

FLORIDA KEYS COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

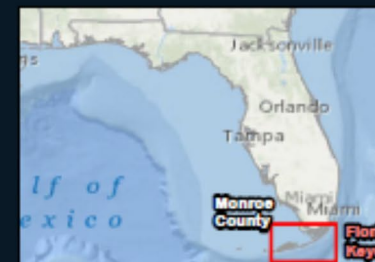


US Army Corps
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Florida Keys National Marine
Sanctuary Steering Committee
Meeting

Kimberly Koelsch
U.S. Army Corps of Engineers
April 18, 2019



Study Authority



This study is focused on reducing the potential damages caused by coastal storms. The study will focus on improving safety and reducing the risk of damages to buildings and other infrastructure.

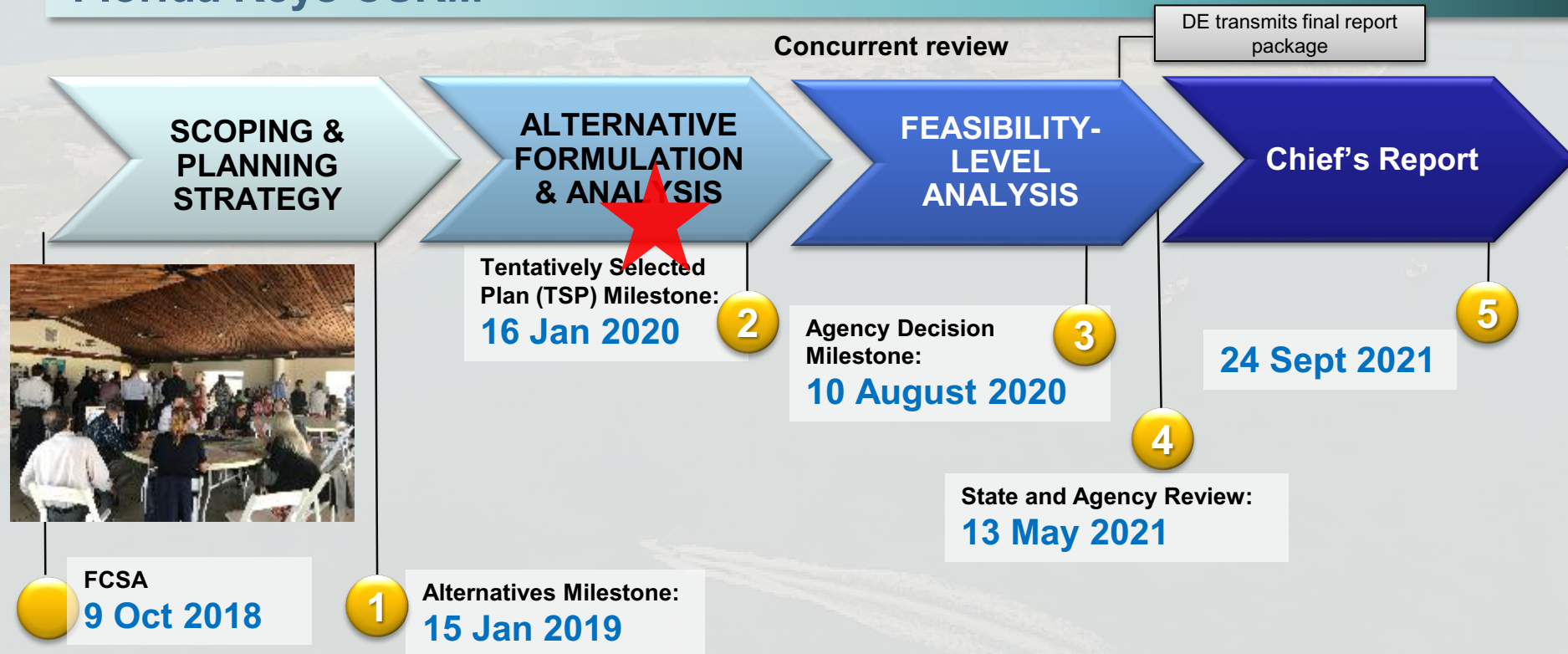
The study authority is Public Law 84-71, June 15, 1955.

Study Purpose

An aerial photograph of a coastal area. In the foreground, a long, multi-lane concrete bridge spans across a body of water. The water is a deep blue-green color. In the middle ground, a road with a median runs parallel to the bridge. To the left of the road, there is a small island or peninsula with some buildings and trees. In the background, the water is a lighter turquoise color, and there are more islands and structures visible. The sky is clear and blue.

The Florida Keys CSRM Feasibility Study will investigate solutions that will reduce damages and risks from coastal storms.

SMART Feasibility Study Process & Schedule: Florida Keys CSRM



Planning Process

- **3x3x3 Planning Process – No more than 3 years, 3 million dollars, and efficient/effective coordination among 3 levels of U.S. Army Corps of Engineers governance**
- **Process and outputs are decision focused, and within the 6 step planning process**
- **Risk and uncertainty for each decision is acknowledged and appropriate level of details is managed**
- **Report developed from the beginning of the study, documenting the decisions**

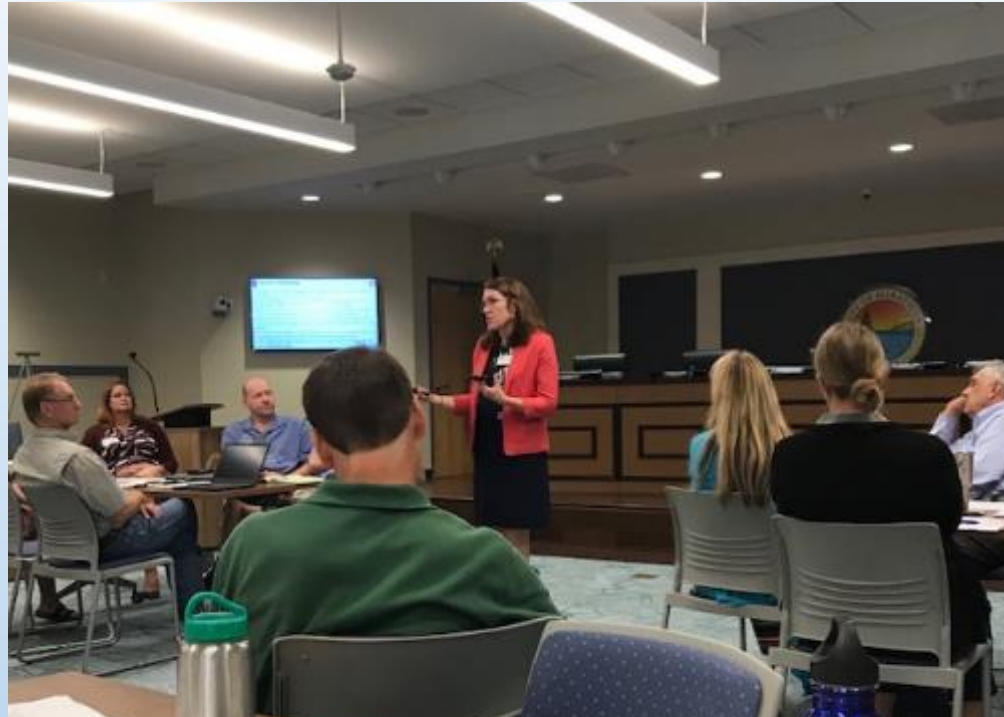
Study Overview

- **Coastal Storm Risk Management Feasibility Study will assess storm damage and risk within the Florida Keys**
- **100% Federally funded**
- **Study will consider multiple alternatives**
- **A project will be recommended for construction as the study outcome + +**
- **Monroe County is the non-Federal sponsor that will ultimately share part of the cost of implementing a project that is recommended by this study**



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Gathering Stakeholder Input



Study Charrette: Marathon, FL November 14, 2018

Attendees included: Monroe County, FDOT, FDEP, NOAA, 4 of the 5 municipalities, University of Florida, FL Keys Aqueduct Authority, Key Largo Wastewater Treatment District, FL Keys Mosquito Control District

NEPA PUBLIC SCOPING MEETINGS

Gathered public and stakeholder input at three NEPA Public Scoping Meetings:

Key West – December 3, 2018

Marathon – December 4, 2018

Key Largo – December 4, 2018



PROBLEMS

- Critical infrastructure is at risk to the effects of coastal storms.
- Critical transportation routes, specifically U.S. Route 1, is at risk to the effects of coastal storms.
- Structures (commercial and residential), are at risk to the effects of coastal storms
- Utilities including water, wastewater, electricity, phone, etc. are at risk to the effects of coastal storms and are essential for human health and safety.
- There are rich environmental resources that are at risk to the effects of coastal storms. Some of these resources, mangroves for example, provide a reduction in the effects of coastal storms on the study area and their loss increases the risk to the built environment and life safety.

OPPORTUNITIES

- Reduce economic damages from coastal storms and coastal flooding
- Reduce the risks to human life, health, and safety
- Reduce the impacts of coastal storms on Route 1
- Improve the resilience of the Florida Keys to the impacts of coastal storms and flooding (Note: the USACE principles of resilience are Prepare, Absorb, Recover, and Adapt)
- Utilize nature based features and/or restoration of the natural coastal system of defenses
- Improve floodplain management
- Improve existing canal system
- Sediment management
- Possible benefits to the Department of Defense facilities located in the vicinity

OBJECTIVES

- Reduce economic damages from coastal storms and coastal flooding to the natural and built environment in the Florida Keys.
- Reduce the coastal storm risk to human life, health, and safety to the population in the Florida Keys.
- Improve the resilience of the Florida Keys to the impacts of coastal storms and flooding.

CONSTRAINTS

- Avoid creating or exacerbating flooding within the project area and to local military installations
- Minimize impacts to environmental and cultural/historic resources in the study area and nearby (e.g. National Marine Sanctuary)
- Avoid the large amount of protected and Federal land within the study area

Florida Keys CSRM Feasibility Study Recommendations
will be a combination of:

Structural
Measures



Nonstructural
Measures



Natural and
Nature-Based
Features

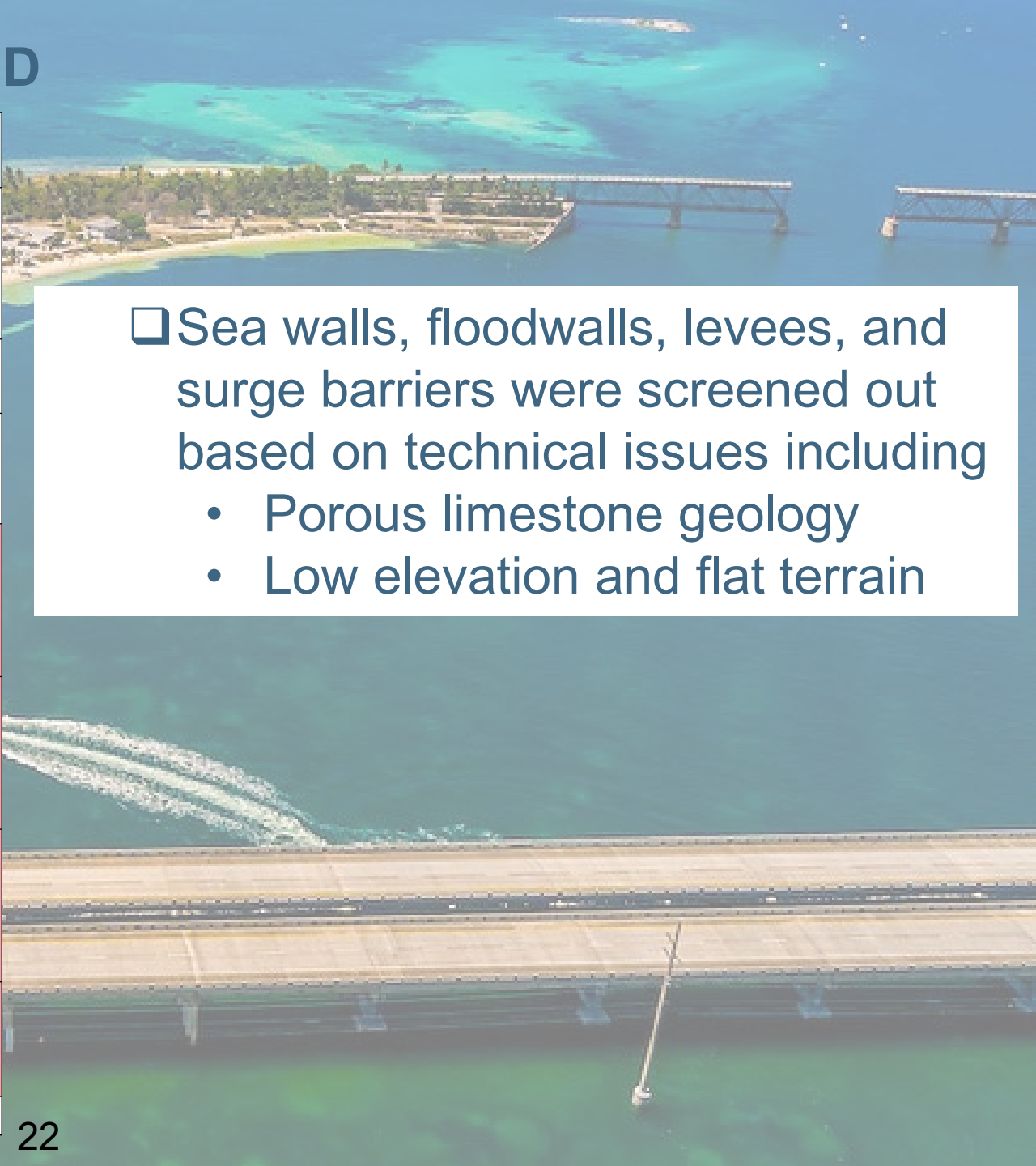
MEASURES

- ❑ Suite of measures developed with input from the sponsor and key stakeholders
- ❑ The suite of measures was initially screened using various qualitative factors, including:
 - Does the measure provide a relative measure of coastal storm risk reduction?
 - Is the measure technically feasible considering the study area characteristics?
 - Is the measure sustainable and an economically efficient method of coastal storm risk reduction for the Florida Keys?

STRUCTURAL MEASURES CONSIDERED

Measure	Notes	Carried Forward?
Breakwaters	The National Marine Sanctuary does not prohibit the construction of breakwaters, but they must be coordinated with to ensure placement is acceptable	Y
Shoreline Stabilization		Y
Canal Improvements	Includes shoreline stabilization, debris removal, and dredging or filling as appropriate	Y
Sea Walls	Screened out due to engineering limitations of porous limestone geology and extensive shoreline length which would be cost prohibitive.	N
Floodwalls	Screened out due to engineering limitations of porous limestone geology and extensive shoreline length which would be cost prohibitive.	N
Levees	Screened out due to engineering limitations of porous limestone geology and extensive shoreline length which would be cost prohibitive.	N
Storm Surge Barriers	Screened out due to flat and low topography that does not provide high ground for surge barrier tie in	N
Beachfill/Dunes		Y

- Sea walls, floodwalls, levees, and surge barriers were screened out based on technical issues including
- Porous limestone geology
 - Low elevation and flat terrain



NONSTRUCTURAL MEASURES CONSIDERED

Measure	Notes	Carried Forward?
Buyout/ Acquisition		Y
Elevation	Includes residential structures and roadways that serve as evacuation routes	Y
Dry/Wet Floodproofing		Y
Warning Systems		Y
Emergency Planning		Y
Land Use Planning	Includes floodplain development restrictions, building code and zoning updates, etc.	Y

- All nonstructural measures were carried forward to be included in initial array of alternatives
- Geologic/technical limitations on the applicability of some structural measures indicates that nonstructural will be a significant component of any plan to reduce risk to structures in vulnerable areas

NATURAL AND NATURE BASED FEATURES (NNBF) CONSIDERED

Measure	Notes	Carried Forward?
Beachfill/Dunes		Y
Mangrove Restoration/Creation		Y
Reef Habitat Restoration/Creation	Includes coral reef	N
SAV Restoration/Creation		Y
Living Shorelines		Y
Drainage Improvements/Water Storage Features		N

- Due to the rich environmental resources and protected lands in the study area vicinity, there is a desire by the sponsor and stakeholders to use NNBF whenever feasible
- NNBF measures will only be included in plans if able to provide measurable CSRSM benefit

PRELIMINARY NNBF SCREENING



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KWK 2020

Supplemental Planning Studies - South Florida
Monroe County - Key West



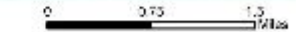
Map: Monroe County, FL NNBF
Developed by: Jenny-Kristie
Date: 4-12-20 9





Supplemental Planning Studies - South Florida

Monroe County - Cudjoe Key



Map: Monroe County DD: NNEF
 Developer: Jy. Tammy Kase
 Date: 4/15/2019



DRAFT METHODOLOGY FOR THE IDENTIFICATION OF MANGROVE RESTORATION AREAS

Identification of Mangrove Restoration Areas:

The PDT will identify potential restoration areas targeted for the Red mangrove (*Rhizophora mangle*) unless shallower areas are identified. A GIS analysis will cross reference historical damages and vulnerability with the following:

- Topography and Bathymetry of area
- Wave Dynamics/velocities
- Bottom Composition
- Tidal prism of restoration area
- Terrestrial inputs of water, sediments, and nutrients
- Upslope Land Use
- Submerged Aquatic Vegetation Habitat
- Historical Mangrove Data
- Existing Mangrove Habitat and population distribution

MANGROVE HABIT SUITABILITY ANALYSIS

The goal is to identify areas of potential mangrove restoration in the Florida Keys Study area that could serve to reduce coastal storm risk in high damage areas.

Questions to be answered:

- What areas in the Florida Keys are in need of mangrove restoration that historically contained mangroves?
- Are there areas of mangrove loss that now contain Submerged Aquatic Vegetation? (do not want to impact existing protected resources)
- What parameters should be assessed to identify potential mangrove restoration sites (absence of SAV, bathymetry, bottom type/suitability, area of historical loss, etc.)?
- Are there additional data sets or reports available to assist with this analysis?
- Historic data layer? Historic time frame?
- Are existing mangrove models/tools available suitable for the analysis? (e.g. TNC and IUNC)

NATURE-BASED BENEFITS DECISION-SUPPORT

The goal of this simulation is to assess how Natural and Nature-based Features (NNBFs) (e.g. mangroves, SAV, etc.), combinations of NNBFs, or NNBFs in combination with structural and/or non-structures features could reduce coastal storm risks.

Questions to be answered:

- Can we use an existing tool/models/analyses? (CH2M and The Nature Conservancy 2017; Narayan 2016; Cuc et al. 2015; Pinsky et al. 2013; Zhang et al. 2012 – mangroves – DEM/wind)
- What parameters should be used to build the model (wave height attenuation reduction, reduction in storm surge amplitude, dimensions of NNBFs, etc.)
- Model weighting: synergistic benefits of multiple NNBFs (e.g. coral reef + SAV + mangrove)?
- How will this be integrated with the economic modeling and assumptions?
- Can we integrate this with an social effects analysis (ecosystem services, recreation, etc.)?

PLAN FORMULATION STRATEGIES

Measures carried forward from the initial screening were combined into alternative plans that would address the following plan formulation strategies or combinations thereof:

- Reduce coastal storm risk along the Route 1 corridor. Specifically, reduce damage to the roadway and address any other infrastructure that is located immediately along Route 1 to reduce the risk to life safety by improving the functionality of the singular evacuation route from the Keys and maintaining connectivity between the islands.
- Reduce coastal storm risk to critical infrastructure. Critical infrastructure includes emergency services (fire, police, EMS), key utilities (communications, power, water, wastewater/sewer), emergency shelters, etc.
- Reduce coastal storm risk to population and development centers. Specifically, reduce life safety risk and damage to structures in vulnerable areas.

INITIAL ARRAY OF ALTERNATIVES

Alternative	Description
1	Route 1 Corridor
2	Critical Infrastructure
3	Population/Development
4	Combo Alts 1 + 2
5	Combo Alts 1 + 3
6	Combo Alts 2 + 3
7	Combo Alts 1 + 2 + 3
8	No Action

Residual risk would be lower in combination plans than in alternatives 1-3

DECISION CRITERIA

- Damages prevented/reduced
- Estimated cost
- Life safety benefits
- Environmental impact or improvement
- Regional Economic Development benefits/impact
- Recreation benefits
- Other Social Effects
- Resilience

RESIDUAL RISK

- **Generally the elevation across the Keys is very low which makes it difficult to protect against a major hurricane**
- **Structural measures are limited in applicability, maximum heights for structure elevation may limit risk reduction**
- **Portion of the county on the mainland and Federal land will remain vulnerable**
- **State and County nature preserves will also remain vulnerable if undeveloped**

FEASIBILITY STUDY MILESTONE SCHEDULE

Signing of Feasibility Cost Share Agreement (CW130)	09 Oct 2018 (A)
Alternatives Milestone (CW261)	15 Jan 2019 (A)
In Progress Review (Final Array)	08 May 2019 (S)
In Progress Review (Preliminary Economics)	15 Aug 2019 (S)
Tentatively Selected Plan Milestone (CW262)	16 Jan 2020 (S)
Release of Draft Study for Concurrent Reviews (CW250)	10 Mar 2020 (S)
Agency Decision Milestone (CW263)	10 Aug 2020 (S)
Submit Final Report Package to Vertical Team (CW160)	13 May 2021 (S)
Signed Chief's Report (CW270)	24 Sep 2021 (S)

NEXT STEPS:

- Complete the structure inventory
- Finalize Alternatives
- Model the Future Without Project (FWOP) Condition
- Develop parametric costs for each Alternative
- Complete a comparison of FWOP damages to parametric costs for Alternatives
- Economic modeling of project alternatives
- Recreational benefits analysis
- Refine costs and economic modeling to identify National Economic Development (NED) Plan
- Coordinate with Monroe County on NED plan, identify if Locally Preferred Plan may be requested
- Cultural and environmental resource surveys
- Complete our recommendation for the Tentatively Selected Plan (TSP)



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Questions or Comments?

Contact: Kimberly Koelsch, Environmental Lead

Rachel Haug, Planning Lead

USACE Norfolk District

803 Front Street

Norfolk, Virginia 23510

phone: (757) 201-7837

Emails: Kimberly.C.Koelsch@usace.army.mil

Rachel.l.haug@usace.army.mil

BACK UP SLIDES

ALTERNATIVE 1: ROUTE 1 CORRIDOR

- ❑ Address the areas along the Route 1 corridor that have been identified as vulnerable to inundation and/or damages due to coastal storms.
- ❑ The measures would reduce impacts on the roadway itself and also any other structures and utilities that are collocated along the roadway that are necessary for evacuation prior to and during a coastal storm event.
- ❑ The Florida Department of Transportation (FDOT) is currently finalizing a vulnerability assessment for Route 1 and this study will be used to refine the location and utilization of the following measures:
 - Road elevation
 - Floodproofing
 - Shoreline stabilization
 - Beachfill/Dunes
 - NNBF



ALTERNATIVE 2: CRITICAL INFRASTRUCTURE

- ❑ Address the risk to critical infrastructure that is identified as vulnerable to damage due to coastal storms.
- ❑ Monroe County developed an inventory of critical infrastructure in the GreenKeys study and this will be used to assist in the identification of vulnerable infrastructure.
- ❑ The following measures have been identified as effective in meeting the goal of the plan formulation strategy:
 - Floodproofing
 - Elevation
 - Shoreline Stabilization
 - NNBF

ALTERNATIVE 3: POPULATION/DEVELOPMENT

- ❑ Address the areas of development and/or where there is population vulnerable to damage due to coastal storms.
- ❑ Repetitive loss data was used initially to identify areas of development/structures that are at risk and the location/applicability of the following measures:
 - Buyout/Acquisition
 - Elevation
 - Dry/Wet Floodproofing
 - All Other Nonstructural Measures
 - Shoreline Stabilization
 - Beachfill/Dunes
 - NNBF

MANGROVE SCREENING METHODOLOGY

Screening Methodology: Data and potential areas will be evaluated using the following criteria:

- Depth less than 4 feet
- Federal and Municipal channels
- Private channels
- Boat marinas, docks
- Hard Structure Inventory (presence of riprap, sea wall, bulkheads, etc.)
- Existing Reefs
- FDOT easements/Rights of Way
- Marine Sanctuary Management Areas
- Availability of Real Estate
- Previous or planned Mitigation Sites

GIS DATA SOURCES

Source of Data: Organization and Website	Title of Data & Date	Applicable Resource	Rationale/Needs
South Florida Water Management District, developed using Florida Division of Emergency Management LIDAR	File name: Keys_5ft DEM 2007	Elevation data	
Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research institute, downloaded from FGDL	Unified Florida Coral Reef Tracts, File File name: REEFTRACT_JAN17 Hard Bottom Data 2013 Seagrass composite (1987-2016)	Reefs (hard bottom data, artificial and natural reefs, mangroves, seagrasses, sediment)	Existing conditions of reefs. Shows coverage of benthic habitats across Florida reef tract
Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research institute, downloaded from FGDL	Sea Turtle Nesting Areas in Florida, File Name: SEA_TURTLE_BCH_DEC17 Composite layer (1979-2017)	Sea turtle nesting beaches	Identifies areas where sea turtle nesting occurs
Florida Department of Transportation	Bridges, File name: Monroe_County_Bridges		Identifying moderate and high risk areas
Florida Department of Transportation	Pavement Condition – December, 2018, Monroe_Pavement_Conditions		Identifying moderate and high risk areas
Division of Marine Fisheries Management, downloaded from FGDL	Artificial Reeds in Florida – March File name: 2018, ARTREF_Mar18	Artificial reefs	Identify existing artificial reefs
Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute	Coastal Barrier Resources System (CBRS) Approximate Polygons for Florida- March 2018, File name: CBRS_MAR18	Protected coastal areas	Identify areas that are protected by the Coastal Barrier Resources Act (CBRA)
US Fish and Wildlife Service	National Wetlands Inventory- Version 2 (2018) Cowardin Classifications	Wetlands	

Source of Data: Organization and Website	Title of Data & Date	Applicable Resource	Rationale/Needs
U.S. Fish and Wildlife Service, National Wetlands Inventory	National Wetlands Inventory Polygons in Florida – Surface Waters and Wetlands, File name: NWIP_V2_MAY18	Wetlands	Identify wetlands
U.S. Fish and Wildlife	File name: Mangrove_Habitat_in_Florida	Mangrove	Locate mangrove habitat areas
U.S. DOT, Bureau of Transportation Statistics, Federal Aviation Administration	Airports in Florida- 2017 File name: Airports_2017		Identify airports
Florida Department of Health	Beach Water Monitoring Locations in Florida – February 2016 File Name:BEACHWTR_FEB16	Water	Identify beach water monitoring areas
Florida Department of Environmental Protection	Brownfield Areas in Florida – February 2016 File Name: BROWNFIELDS_AREAS_FEB18		Identify brownfield sites
University of Florida GeoPlan Center	Detailed Shoreline – September 2015 Filename: countyshore_areas_sep15	Shorelines	
Created by FPMS using a depth grid for the 100-yr floodplain, the DEM above, and FEMA’s National Building Inventory. There are two layers for four sections of the Keys, one layer represents depreciated replacement costs and one represents full replacement costs.	HAZUS layers (8 total)		Identify areas that receive high damages from a 100-year storm, aggregated by census blocks
Downloaded from FEMA Map Services Center	NFHL	Floodplains	Identify areas in the 100-yr and 500-yr floodplain
Monroe County, FL GIS (James Gale)	Roads Filename: W_CENTERLINE	Road Infrastructure	

An aerial photograph of a coastal region. In the foreground, a multi-lane highway bridge spans across a body of water. The water is a deep blue-green color. In the middle ground, there is a large, irregularly shaped island or peninsula with a mix of green vegetation and some buildings. To the right, a long bridge extends into the water. The background shows more of the coastline and the open sea. The text "Project Areas Maps" is overlaid in the center of the image.

Project Areas Maps



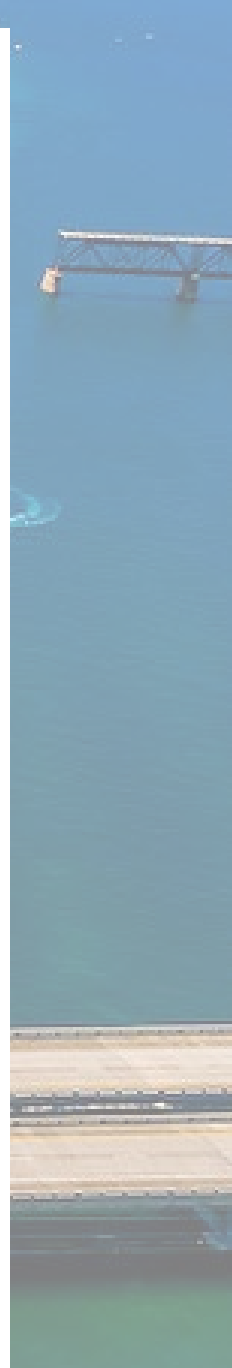
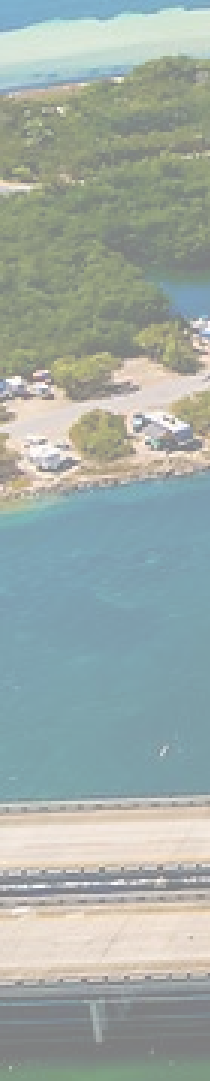
Supplemental Planning Studies - South Florida

Monroe County - Key West

0 0.75 1.5 Miles

Map: MonroeCounty_DD_Haz_Nav_LanUse1
Developer: Tommy K. Koon
Date: 3/13/09





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FLORENCE, FL

Supplemental Planning Studies - South Florida

Monroe County - Middle Keys



0 2 4 Miles

Map: MonroeCounty_DDU_142_Aas_LenUser
Developed by: Jammy Kwock
Date: 3/13/2019







Supplemental Planning Studies - South Florida
Monroe County - Upper Keys

0 3.25 6.5 Miles

Map: MonroeCounty_ILD_Haz_Nav_LatLoc1
 Developed By: Tammy Green
 Date: 3/13/2019

GIS DATA REQUESTS:

Water Depth Data with Shallow Water Contours

Seagrass (SAV) Loss Layer

Mangrove Damage Data (IRMA Data?)

Mangrove Historical Layer