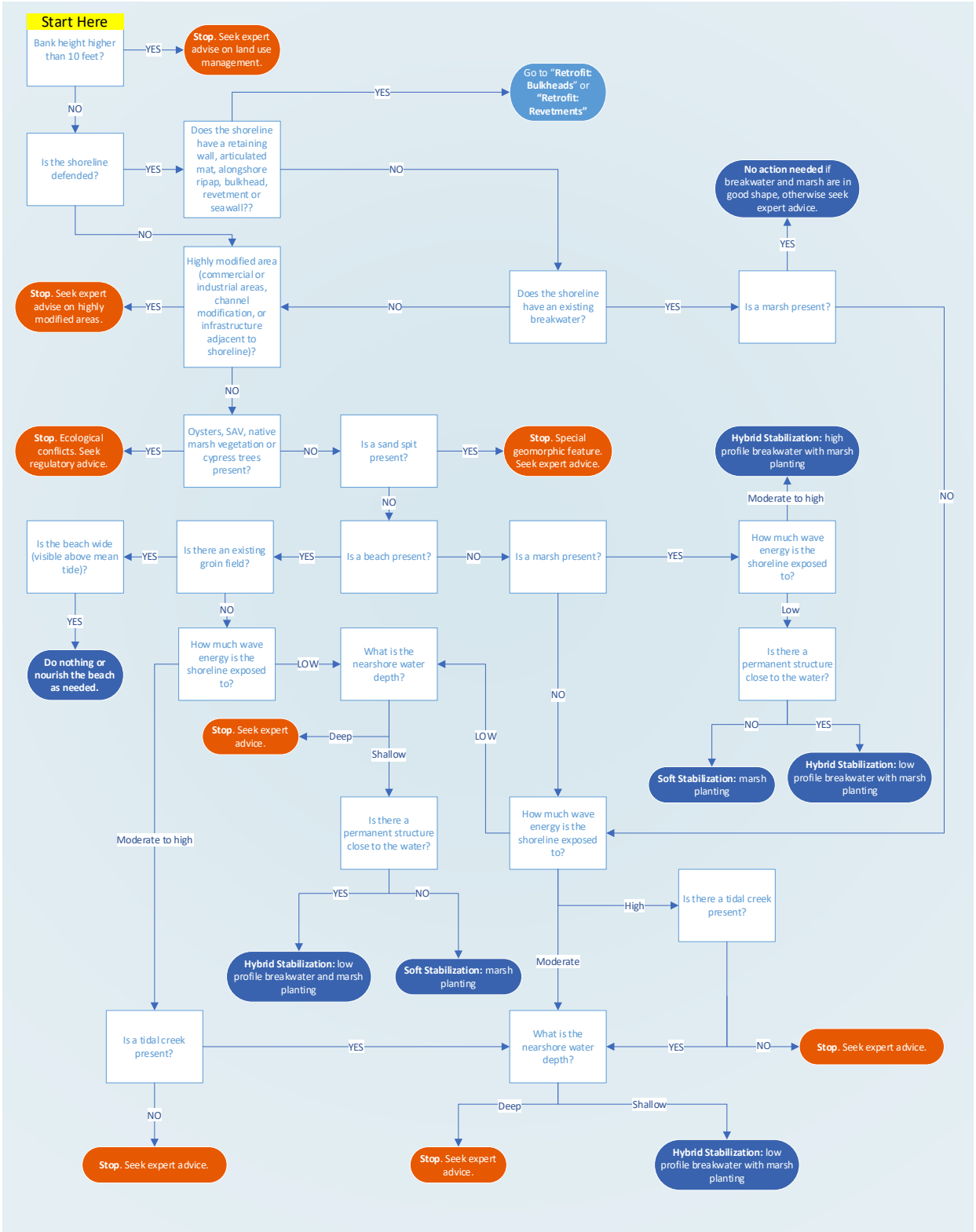


Figure 1 Decision tree designed to guide the geospatial model for shoreline stabilization techniques to be used for sections of the coast that *do not currently have hardened structures* in place along the shore.

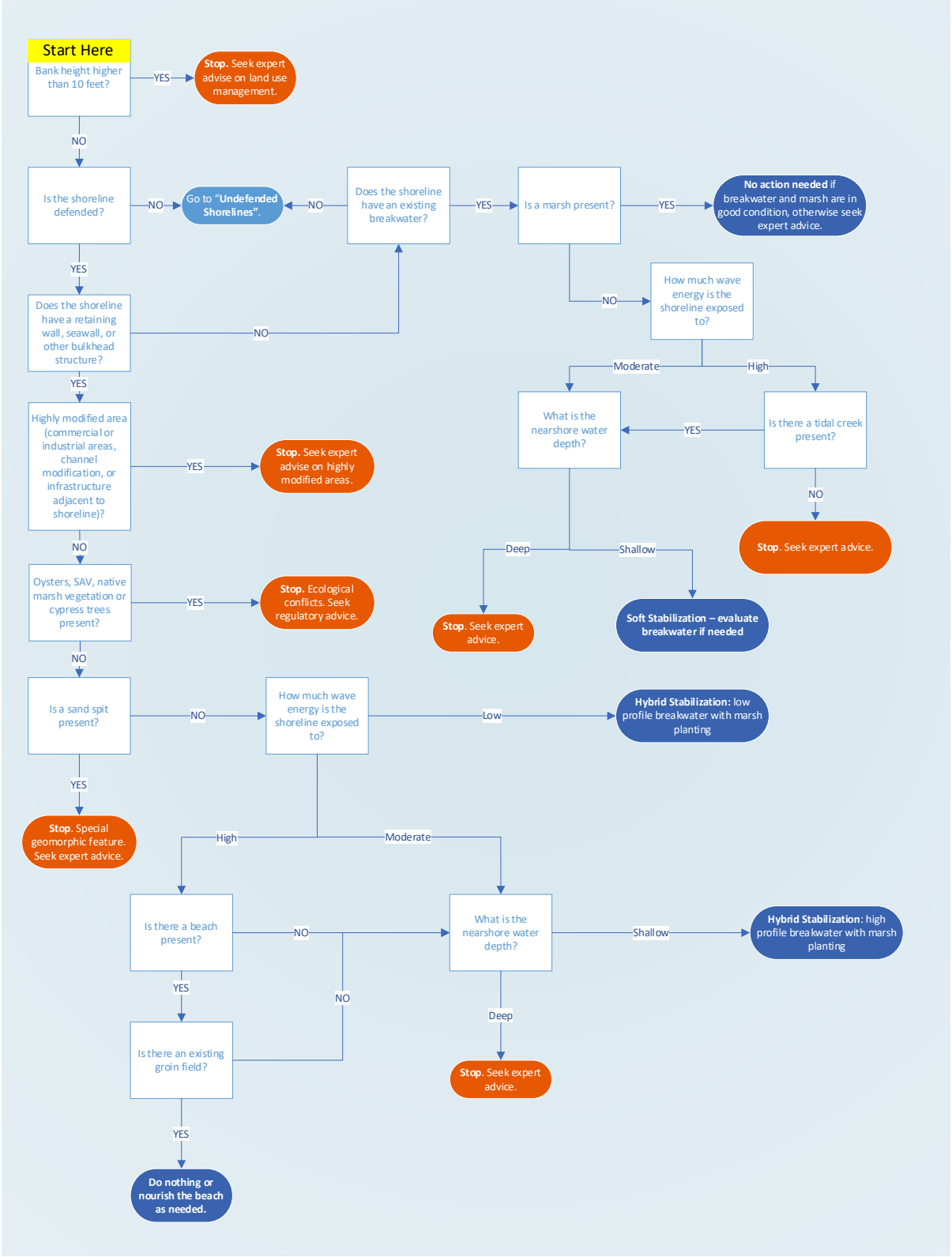


Figure 2 Decision tree designed to guide the geospatial model for shoreline stabilization techniques to be used for sections of the coast that *currently have a seawall or bulkhead structure* in place along the shore.

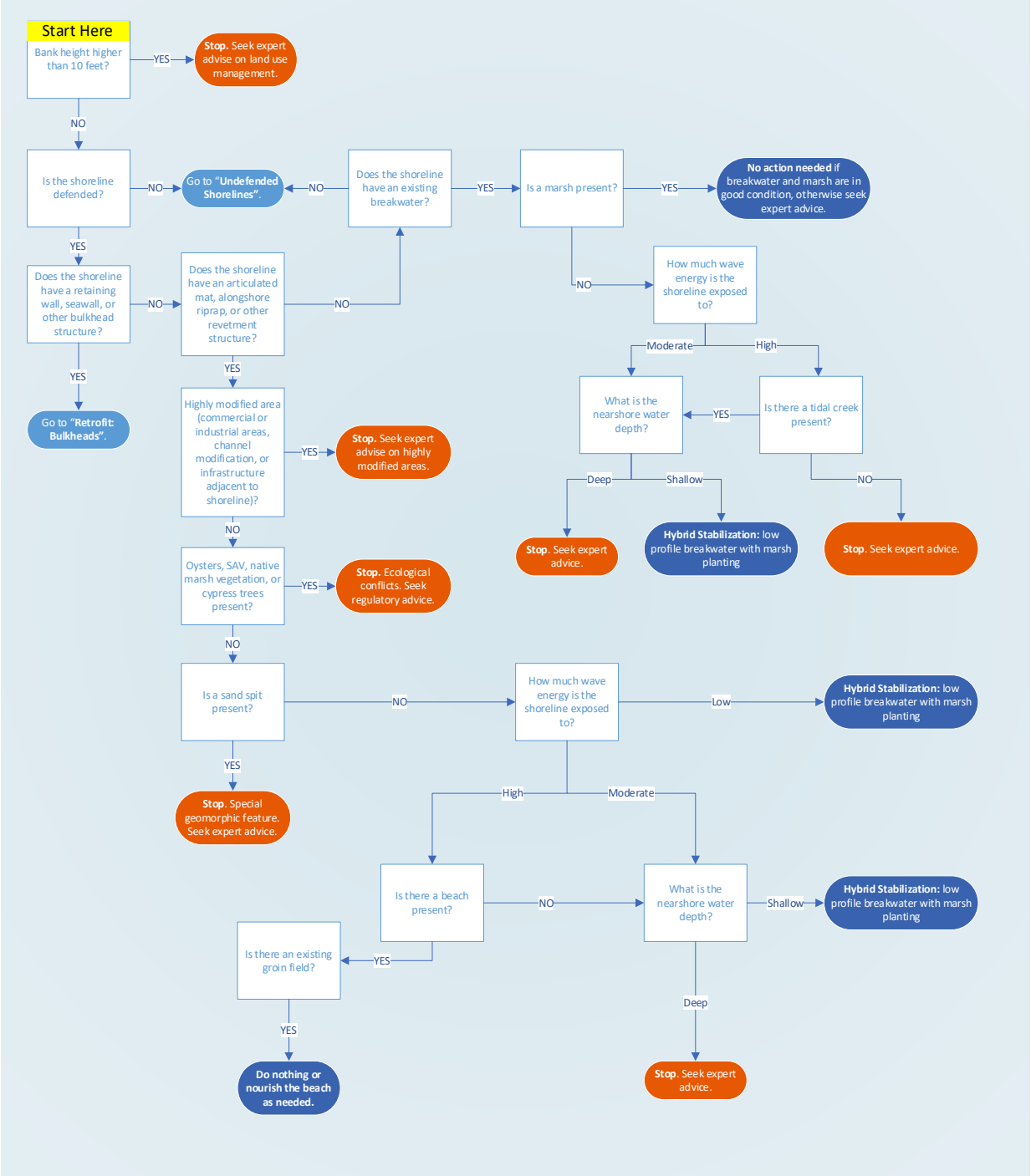


Figure 3 Decision tree designed to guide the geospatial model for shoreline stabilization techniques to be used for sections of the coast that *currently have revetment or riprap structures* in place along the shore.

Results

The outputs from the Living Shoreline Site Suitability Integrated Model provide recommendations for five different living shoreline techniques as well as one recommendation for scenarios in which living shorelines may not be appropriate without expert advice (Figure 4). Of the nearly 4,446 miles of shoreline that were analyzed across the entire state of Texas, roughly 75% of the coast was determined to be appropriate for some type of living shoreline project, with only 25% being classified as needing expert advice due to the shoreline conditions present in these areas (Figure 5, Table 2). Strictly soft stabilization techniques were determined to be suitable for over 1300 miles of shoreline, comprising nearly 30% of the coast mapped. 35% of the coast was suitable for hybrid stabilization, where a combination of soft and hardened features would be used. Where hardened structures already were constructed along the shoreline, roughly 3% were appropriate for retrofit with hybrid techniques for existing revetment structures and another 3% for existing bulkhead structures. In areas with an existing breakwater offshore of the shoreline, retrofit with soft stabilization was recommended for 4% of the coast.

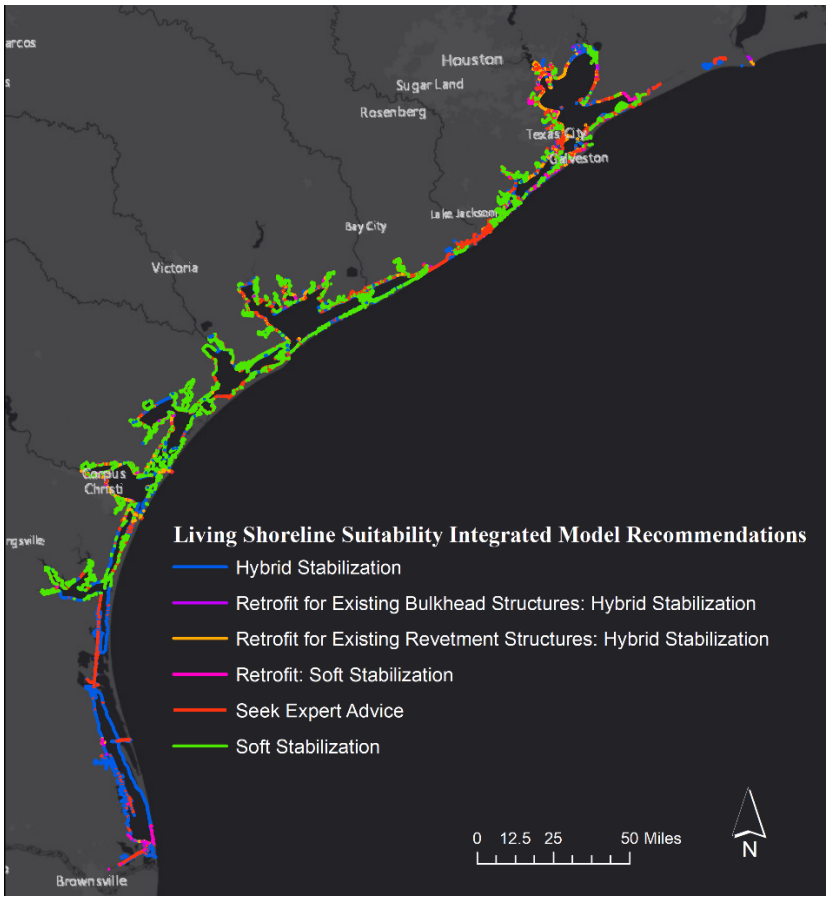


Figure 4 Model output showing the 6 different living shoreline recommendations based on shoreline characteristics for the Texas coast.

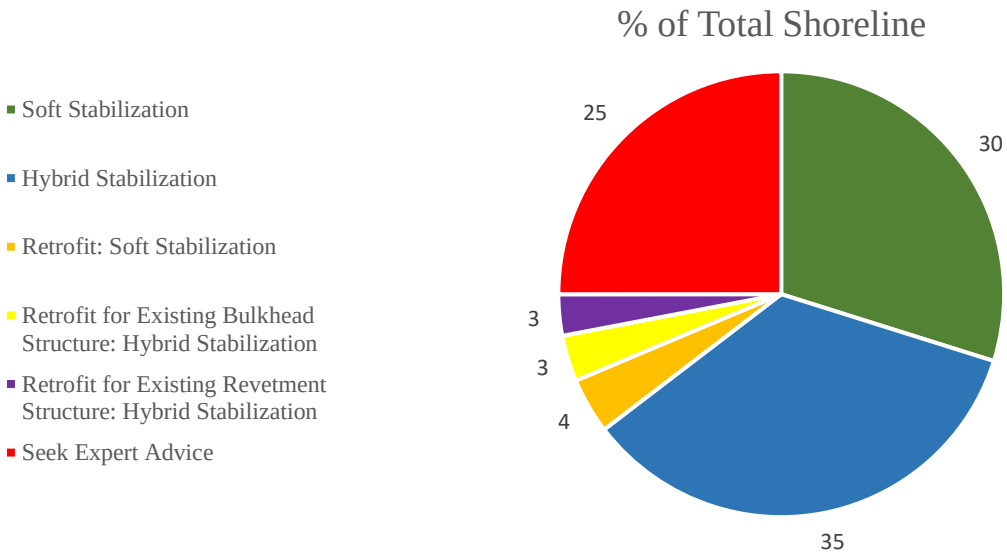


Figure 5 Percent of the total shoreline analyzed that was classified as being suitable for each of the six shoreline stabilization outcomes using the Living Shoreline Suitability Integrated Model.

Table 1: Recommended stabilization techniques classified by each combination of shoreline characteristics

	Nearshore Water Depth	Fetch	Erosion Rates	Scarp Present	Distance from Shipping Channel	Hardened Shoreline	Ecologically Sensitive Feature Present	Tidal Creek Present
Soft Stabilization	Shallow	Low	Low	No	Far	No	Beach or Marsh	No
Hybrid Stabilization	Shallow	Moderate-High	Moderate-High	Yes or No	Near, Bordering, or Far	Permanent Structure Close to Shore (ie groin)	Marsh	Yes with Beach or Marsh
Retrofit: Soft Stabilization	Shallow	Low	Low-Accreting	No	Far	Permanent Structure Close to Shore (ie breakwater)	No	No
Retrofit for Existing Bulkhead Structure: Hybrid Stabilization	Shallow	Moderate-High	Moderate-High	Yes or No	Near, Bordering, or Far	Bulkhead or Sea Wall	No	No
Retrofit for Existing Revetment Structure: Hybrid Stabilization	Shallow	Moderate-High	Moderate-High	Yes or No	Near, Bordering, or Far	Revetment or Rip Rap	No	No
Seek Expert Advice	Deep	Moderate-High (in combination w/ other factors)	High	>10 ft	Bordering	Highly Modified	Oysters, SAV, or Extensive Native Marsh	Yes with No Beach or Marsh

Table 2: Length of the shoreline recommended for each type of living shoreline technique and the percent of the entire coastline for each classification.

	Shoreline Length (m)	Shoreline Length (mi)	% of Total Shoreline
Soft Stabilization	2135714.02	1327.13	29.85
Hybrid Stabilization	2487239.93	1545.50	34.76
Retrofit: Soft Stabilization	289848.42	180.13	4.05
Retrofit for Existing Bulkhead Structure: Hybrid Stabilization	239316.29	148.70	3.34
Retrofit for Existing Revetment Structure: Hybrid Stabilization	213715.10	132.80	2.99
Seek Expert Advice	1789095.98	1111.72	25.01
Total Shoreline	7154929.74	4445.98	100

Appendix II: User Survey Questions

LIVING SHORELINE USER SURVEY

The Galveston Bay Foundation (GBF) recently developed an online map viewer, the **Galveston Bay Shoreline Protection Model**, that provides shoreline protection recommendations for specific locations along the Galveston Bay shoreline. Independently, the Harte Research Institute (HRI) was contracted by the Texas General Land Office (GLO) to develop a **Living Shoreline Site Suitability Model** for multiple systems along the Texas coast: Nueces Bay, Corpus Christi Bay, Aransas Bay, Copano Bay, and Galveston Bay.

While similar in design and purpose, the two map viewers differ in their approach and recommendations. GBF, HRI, and GLO are working together to streamline these models for the entire Texas coast to help encourage the use of living shorelines and make the implementation of living shorelines simpler, but we are in need of YOUR HELP to identify the pros and cons of each model.

How YOU can help:

STEP 1 - Visit each map viewer online
*Please copy & paste the links below into your web browser.

GBF Map Viewer – "Galveston Bay Shoreline Protection Model"
cmap2.vims.edu/GBShoreProtectViewer/

GLO Map Viewer – "Living Shoreline Site Suitability Model"
gomaportal.tamucc.edu/GLO/LivingShorelines_StoryMap/

Within each of the tools, do some exploring! We recommend plugging in the address of your favorite bayfront location, seeing what type of shoreline protection is recommended, and reading through the notes. Also take time to navigate to an unfamiliar location on the map and see if you can get information along that shoreline.

STEP 2 - Take our Survey!

It's only 14 questions and will take less than 5 minutes.
Click on the arrow below to get started.
THANK YOU!

1) Which of the following best describes you? (select all that apply)
   a. Bayfront or oceanfront property owner
   b. Coastal community resident who does NOT own bayfront or oceanfront property
   c. Engineer
   d. Environmental Consultant
   e. Marine construction contractor
   f. Natural resource manager
   g. Federal employee
   h. State employee
   i. NGO employee
   j. Student
   k. Other (please specify) _____
   l. None of these apply to me

2) In which county(ies) do you live and/or own property? (select all that apply)

a. Aransas
b. Brazoria
c. Calhoun
d. Cameron
e. Chambers
f. Galveston
g. Harris
h. Jackson
i. Jefferson
j. Kenedy
k. Kleberg
l. Matagorda
m. Nueces
n. Orange
o. Refugio
p. San Patricio
q. Victoria
r. Willacy
s. Other (please specify) _____

3) How familiar are you with living shorelines?

a. *Not familiar at all*. What is a living shoreline?
b. *Somewhat familiar*. I've heard of living shorelines but would like to learn more.
c. *Very familiar*. I would feel very comfortable explaining what living shorelines are, their pros and cons, and how they are implemented.
d. I don't know.

4) Do you currently have a living shoreline on your bayfront or oceanfront property?

a. Yes, I currently have a living shoreline.
b. No, but I had a living shoreline in the past.
c. No, but I am working towards implementing one.
d. No, I tried to implement one, but I was not able to.
e. No, but I would consider implementing one.
f. No, and I am NOT interested in a living shoreline for my property.
g. Not applicable.

5) To what degree would you consider a living shoreline to protect your bayfront or oceanfront property?

a. I currently have a living shoreline.
b. I would definitely consider it.
c. I might consider it.
d. I would never consider it.
e. I don't know.
f. Not applicable.

6) Were you aware these map viewers existed before taking this survey?

a. Yes
b. Maybe
c. No

7) How likely are you to use either one of these map viewers?

a. *Not likely at all*. I have no need for these tools.
b. *Somewhat li*kely. I may have a need for these tools.
c. *Very likely*. I plan to use these tools to help plan my shoreline protection project.
d. I don't know.

8) Which map viewer do you prefer?

a. GBF Map Viewer – "Galveston Bay Shoreline Protection Model"
b. GLO Map Viewer – "Living Shoreline Site Suitability Model"
c. I like them about the same.
d. I don't know.
e. Other (please specify) _____.

9) Please rate the following features of the **GLO Map Viewer**.
(1 = strongly dislike; 2 = neither like nor dislike; 3 = strongly like; 4 = don't know)

a. Map viewer instructions
b. Map functionality (zooming, scrolling, clicking, searching, etc.)
c. Terminology
d. Shoreline protection recommendations
e. Aesthetics and layout
f. Other (please specify): _____

10) Which of the following features of the **GLO Map Viewer** need to be improved and/or added?
(select all that apply)

a. Instructions on how to use the map viewer
b. More specific/detailed shoreline protection recommendations
c. Basic information on living shorelines
d. Next steps for implementing a living shoreline project
e. I don't know.
f. Other (please specify): _____

11) Please rate the following features of the **GBF Map Viewer**.
(1 = strongly dislike; 2 = neither like nor dislike; 3 = strongly like; 4 = don't know)

a. Map viewer instructions
b. Map functionality (zooming, scrolling, clicking, searching, etc.)
c. Terminology
d. Shoreline protection recommendations
e. Aesthetics and layout
f. Other (please specify): _____

12) Which of the following features of the **GBF Map Viewer** need to be improved and/or added?
(select all that apply)

a) Instructions on how to use the map viewer
b) More specific/detailed shoreline protection recommendations
c) Basic information on living shorelines
d) Next steps for implementing a living shoreline project
e) I don't know.
f) Other (please specify): _____

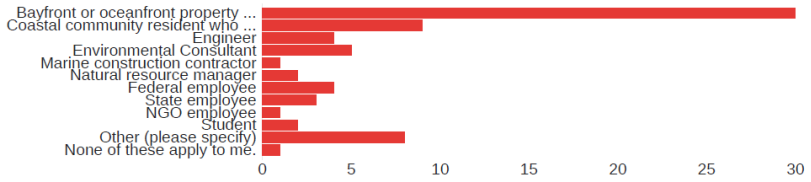
13) Any additional comments or suggestions you'd like to add about the GBF map viewer?

GLO Map Viewer _____
GBF Map Viewer _____

Appendix III: User Survey Results

Field	Min.	Max.	Mean	Standard Deviation	Variance	Responses
Q_RecaptchaScore	1	1	1	0	0	83

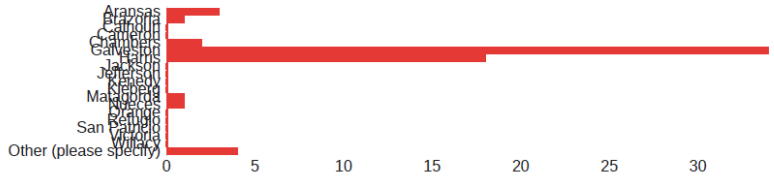
Q1 - Question 1



Field	Choice Count
Bayfront or oceanfront property owner	30
Coastal community resident who does NOT own bayfront or oceanfront property	9
Engineer	4
Environmental Consultant	5
Marine construction contractor	1
Natural resource manager	2
Federal employee	4
State employee	3
NGO employee	1
Student	2
Other (please specify)	8
None of these apply to me.	1
Total	70

Other (please specify) - Text

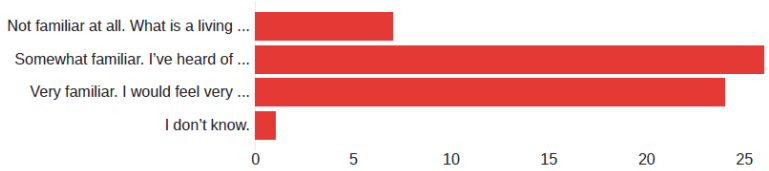
Q2 - Question 2



Field	Choice Count
Aransas	3
Brazoria	1
Calhoun	0
Cameron	0
Chambers	2
Galveston	34
Harris	18
Jackson	0
Jefferson	0
Kenedy	0
Kleberg	0
Matagorda	1
Nueces	1
Orange	0
Refugio	0
San Patricio	0
Victoria	0
Willacy	0
Other (please specify)	4
Total	64

Other (please specify) - Text

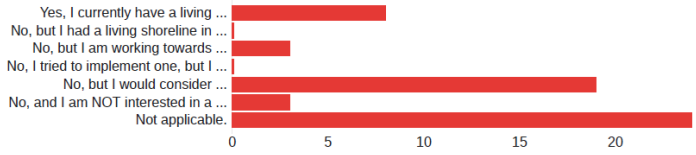
Q3 - Question 3



Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Question 3	1	4	2	1	0	58

Field	Choice Count
Not familiar at all. What is a living shoreline?	7
Somewhat familiar. I've heard of living shorelines but would like to learn more.	26
Very familiar. I would feel very comfortable explaining what living shorelines are, their pros and cons, and how they are implemented.	24
I don't know.	1
Total	58

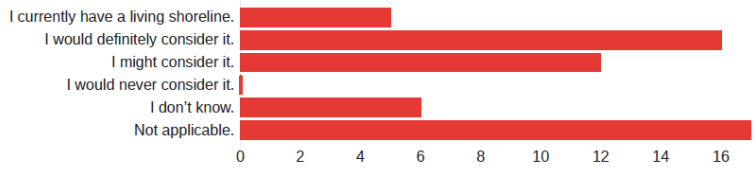
Q4 - Question 4



Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Question 4	1	7	5	2	4	57

Field	Choice Count
Yes, I currently have a living shoreline.	8
No, but I had a living shoreline in the past.	0
No, but I am working towards implementing one.	3
No, I tried to implement one, but I was not able to.	0
No, but I would consider implementing one.	19
No, and I am NOT interested in a living shoreline for my property.	3
Not applicable.	24
Total	57

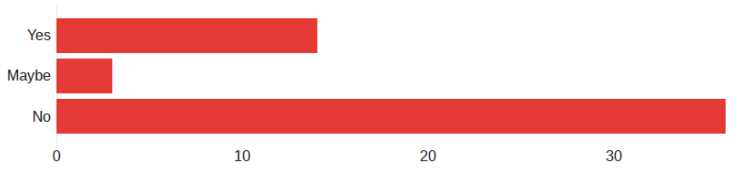
Q5 - Question 5



Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Question 5	1	6	4	2	3	56

Field	Choice Count
I currently have a living shoreline.	5
I would definitely consider it.	16
I might consider it.	12
I would never consider it.	0
I don't know.	6
Not applicable.	17
Total	56

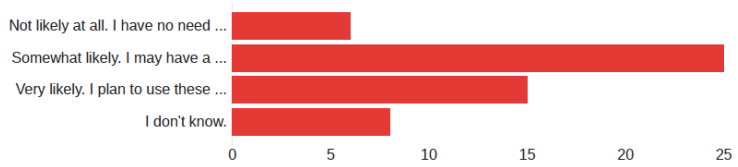
Q6 - Question 6



Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Question 6	1	3	2	1	1	53

Field	Choice Count
Yes	14
Maybe	3
No	36
Total	53

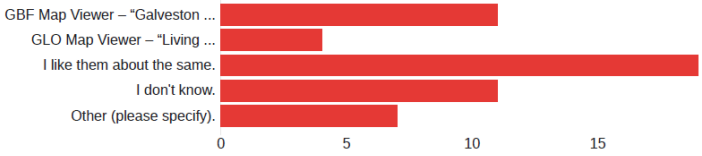
Q7 - Question 7



Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Question 7	1	4	2	1	1	54

Field	Choice Count
Not likely at all. I have no need for these tools.	6
Somewhat likely. I may have a need for these tools.	25
Very likely. I plan to use these tools to help plan my shoreline protection project.	15
I don't know.	8
Total	54

Q8 - Question 8



Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Question 8 - Selected Choice	1	5	3	1	2	52

Field	Choice Count
GBF Map Viewer – "Galveston Bay Shoreline Protection Model"	11
GLO Map Viewer – "Living Shoreline Site Suitability Model"	4
I like them about the same.	19
I don't know.	11
Other (please specify).	7
Total	52

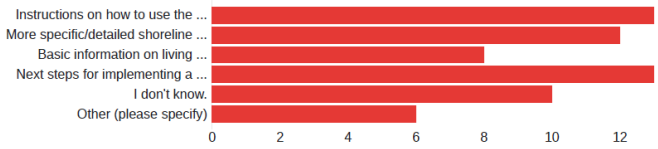
Other (please specify). - Text

Q9 - Question 9

Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Map viewer instructions	1	4	3	1	1	27
Map functionality (zooming, scrolling, clicking, searching, etc.)	2	4	3	1	0	26
Terminology	1	4	3	1	1	24
Shoreline protection recommendations	1	4	3	1	1	27
Aesthetics and layout	1	4	3	1	1	26
Other (please specify)	1	4	3	1	2	7

Other (please specify) - Text

Q10 - Question 10



Field	Choice Count
Instructions on how to use the map viewer.	13
More specific/detailed shoreline protection recommendations.	12
Basic information on living shorelines.	8
Next steps for implementing a living shoreline project.	13
I don't know.	10
Other (please specify)	6
Total	62

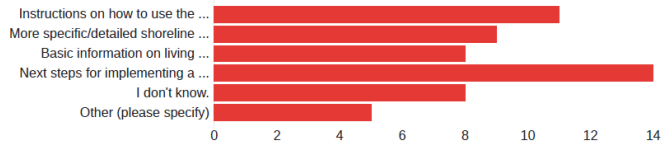
Other (please specify) - Text

Q11 - Question 11

Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Map viewer instructions	2	4	3	1	1	22
Map functionality (zooming, scrolling, clicking, searching, etc.)	2	4	3	1	1	26
Terminology	1	4	3	1	1	22
Shoreline protection recommendations	1	4	3	1	1	24
Aesthetics and layout	2	4	3	1	1	26
Other (please specify)	2	4	3	1	1	5

Other (please specify) - Text

Q12 - Question 12



Field	Choice Count
Instructions on how to use the map viewer.	11
More specific/detailed shoreline protection recommendations.	9
Basic information on living shorelines.	8
Next steps for implementing a living shoreline project.	14
I don't know.	8
Other (please specify)	5
Total	55

Other (please specify) - Text

Q13- Question 13

GLO Map Viewer	GBF Map Viewer
N/A	N/A
N/A	N/A
no	no
N/A	N/A
N/A	N/A

Appendix IV: Workshop Survey Questions

2022 LIVING SHORELINES EVENTS
FOLLOW-UP SURVEY

You have received this survey because you attended one of the Living Shorelines events hosted by the Galveston Bay Foundation (GBF), Harte Research Institute (HRI), and the TX General Land Office (GLO): ***Dine and Discuss Living Shorelines*** or the ***Virtual Living Shorelines Workshop***.

We hope you found the presentation at these events informative and helpful. To improve our community outreach efforts as well as the tools developed for living shoreline implementation, we would greatly appreciate your feedback.

Please click on the arrow below to begin the survey.

It is only 14 questions and will take less than 5 minutes.

Thank you!

1) Which of the following best describes you? (select all that apply)
- a. Academic personnel
- b. Bayfront or oceanfront property owner
- c. Coastal community resident who does NOT own bayfront or oceanfront property
- d. Engineer
- e. Environmental Consultant
- f. Marine construction contractor
- g. Natural resource manager
- h. Federal employee
- i. State employee
- j. NGO employee
- k. Student
- l. Other (please specify) _____
- m. None of these apply to me

2) In which county(ies) do you live and/or own property? (select all that apply)
- a. Aransas
- b. Brazoria
- c. Calhoun
- d. Cameron
- e. Chambers
- f. Galveston
- g. Harris
- h. Jackson
- i. Jefferson
- j. Kenedy
- k. Kleberg
- l. Matagorda
- m. Nueces
- n. Orange
- o. Refugio
- p. San Patricio
- q. Victoria
- r. Willacy
- s. Other (please specify) _____

3) How familiar are you with living shorelines?

a. *Not familiar at all*. What is a living shoreline?
b. *Somewhat familiar*. I've heard of living shorelines but would like to learn more.
c. *Very familiar*. I would feel very comfortable explaining what living shorelines are, their pros and cons, and how they are implemented.
d. I don't know.

4) Do you currently have a living shoreline on your bayfront or oceanfront property?

a. Yes, I currently have a living shoreline.
b. No, but I had a living shoreline in the past.
c. No, but I am working towards implementing one.
d. No, I tried to implement one, but I was not able to.
e. No, but I would consider implementing one.
f. No, and I am NOT interested in a living shoreline for my property.
g. Not applicable.

4) Do you currently have a living shoreline on your bayfront or oceanfront property?

a. Yes, I currently have a living shoreline.
b. No, but I had a living shoreline in the past.
c. No, but I am working towards implementing one.
d. No, I tried to implement one, but I was not able to.
e. No, but I would consider implementing one.
f. No, and I am NOT interested in a living shoreline for my property.
g. Not applicable.

5) To what degree would you consider a living shoreline to protect your bayfront or oceanfront property?

a. I currently have a living shoreline.
b. I would definitely consider it.
c. I might consider it.
d. I would never consider it.
e. I don't know.
f. Not applicable.

6) How likely are you to utilize living shorelines in your line of work?

a. Not likely at all.
b. Somewhat likely.
c. Very likely.
d. I don't know.
e. Not applicable.

6) How likely are you to utilize living shorelines in your line of work?

a. Not likely at all.
b. Somewhat likely.
c. Very likely.
d. I don't know.
e. Not applicable.

7) What, if any, are the obstacles keeping you from utilizing a living shoreline (either personally or professionally)?

a. Cost
b. Permitting
c. Timeframe to implementation
d. Lack of knowledge
e. All of the above
f. I don't know
g. Not applicable

8) Of the living shorelines tools available, which are you most likely to use?

a. A Guide to Living Shorelines in Texas (GLO)
https://cleancoast.texas.gov/documents/guide-to-living-shorelines-texas.pdf
b. TX Living Shoreline Site Suitability Tool (HRI)
https://storymaps.arcgis.com/stories/d6989e741253424584c06ead83078c5d
c. New Living Shorelines Website (GLO)
www.glo.texas.gov/livingshorelines
d. All of the above
e. None of the above
f. I don't know

9) Were you aware these living shorelines tools existed before attending the Dine & Discuss Event or Virtual Workshop?

a. Yes
b. Maybe
c. No

10) If you attended a ***Dine & Discuss Event***, what did you find most beneficial/effective?

a. In-person networking
b. Presentation content
c. Q&A session
d. List of tools and resources provided
e. All of the above
f. None of the above
g. I don't know
h. Not applicable

11) If you attended the ***Virtual Workshop***, what did you find most beneficial/effective?

a. Presentation content
b. Q&A session
c. List of tools and resources provided
d. All of the above
e. None of the above
f. I don't know
g. Not applicable

12) Would you be interested in attending future Living Shorelines Events?

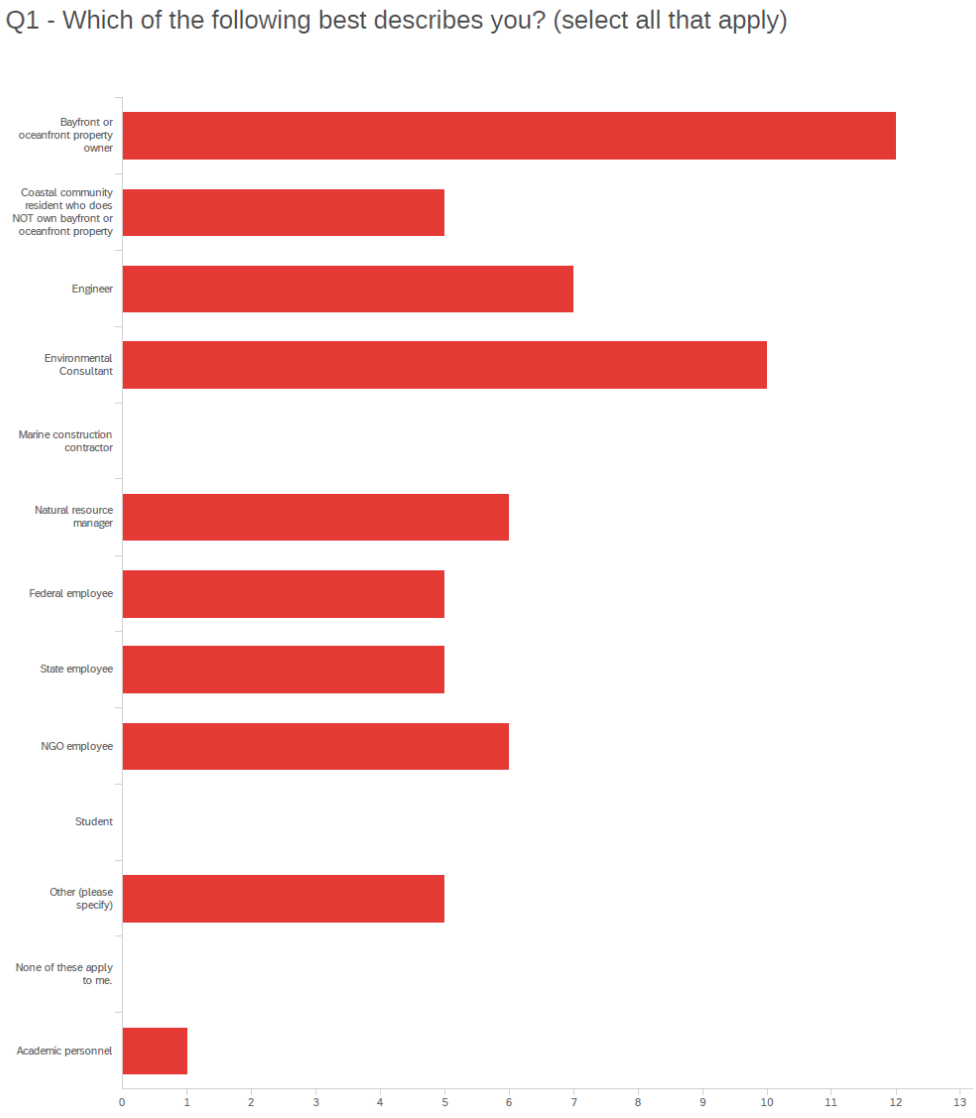
a. Yes
b. Maybe
c. No

13) If yes, what sort of additional Living Shoreline information would you like to learn more about?

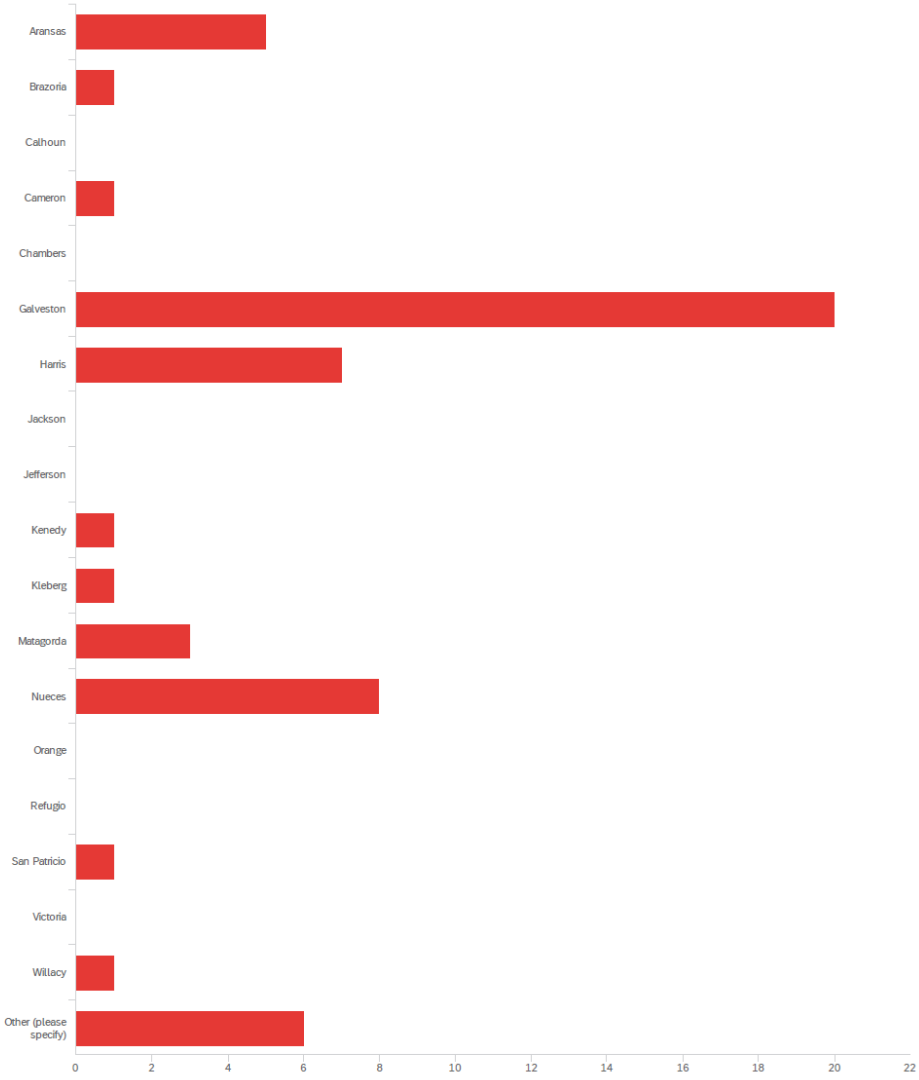
14) Any additional comments or suggestions you'd like to add?

Appendix V: Workshop Survey Results

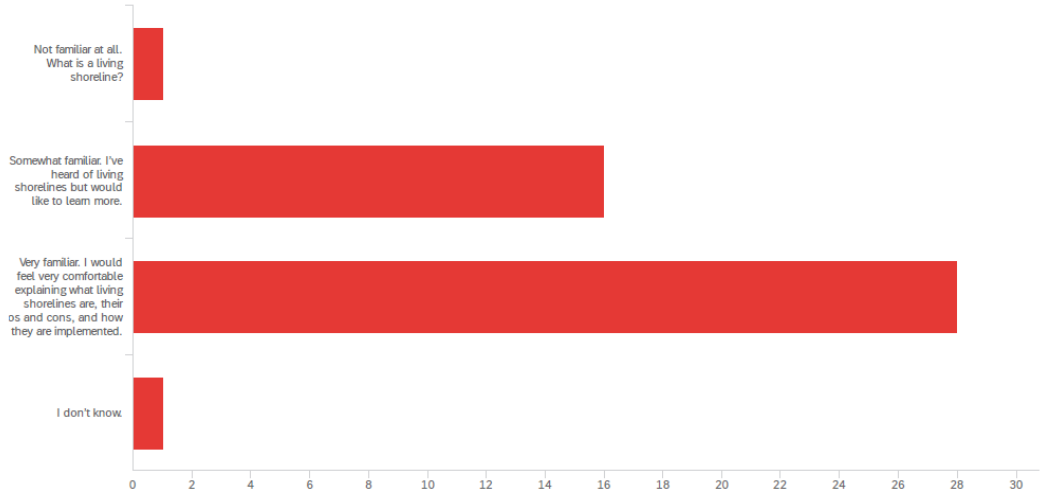
Field	Min.	Max.	Mean	Standard Deviation	Variance	Responses
Q_RecaptchaScore	0.40	1.00	0.95	0.10	0.01	54



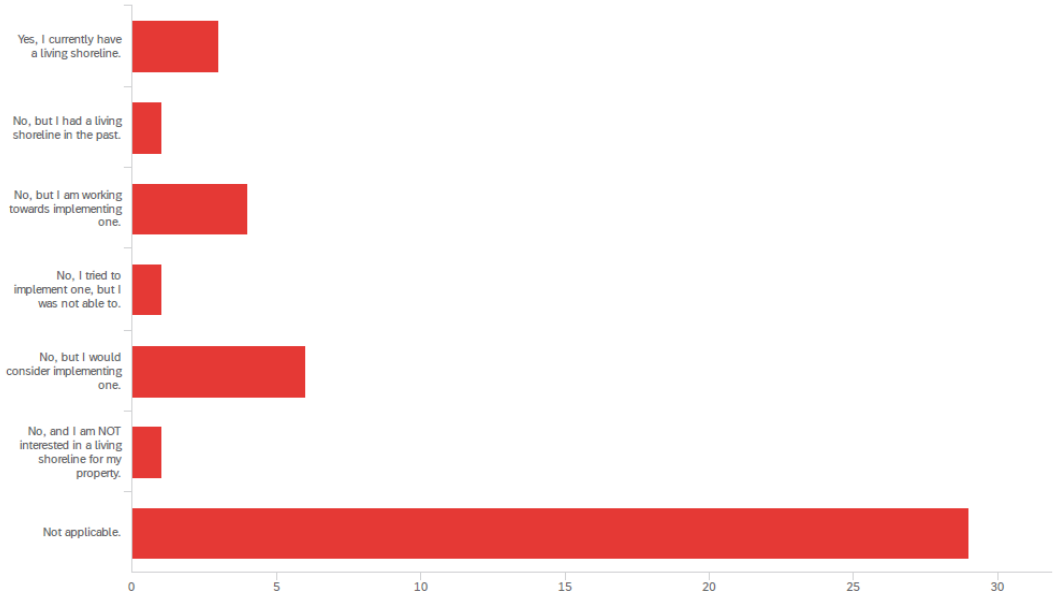
Q2 - In which county(ies) do you live and/or own property? (select all that apply)



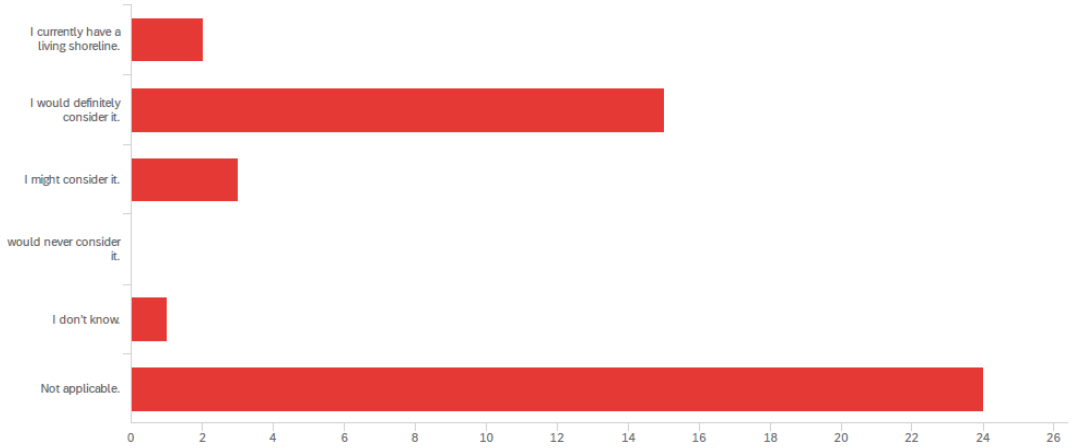
Q3- How familiar are you with living shorelines?



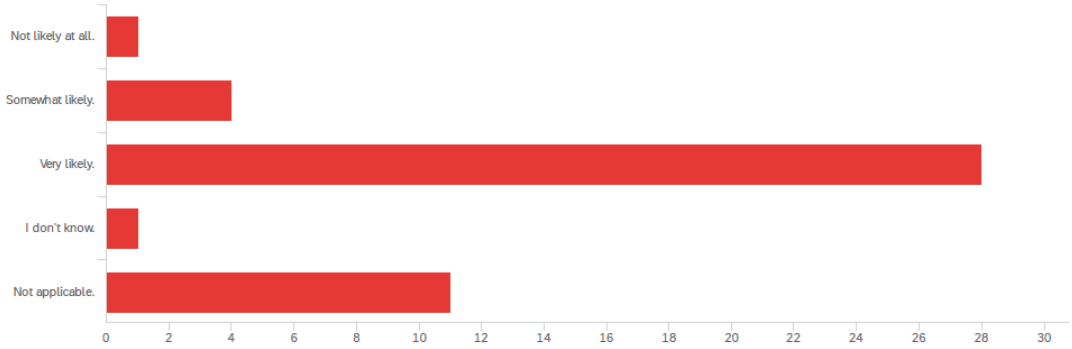
Q4- Do you currently have a living shoreline on your bayfront or oceanfront property?



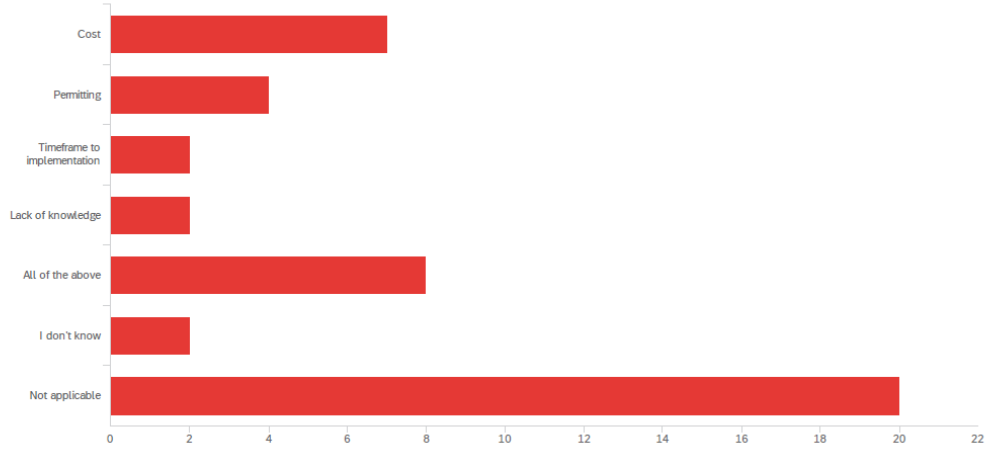
Q5 - To what degree would you consider a living shoreline to protect your bayfront or oceanfront property



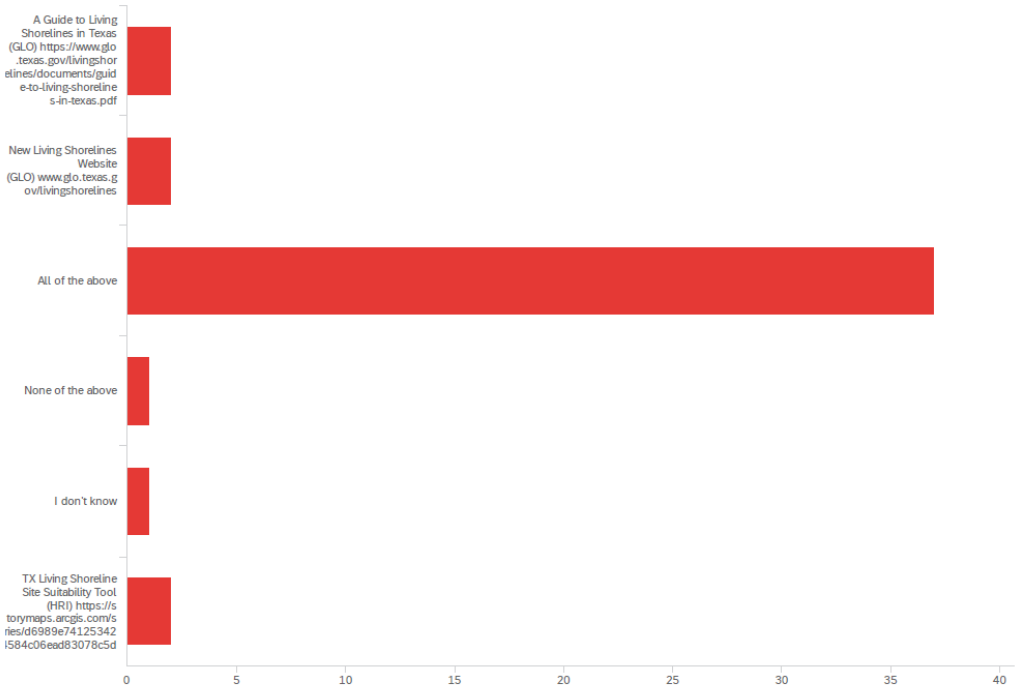
Q6 - How likely are you to utilize living shorelines in your line of work?



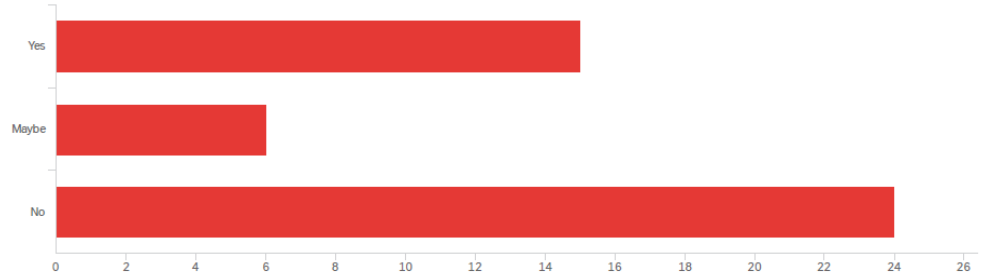
Q7 - What, if any, are the obstacles keeping you from utilizing a living shoreline



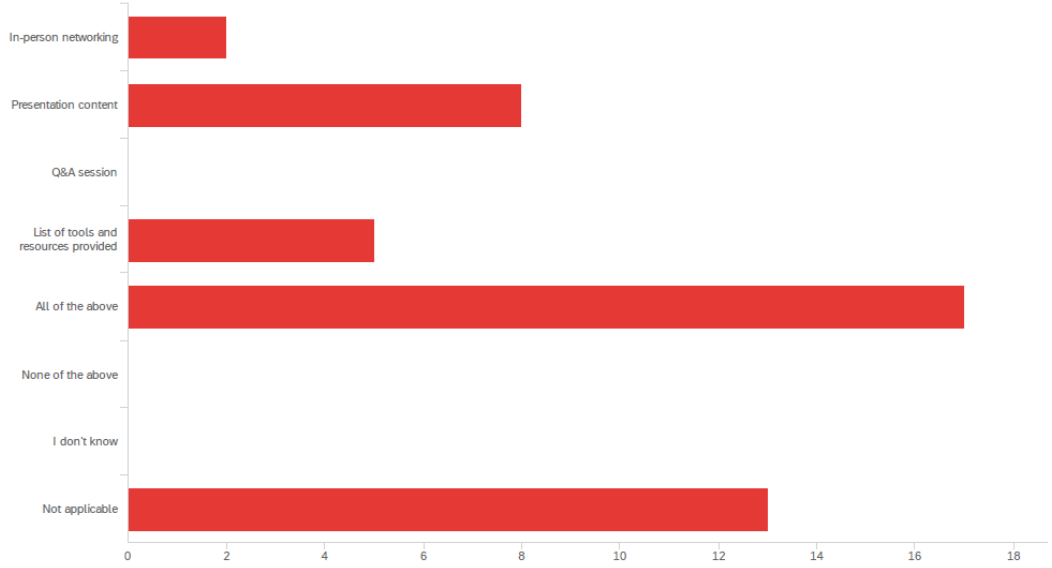
Q8 - Of the living shorelines tools available, which are you most likely to use?



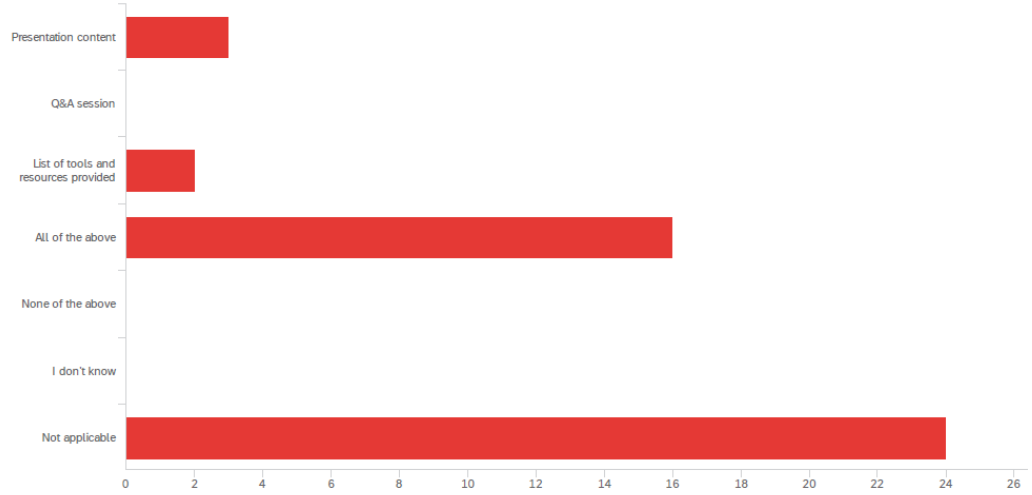
Q9 - Were you aware these living shorelines tools existed before attending a workshop?



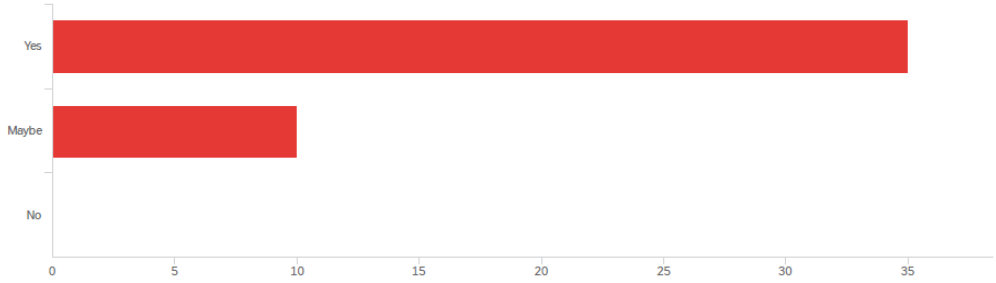
Q10 - If you attended a Dine & Discuss Event, what did you find most beneficial/effective?



Q11 - If you attended the Virtual Workshop, what did you find most beneficial/effective?



Q12 - Would you be interested in attending future Living Shorelines Events?



Q13 - If yes, what sort of additional information would you like to learn more about?

If yes, what sort of additional information would you like to learn more ab...
How to implement the concept without spending a fortune trying to meet all the regulation, plus the fact that constant ship channel waves make a serious challange to working; not a simple tasktant
More case studies.
Upcoming projects around Texas and example projects
post construction monitoring and performance of structures
Information related to the construction of the different types of LS such as construction constraints, cost analysis, modeling, any typical geotechnical needs, suitable sediments, etc.
hearing what challenges the public is having.
As much as possible.
funding sources!
The biology of plant species to use in a project and where to locate those plants. How to use a living shoreline to enhance the aesthetics of the site or even create an "artiistic edge" to a project. How to make a living shoreline appear to be as natural as possible.
Larger projects >20 acres
mangrove trees
success in high energy areas
help with cost
Gulf Intracoastal Water Way interactions with shorelines
Materials used, Details about successful projects, Obstacles with approvals and how they were cleared
Cost effective practices
Volunteerism. I really thought that the presentation was going to include a call for volunteers.
easier implementation process; streamline bureaucracy
Actual living shoreline tour.
Is it feasible on a High-Impact shoreline?
cost
Differing opinions from regulatory agencies on what qualifies as a living shoreline.
grants for private landowners
Current projects or examples of new techniqued

Q14 - Any additional comments or suggestions you'd like to add?

Any additional comments or suggestions you'd like to add?
try to get the various "approval" agencies to implement a healthy dose of common sense
targeting industry and port managers would be good to have them attend as well
It was a pleasure attending! I thoroughly enjoyed the discussion topics. Great job!
Thank you for a great event!
I'm really glad you folks are doing this. Thanks.
Please thank all the speakers for donating their time! It was a very informative workshop!
N/A
n/a
no
I would like to see Living Shoreline initiatives and resources expanded to inland waters. Thank you for the opportunity to provide feedback. Best,
It was a very educational workshop i learned a lot l
great information
Good job!
Very well-organized and planned event. Excellent presentation quality.
Thank you for giving the presentation. It allowed us to start thinking how we can help our property while living in Bayou Vista.