

Monroe County
Resiliency Efforts
Rhonda Haag,
Chief Resilience
Officer



MONROE COUNTY
FLORIDA



wood. ERIN L. DEADY, P.A. 



Agenda for Today

- County's Resiliency and Climate Program
- Roads Elevation Program
- USACE Keys Coastal Risk Study

Sea Level Rise-Related Planning *Completed to Date*

Monroe County's sea level rise planning launched in 2016: GreenKeys

- 5-year work plan, 165 recommendations
- Recommendations included:
 - Pilot Roads Projects
 - Improve elevation data
 - Engineering level analysis of transportation impacts countywide (this Roads Adaptation Project)
 - Numerous other vulnerability recommendations, including updates when significant new data available

Energy and Climate Element of Comprehensive Plan (2016)

Pilot Road Elevation Projects Big Pine and Twin Lakes initiated in 2016 and design/permits completed 2020

Roads Mobile LiDAR elevation data (2019 completed)

Grants for Sea Level Rise planning and projects

- Sands road elevation project – in grant award



Sea Level Rise-Related Planning In Process

Roads Adaptation Plan (Launched 2019)

- Identify sea level rise impacts to roads and drainage comprehensively
- Identify policy and funding options
- Develop engineering alternatives and Implementation Plan

Vulnerability Assessment for other County non-road assets being updated separately for habitat, buildings, and infrastructure

Comprehensive Plan (2021 initiate update)

- Peril of Flood amendments to address State requirements (drafted, RPG 2019)
- Adaptation Action Areas

Pending Grants and Projects in application review

- Twin Lakes roads elevation (State & Fed)
- Regional Roads Adaptation Planning with Municipalities and 6 County Neighborhood evaluations (State)
- Natural Areas Adaptation Plan (State)



Monroe County Roadway Vulnerability Study

GOALS:

- 1) Help make the Keys more able to withstand sea level rise impacts (become more resilient)
- 2) Help maintain access to homes and businesses
- 3) Help protect property values.



King Ave, Key Largo



Sexton Way, Key Largo

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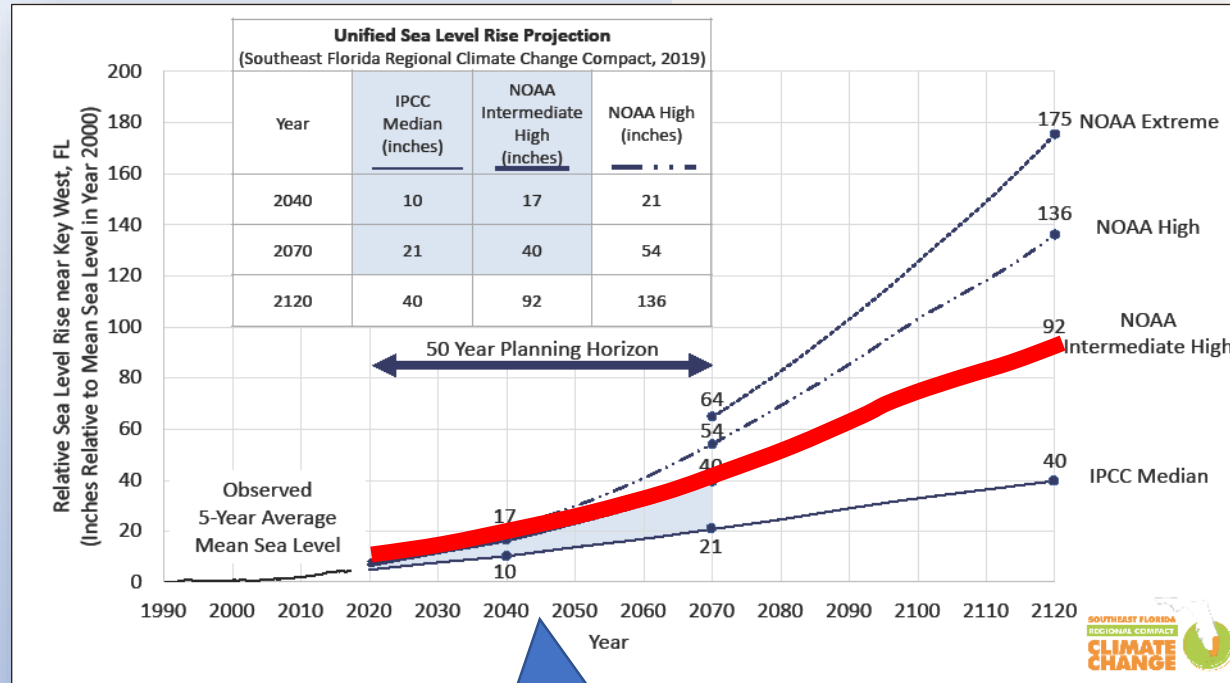


King Ave, Key Largo



Kennedy Drive, Key West

SE FL Regional Climate Compact Updated Projections 2019



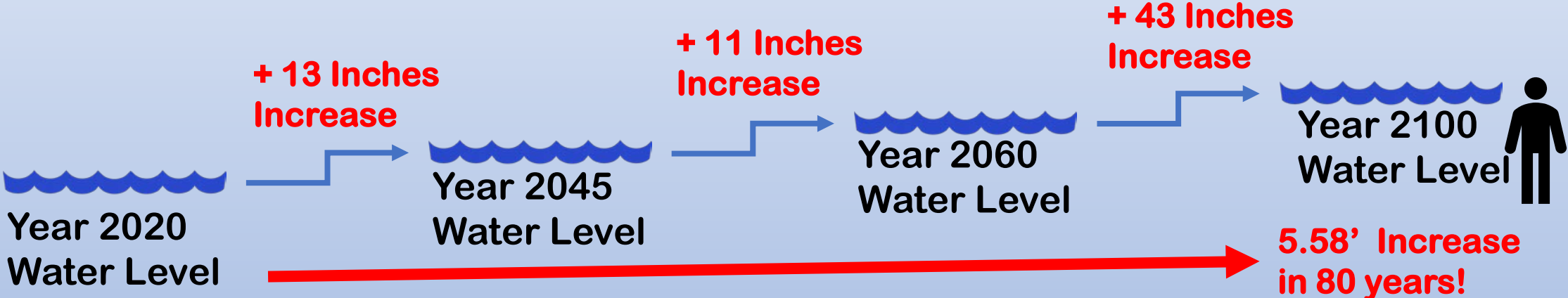
2045	NOAA Tidal Datum (ft) (Relative to 2000 MSL)	SLR Projection (ft)	2045 Water Level Projection (ft) (NAVD88)
NOAA 2017 Int-High (SLR)	0.6037	1.66	2.26
NOAA 2017 Int-High (SLR + King Tide)	-0.6168	4.02	3.40



Monroe County Roadway Vulnerability Study

Increasing Projected Water Levels Throughout County...

SLR Condition: *NOAA 2017 Intermediate-High*





Roadway Vulnerability Assessment – What did it reveal?

Old State Rd 4A (SLR Projection + King Tide measured from Roadway Surface)



Monroe County Roadway Vulnerability Study

Increasing Projected Water Levels Throughout County...

SLR Condition: **NOAA 2017 Intermediate High + King Tides**




Monroe County Roadway Vulnerability Study

Vulnerability and Criticality Evaluation to determine **Initial 25%** of road segments to be further evaluated (remaining 75% addressed later)

 **Task 1:**
Data Collection




 **Task 2:**
Engineering Analysis



 **Task 3:**
Concept Development

 **Task 4:**
Policy Review & Regulations

 **Task 5:**
Stakeholder & Public Outreach

 **Task 6:**
Implementation Plan

Began November 2021
Conceptual Roadway and Drainage Design, Cost Estimates, Environmental /Permitting, Financial Analysis

....IN PROGRESS

Monroe County Roadway Vulnerability Study

What is vulnerability?



What is criticality?



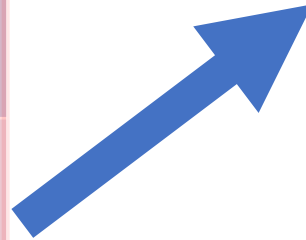
Vulnerability and Criticality
Assessment :
The most critical locations
impacted by
Sea Level Rise + King Tides
for 2045

Recommended Weight Factors to obtain Weighted Averages

STEP 1 = Vulnerability Score

STEP 2 = Criticality Score

Vulnerability Evaluation Factors	Weighting Percentages
Roadway Surface Inundation Depth	60%
Roadway Groundwater Clearance	25%
Roadway Inundation Due to Storm Surge	5%
Roadway Surface Wave Impact Potential	5%
Roadway Existing Pavement Condition	5%



Criticality Evaluation Factors	Weighting Percentages
Vulnerability Score	50%
Number of Residential Units	25%
Roadways Associated with Critical Facilities (Police, Fire, Hospital)	10%
Wetlands/Natural Habitats associated with Road Segment	5%
Roadway Functional Classification and Evacuation Routes	5%
Non-Residential Parcel Building Size (Commercial Buildings)	3%
T&E and Focus Species associated with Road Segment	2%

Monroe County Roadway Vulnerability Study

Initial 25% of Road Segments Based on Preliminary Scoring to proceed to Engineering Concept Design Evaluation

	No. of Keys	Roadway Segments	Sub-Divisions	Length (Miles)	Residential Units
Initial 25%	17	709	240	78.01	8303
All Unincorporated County (100%)	24	2383	260	311.00	17703
Percentage of Total	71%	30%	92%	25%	47%



Monroe County Roadway Vulnerability Study

Increasing Projected Water Levels Throughout County...

SLR Condition: **NOAA 2017 Intermediate-High + King Tides**

\$1.8 Billion*

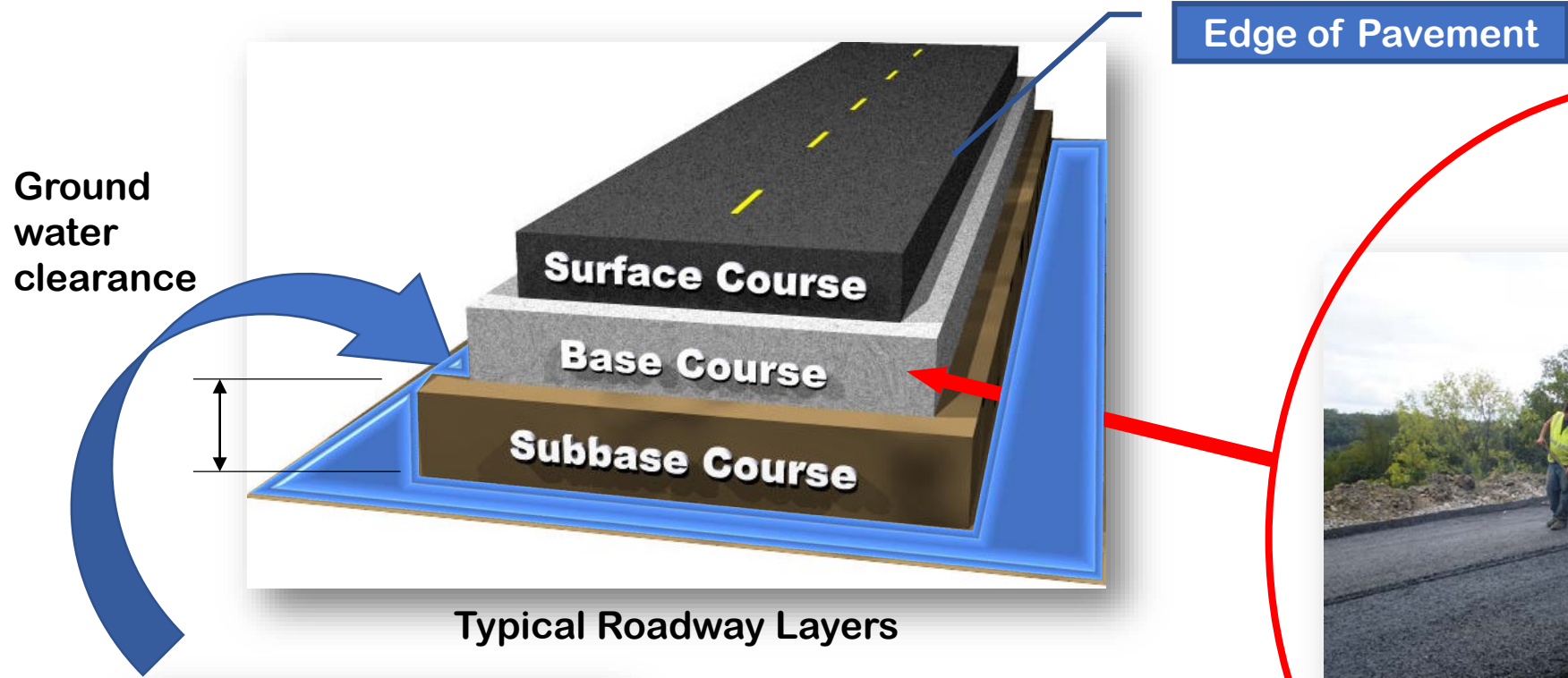
Projected SLR + King Tides will affect the following:	2045	Unincorporated Countywide %	2060	Unincorporated Countywide %	2100	Unincorporated Countywide %
Miles of Vulnerable and Critical County Maintained Roadways	152 MI	49%	206 MI	66%	252 MI	81%
# of Residential Units along County Maintained Roadways	12,585 Res. Units	71%	14,501 Res. Units	82%	16,370 Res. Units	92%

311 Total Road Miles County Wide

* Cost estimate is conceptual and assumes reconstruction of the roadway and use of an injection well system. Cost estimates do not include design, right-of-way acquisition, harmonization/cost to cure, and legal fees. Cost estimates are preliminary and subject to change.

Typical Design Approach

How to make a Roadway more resilient

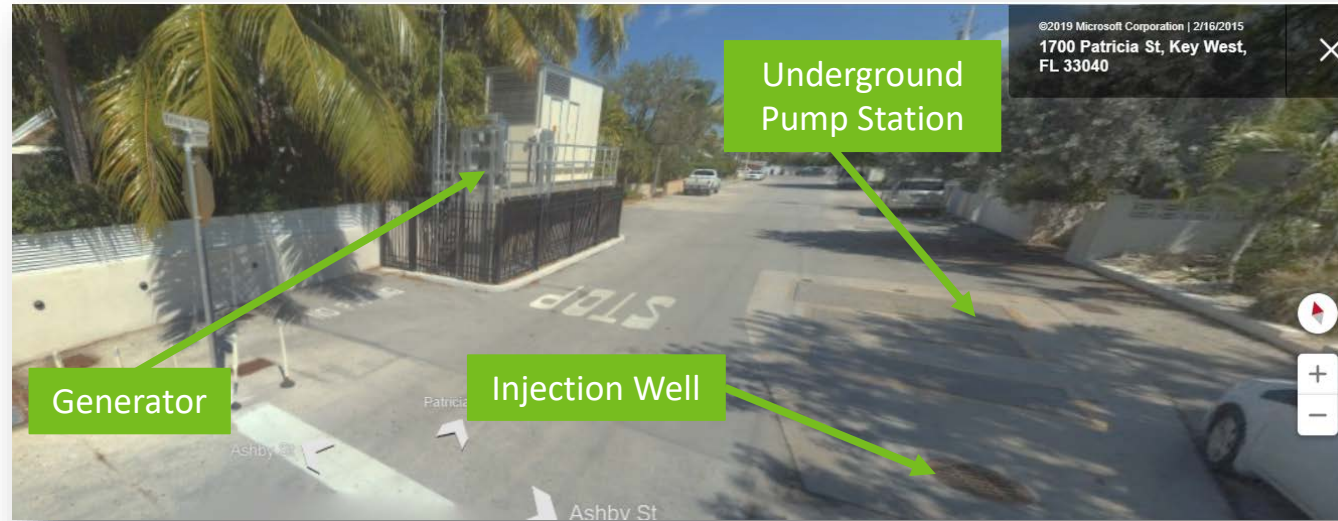


Asphalt "Black" Base Course



Geotextile Reinforcement

Storm Drain Layout – Pump Station Examples



Underground Pump Station Injection Well on Patricia Street, Key West



**Underground Pump Station Injection Well
(No Pump Station building)**

(Romtecutilities.com)

Storm Drain Layout – Pump Station Examples



- **Bungalow-Style House Pump Station**
- **Tampa, FL**
- **\$4.8 Million**

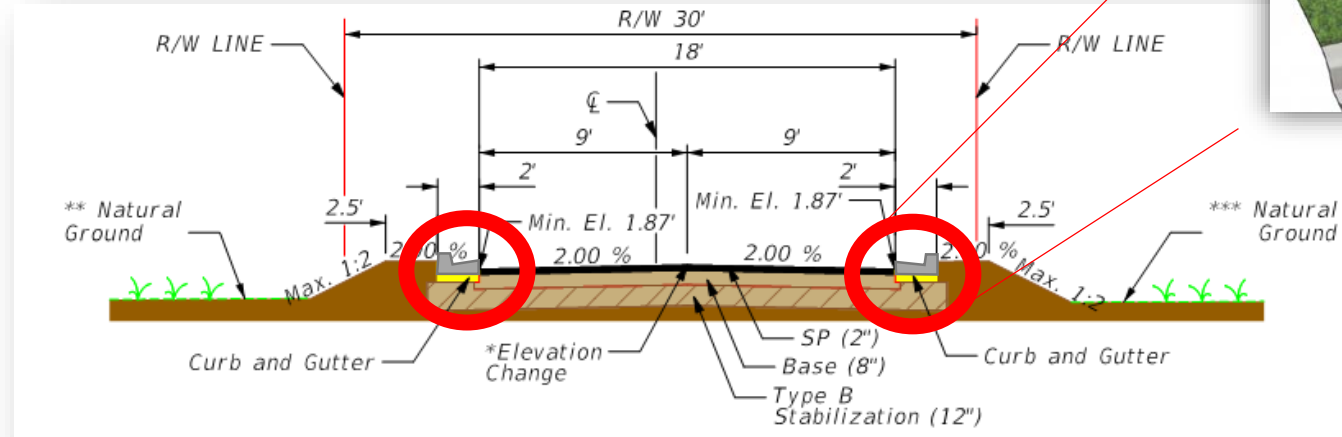
(Tampabay.com)



- **Wade Avenue Pumping Station House**
- **Raleigh, NC**

(atlasobscura.com)

Roadway Typical Sections – Curb and Gutter



Curb & Gutter

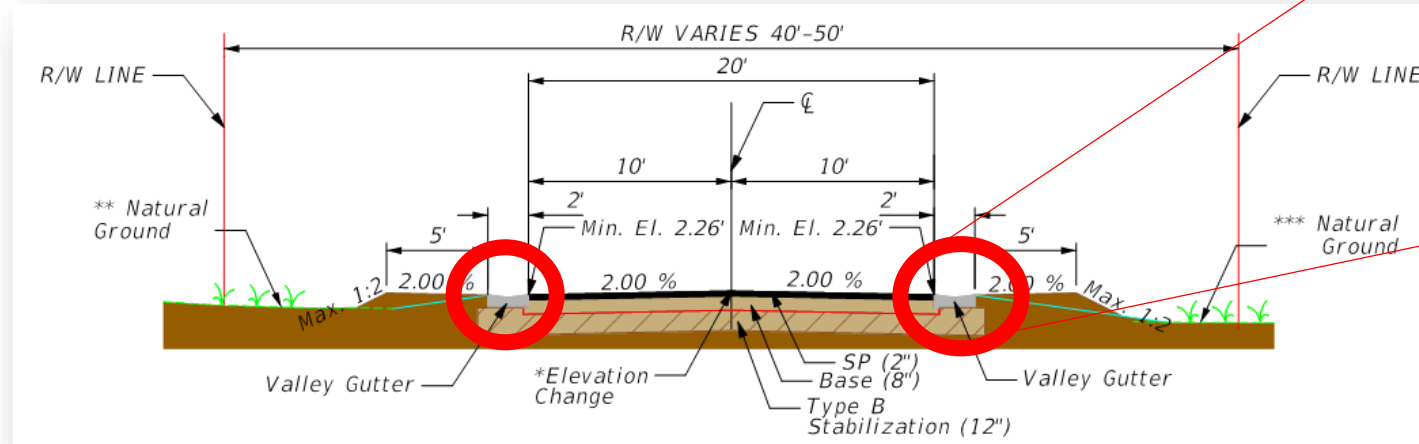


Considered at Stillwright Point – North Drive



Typical Section Example Location

Roadway Typical Sections - Valley Gutters



Valley Gutters

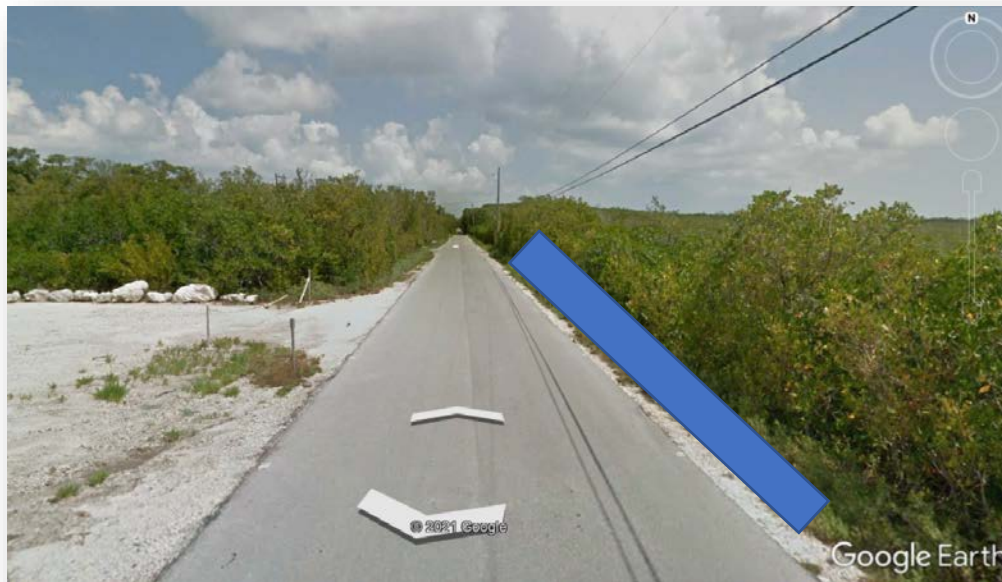
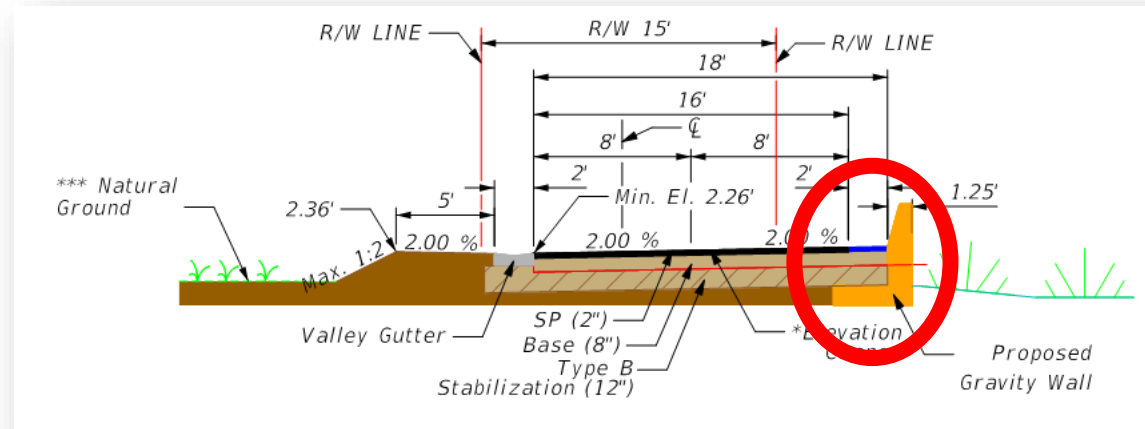


Considered at Hammer Point Park – Cromwell Court



Typical Section Example Location

Roadway Typical Sections – Gravity Wall

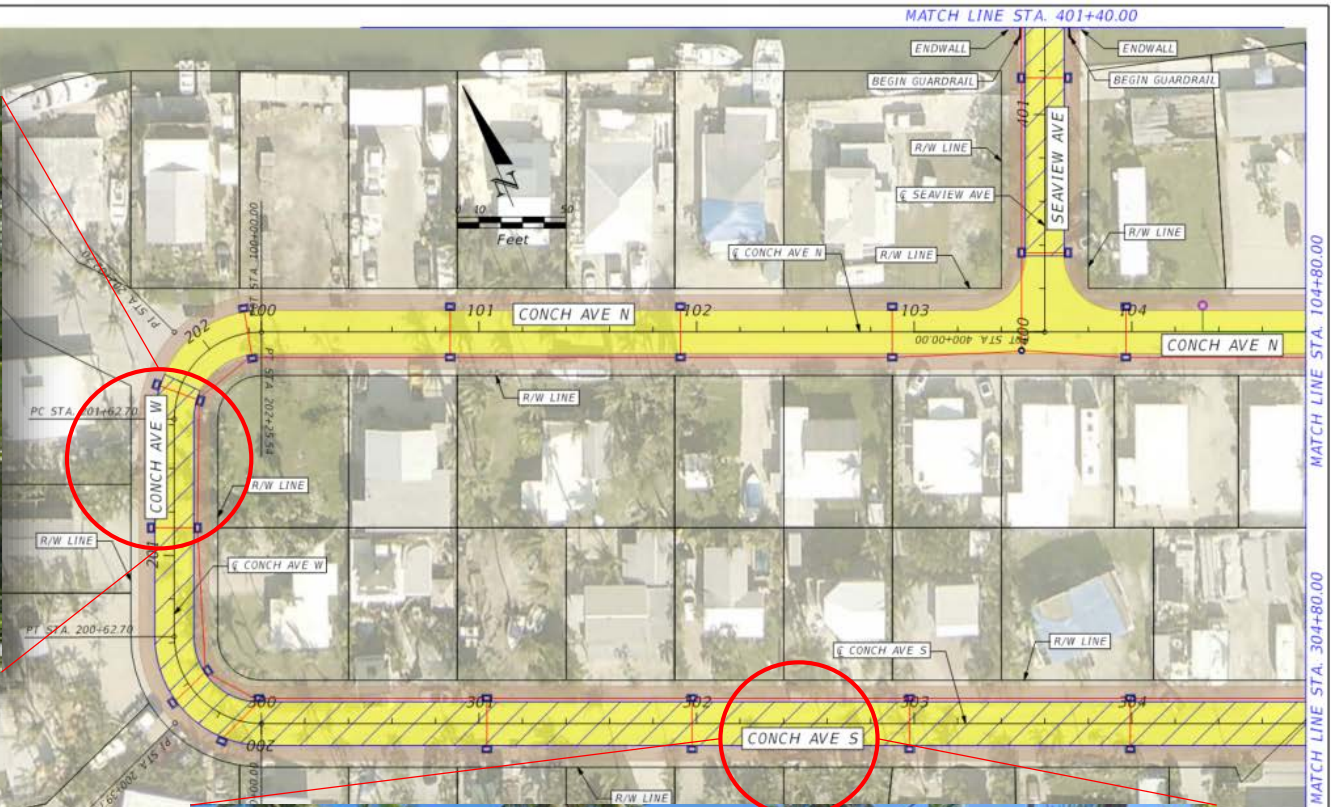


Winston Waterways – Valencia Road

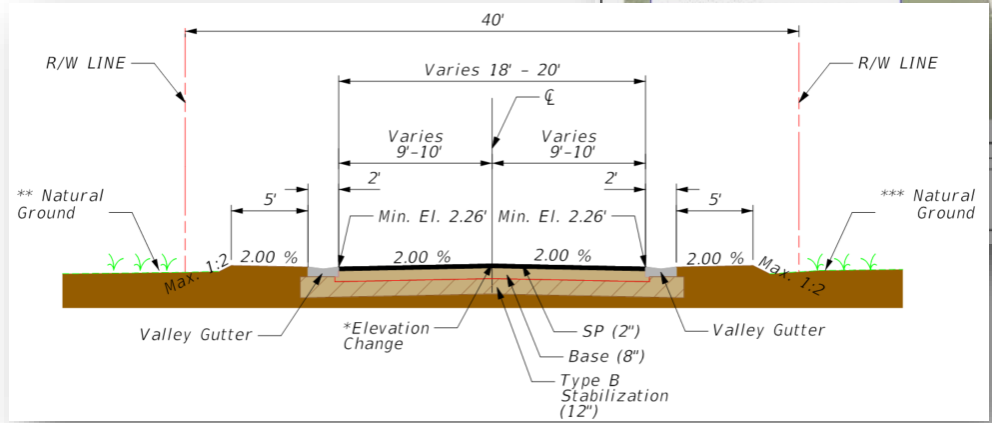


Stillwright Point – South Blackwater Lane

Project Examples – Conch Key



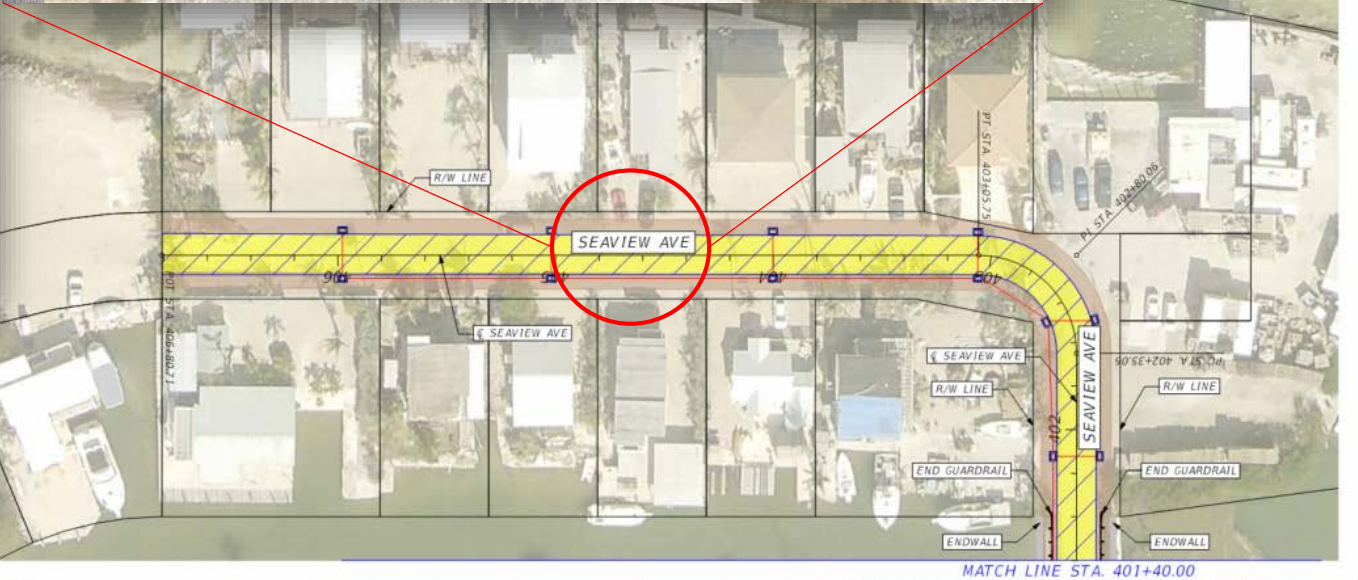
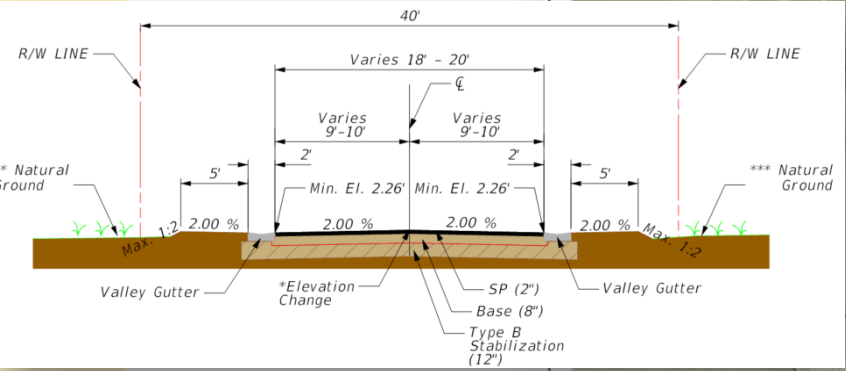
- LEGEND**
- STORM INLETS
 - MANHOLES/JUNCTIONS
 - INJECTION WELLS
 - STORM DRAIN
 - FORCE MAIN



DESCRIPTION	SHEET NO.
	4

P.W.S.

2.25' Road Elevation Change



LEGEND

- STORM INLETS
- MANHOLES/JUNCTIONS
- STORM DRAIN
- ▨ PAVEMENT RECONSTRUCTION LIMITS
- ▨ PAVEMENT RECONSTRUCTION LIMITS WITH ROADWAY ELEVATION CHANGE
- ▨ ROADSIDE RECONSTRUCTION LIMITS

REVISIONS	
DATE	DESCRIPTION



HDR ENGINEERING, INC.
15450 NEW BARN ROAD, SUITE 304
MIAMI LAKES, FL 33014-2169



MONROE COUNTY ROADWAY VULNERABILITY ANALYSIS AND CAPITAL PLAN
CONCH KEY

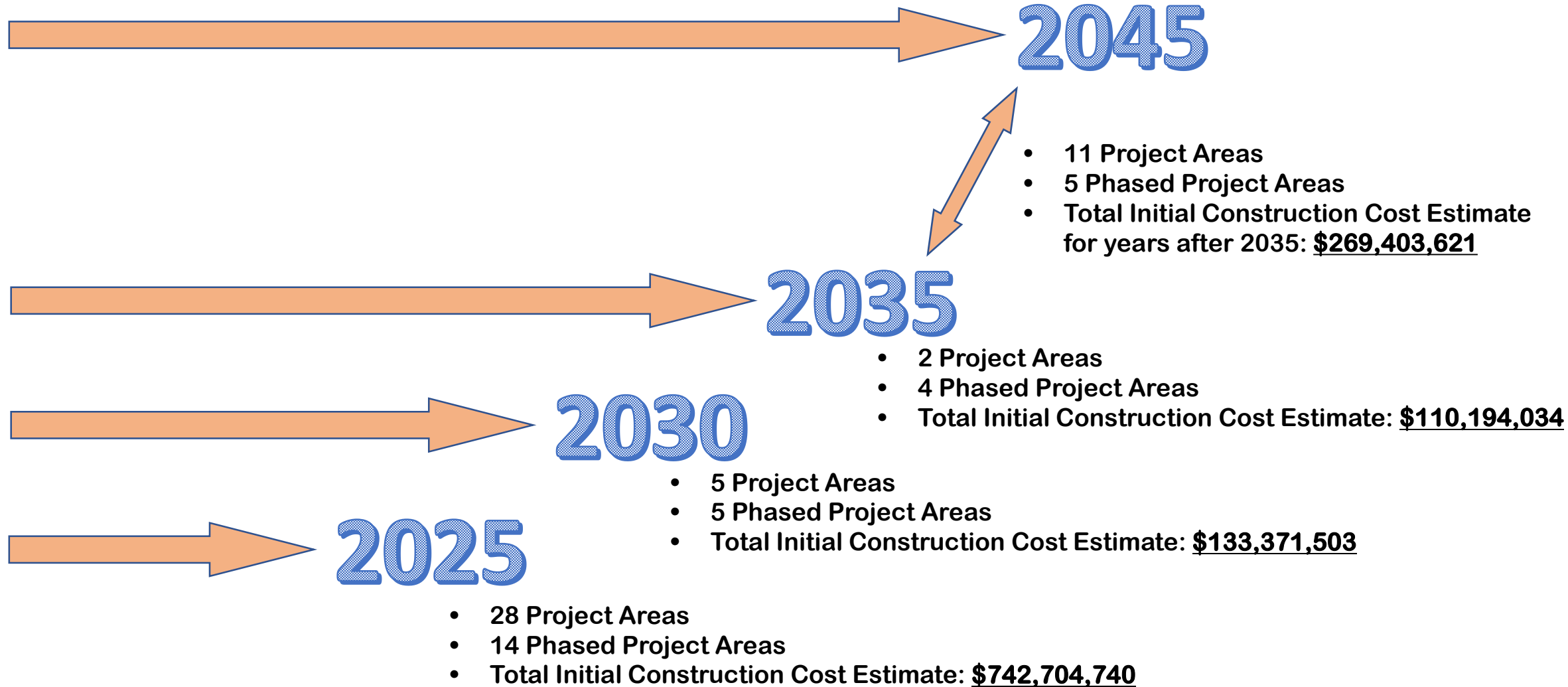
SHEET NO. 6

Phased Adaptation Plan

Phased Adaptation Plan – Areas for possible improvement in phases



Adaptation Implementation Plan for top 38% Only



Opportunities for Green Engineering and Pedestrian Improvements

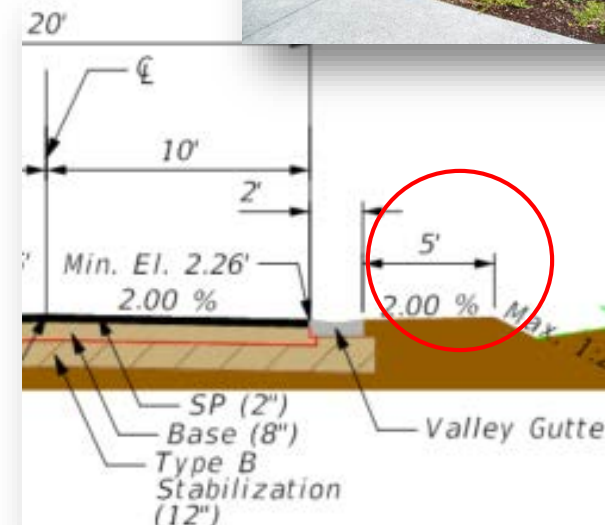
1. Right-of-way constraints **limits** green engineering opportunities along the roadway.

However, could use **available road adjacent land** for:

- Installation of weirs or earthen berms at strategic locations to divert water to treatment swales or Water Avenues
- Add parks with bio-swales, playground, and benches

2. Proposed 5' stabilized roadside area along the proposed roadway limits is accessible to pedestrians.

3. Did not remove existing bicycle lanes/shoulder areas within the study limits.



County Adaptation + Parcel Adaptation

Projected Sea Level Rise impacts to **private properties** (due to low elevation) will continue to increase along vacant lots, shorelines and property lines as waters continue to rise

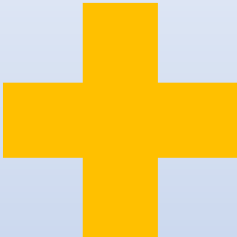


2025
2035
2045

County Adaptation + Parcel Adaptation

Countywide Adaptation

- Roads
- Habitat/Resources
- Elevate or mitigate County buildings
- Infrastructure



Private Property Response

- Elevate or mitigate private structures
- Lot fill and driveways
 - Shorelines



Achieving Resilience

- County
- People
- Habitat
- Economy



U.S. Army Corp Study



**US Army Corps
of Engineers**®
Norfolk District



MONROE COUNTY
FLORIDA

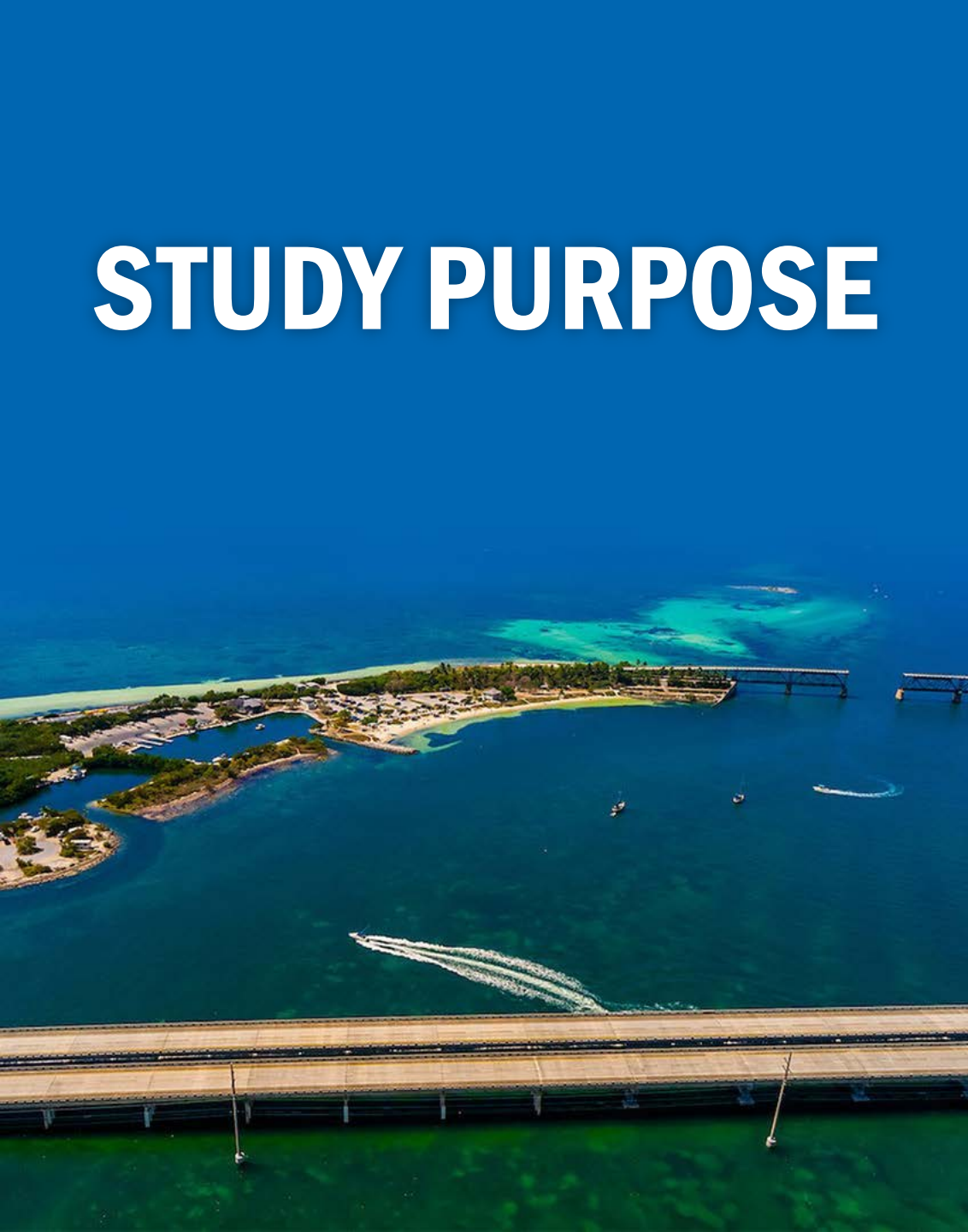
FLORIDA KEYS COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

Rachel Haug
Senior Planner and Study Lead
Norfolk District
U.S. Army Corps of Engineers



STUDY PURPOSE

The Florida Keys Coastal Storm Risk Management Study is investigating solutions that will improve resiliency by reducing damage and risk from impacts of coastal storms taking into account sea level rise.



RECOMMENDED PLAN



The Recommended Plan Includes:

- U.S. 1 shoreline stabilization (revetment) in 6 areas
- Nonstructural measures for residential and non-residential structures at risk:
 - Elevation of residential properties
 - Floodproofing of commercial properties
 - The plan does not include structure acquisition
- Floodproofing critical infrastructure at risk

Estimated Project Costs and Benefits:

- Total Estimated Project Cost (65/35 cost share):
\$2,772,359,000
 - 65% federal funding of project = \$1,802,033,000
 - 35% non-federal funding of project = \$970,326,000
- Total Average Annual Benefit: **\$131,603,000**
- BCR is **1.5**

NONSTRUCTURAL MEASURES INCLUDED IN RECOMMENDED PLAN

Reduce storm damage to structures identified at risk by implementing one of the following measures based on structure type and risk:

- Elevation of residential structures
 - 4,698 structures



- Floodproofing of commercial properties and critical infrastructure
 - 1,052 commercial structures
 - 53 critical infrastructure buildings



NONSTRUCTURAL MEASURES IN RECOMMENDED PLAN



Location	Elevation	Floodproofing	Critical Infrastructure Floodproofing	Total NS
City of Key Colony Beach	30	7	2	39
City of Key West	2,028	382	12	2,422
City of Layton	31	9	1	41
City of Marathon	562	225	14	801
Unincorporated Monroe County	1,839	348	15	2,202
Village of Islamorada	208	81	9	298
Grand Total	4,698	1,052	53	5,803

NONSTRUCTURAL COST DISTRIBUTION

Location	Elevation	Floodproofing	Critical Infrastructure Floodproofing	Total NS
City of Key Colony Beach	\$14,842,720	\$2,662,316	\$911,396	\$18,416,432
City of Key West	\$1,003,367,893	\$145,286,365	\$5,468,377	\$1,154,122,635
City of Layton	\$15,337,478	\$3,422,977	\$455,698	\$19,216,153
City of Marathon	\$278,053,627	\$85,574,430	\$6,379,774	\$370,007,830
Unincorporated Monroe County	\$909,858,755	\$132,355,118	\$6,835,472	\$1,049,049,344
Village of Islamorada	\$102,909,527	\$30,806,795	\$4,101,283	\$137,817,605
Grand Total	\$2,324,370,000	\$400,108,000	\$24,152,000	\$2,748,630,000

The costs on this slide are estimates that are based on an average cost per structure for each nonstructural measure category.



NON-FEDERAL SPONSOR RESPONSIBILITIES FOR PROJECT IMPLEMENTATION

- ❑ Monroe County is the non-federal sponsor
- ❑ Project Partnership Agreement (PPA) will be executed between USACE and the County following a construction new start designation from Congress.
 - PPA will include all project elements and outline the sponsor's financial commitment to construction of the project.
 - Could occur as early as FY24 but would be requested each following year not received.
- ❑ The County may seek funds from other non-federal sources for their 35% share of the project implementation cost.
 - PPA will only include USACE and Monroe County
- ❑ FY23 budget request will be submitted for federal funding needed to begin the preconstruction engineering and design for the U.S. 1 Revetments
 - Design agreement will be signed with County if FY23 budget request is appropriated

Thank You



**Haag-Rhonda
@MonroeCounty-Fl.gov**

