

**Rhonda Haag - Chief
Resilience Officer**

**Judy Clarke - Director
Engineering Svsc &
Roads**



MONROE COUNTY
FLORIDA

HR wood.

ERIN L. DEADY, P.A. 

Monroe County Roadway Vulnerability Analysis and Capital Plan Update

June 21, 2021



Task 1:
Data Collection



Task 2:
Engineering Analysis



Task 3:
Concept Development

....IN PROGRESS



Task 4:
Policy Review & Regulations

....IN PROGRESS



Task 5:
Stakeholder & Public Outreach

....IN PROGRESS



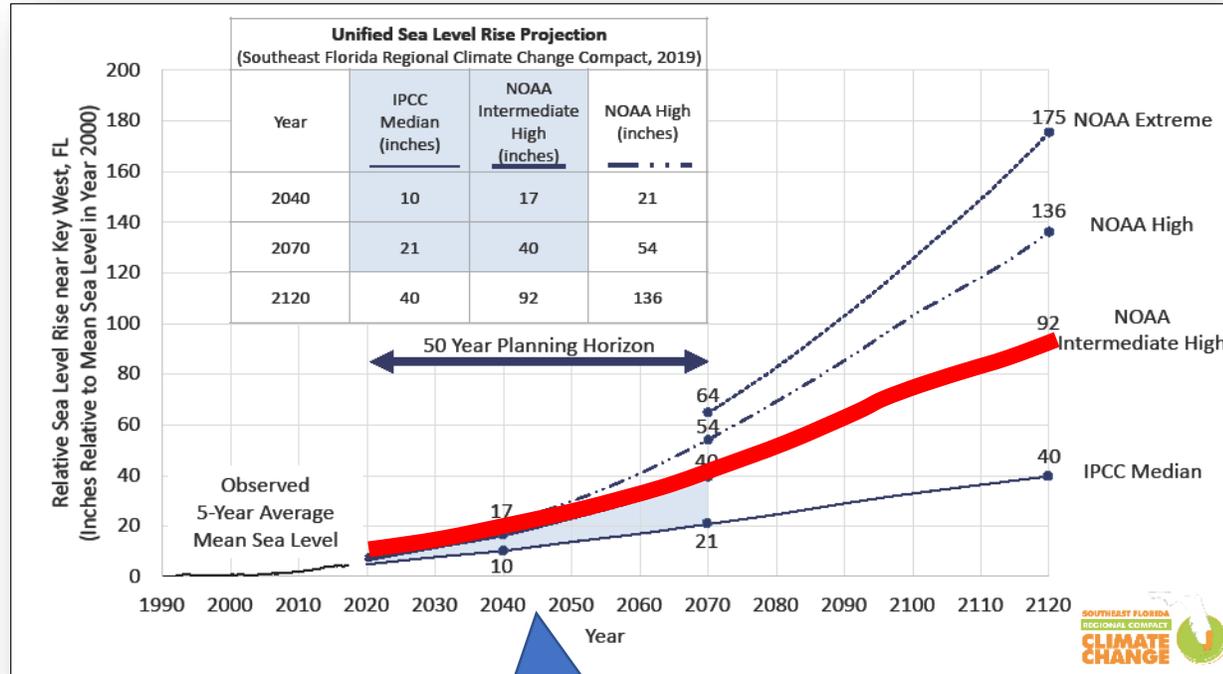
Task 6:
Implementation Plan



Design Criteria and Sea Level Rise Projections used for the Analysis



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



Vulnerability and Criticality
Assessment :

**The most critical locations
impacted by SLR + 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%

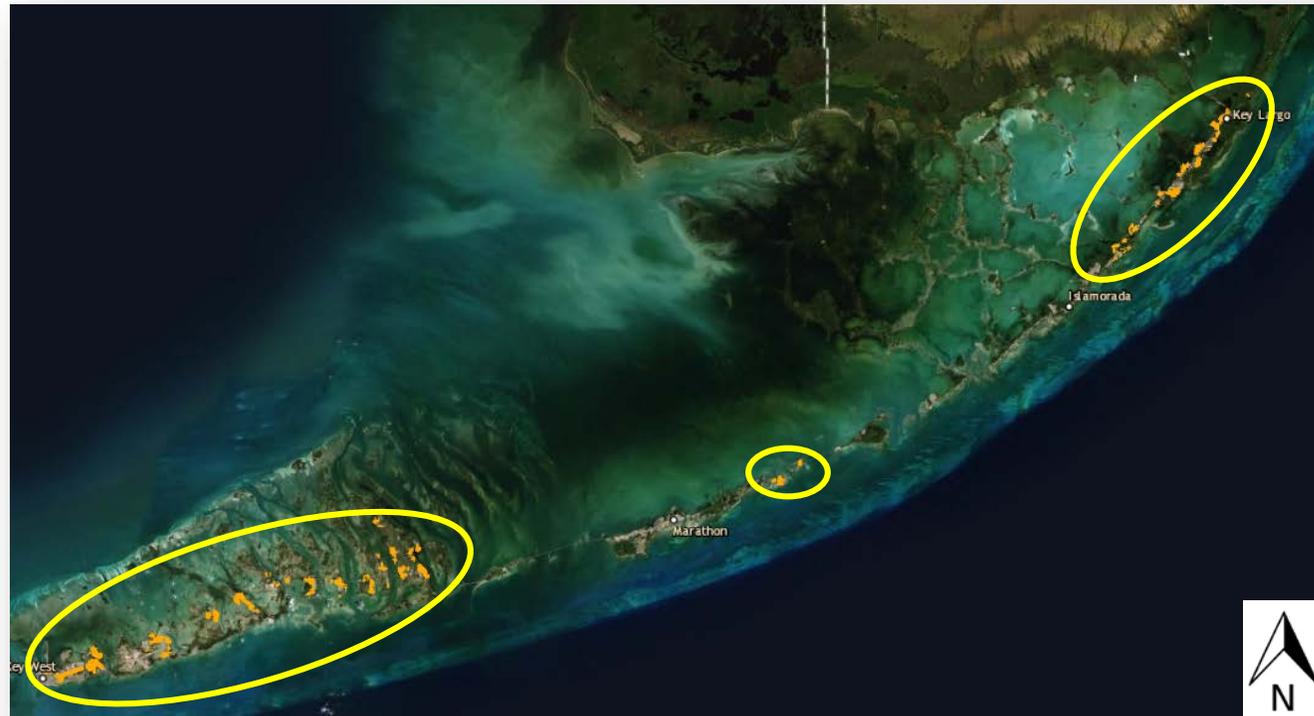
Modeling Output – Criticality Score Project List

No.	ROAD_NAME	KEY_NAME	DISTRICT	SUBDIVISION	SEGMENT_ID	Criticality Score	Length (feet)	Length (miles)	Res. Units
1	BAY DR	SADDLEBUNCH KEYS	LOWER	BAY POINT AMENDED PLAT	LOW-516	5.00	3,110.43	0.59	67
2	ADAMS DR	KEY LARGO	UPPER	TWIN LAKES 2ND ADDITION	UPP-316	5.00	1,719.11	0.33	40
3	PALM AVE	KEY WEST	LOWER	KEY WEST	LOW-356	5.00	1,629.96	0.31	169
4	JEAN LA FITTE DR	KEY LARGO	UPPER	PIRATES COVE	UPP-869	5.00	1,374.99	0.26	31
5	LONG KEY RD	KEY LARGO	UPPER	LAKE SURPRISE ESTATES	UPP-743	5.00	1,286.79	0.24	41
6	NORTH DR	KEY LARGO	UPPER	STILLWRIGHT POINT	UPP-766	5.00	1,241.54	0.24	32
7	GRASSY RD	KEY LARGO	UPPER	SEXTON COVE ESTATES	UPP-860	5.00	1,152.76	0.22	21
8	MARTINIQUE LN	RAMROD KEY	LOWER	BREEZESWEPT BEACH ESTATES	LOW-24	5.00	1,121.12	0.21	25
9	9TH AVE	STOCK ISLAND	LOWER	LINCOLN GARDENS #2	LOW-1176	5.00	1,050.00	0.20	37
10	8TH AVE	STOCK ISLAND	LOWER	LINCOLN GARDENS #1	LOW-1102	5.00	1,050.00	0.20	40

248	FIRST ST	KEY WEST	LOWER	KEY WEST	LOW-676	4.67	2,092.62	0.40	35
249	DE LUSSAN LN	CUDJOE KEY	LOWER	CUTTHROAT HARBOR ESTATES 1ST ADDITION	LOW-53	4.67	480.00	0.09	9
250	PALM DR	SADDLEBUNCH KEYS	LOWER	BAY POINT TRAILER PARK	LOW-644	4.67	151.88	0.03	3
251	INDIES DR N	DUCK KEY	MIDDLE	DUCK KEY RESUBDIVISION SECTION	MID-60	4.66	768.52	0.15	14
252	5TH LN	KEY LARGO	UPPER	WINSTON WATERWAYS #2	UPP-70	4.66	289.50	0.05	4
253	WEST INDIES DR	RAMROD KEY	LOWER	BREEZESWEPT BEACH ESTATES	LOW-86	4.65	290.83	0.06	6

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

	No. of Keys	Rdwy 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%



NOAA 2017 Intermediate-High SLR Projection + King Tide Prediction for 2045

Defining the Project Areas

Additional Roadway Segments for Comprehensive Project Areas

Ramrod Key – Initial 25% Critical Roadways



Roadway segments that were not included in the initial 25%

Roadway segments included in the initial 25%

Ramrod Key – SLR + King Tide 2045 Vulnerability Assessment



Recommend the entire key Be considered a Project Area

Project Locations -Lower Keys



Project Locations - Lower Keys



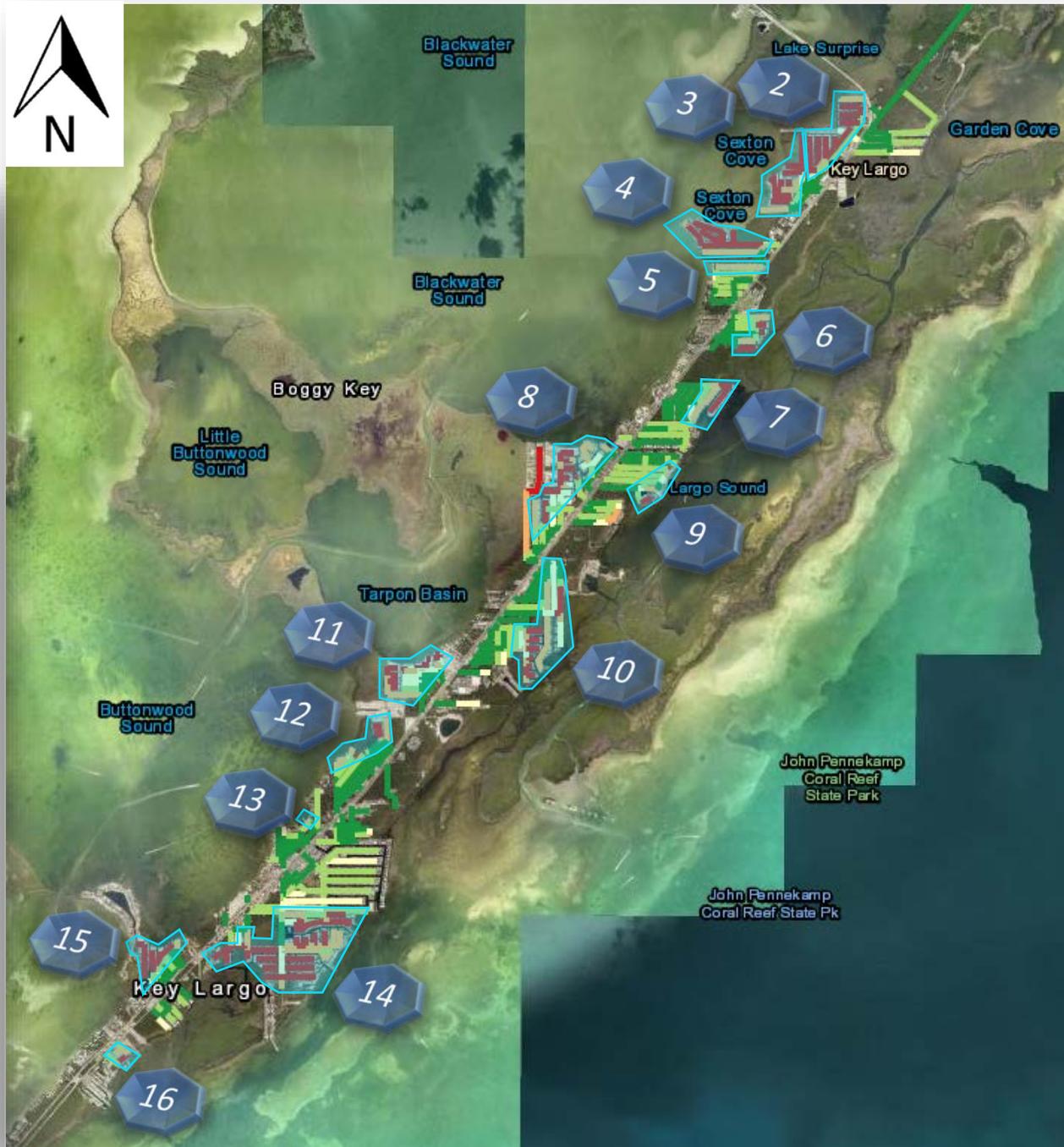
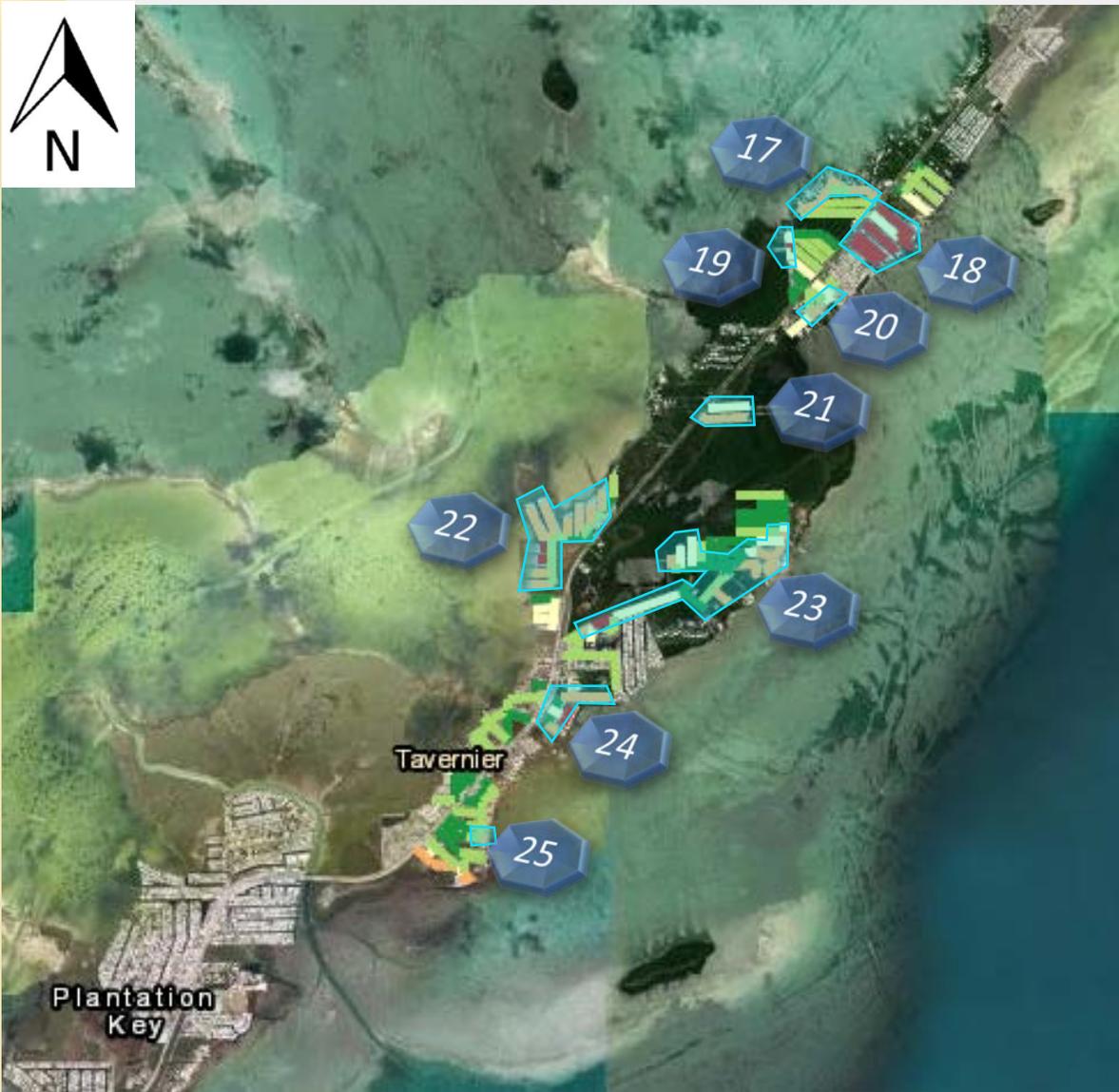
Project Locations - Lower Keys



Project Locations - Middle Keys



Project Locations - Upper Keys



Project Area No.	Area	Key	
1	Upper Keys		
2	Upper Keys	Key Largo	
3	Upper Keys	Key Largo	
4	Upper Keys	Key Largo	
5	Upper Keys	Key Largo	
6	Upper Keys	Key Largo	KE
7	Upper Keys	Key Largo	
8	Upper Keys	Key Largo	CR
9	Upper Keys	Key Largo	LA
10	Upper Keys	Key Largo	WI
11	Upper Keys	Key Largo	
12	Upper Keys	Key Largo	
13	Upper Keys	Key Largo	
14	Upper Keys	Key Largo	KE SH
15	Upper Keys	Key Largo	
16	Upper Keys	Key Largo	
17	Upper Keys	Key Largo	BA
18	Upper Keys	Key Largo	
19	Upper Keys	Key Largo	
20	Upper Keys	Key Largo	
21	Upper Keys	Key Largo	
22	Upper Keys	Key Largo	
23	Upper Keys	Key Largo	BI H
24	Upper Keys	Key Largo	

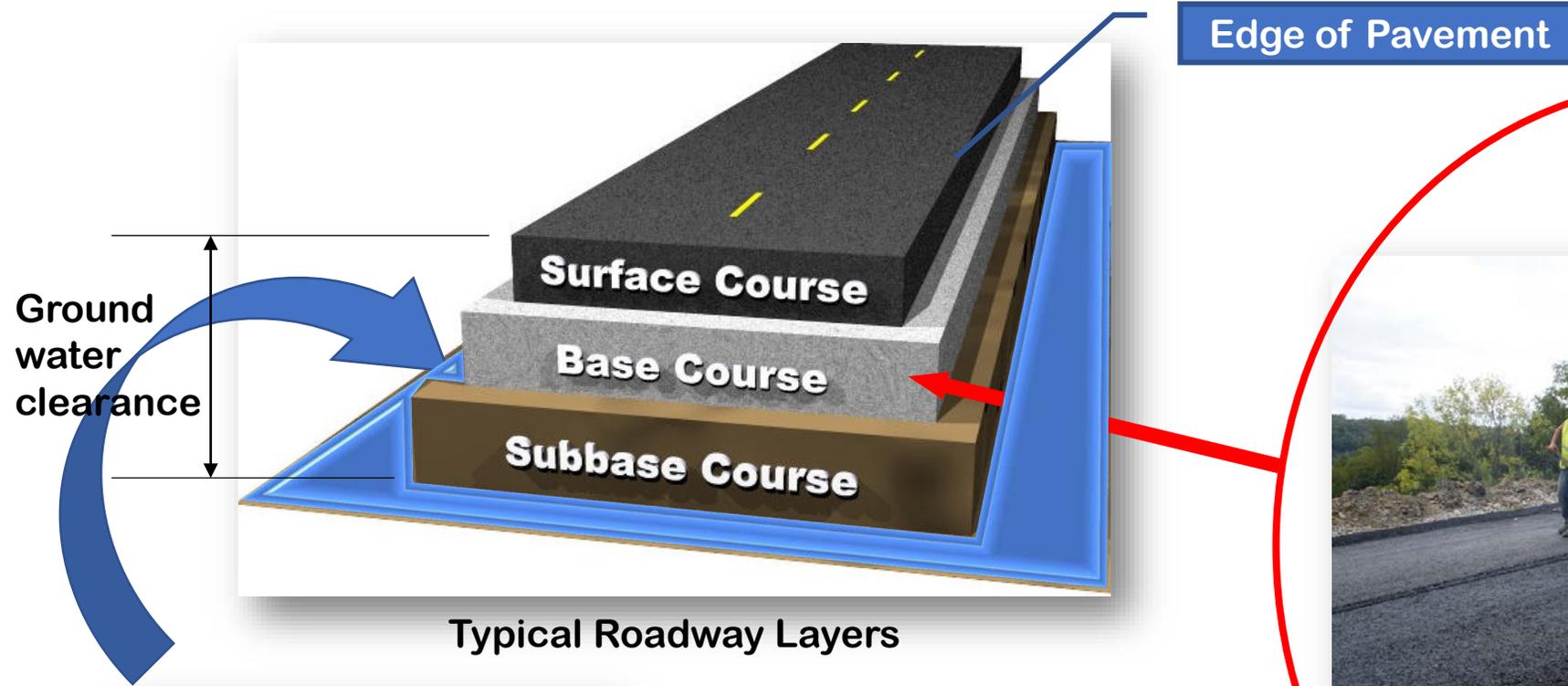
Project Area No.	Area	Key
25	Upper Keys	Key Largo
26	Middle Keys	Conch
27	Middle Keys	Duck
28	Lower Keys	Big Pine
29	Lower Keys	Big Pine
30	Lower Keys	Big Pine
31	Lower Keys	Big Pine
32	Lower Keys	Big Pine
33	Lower Keys	Big Pine
34	Lower Keys	Big Pine
35	Lower Keys	Big Pine
36	Lower Keys	Little Torch
37	Lower Keys	Little Torch
38	Lower Keys	Ramrod
39	Lower Keys	Ramrod
40	Lower Keys	Summerland
41	Lower Keys	Summerland
42	Lower Keys	Summerland
43	Lower Keys	Summerland
44	Lower Keys	Summerland
45	Lower Keys	Cudjoe
46	Lower Keys	Cudjoe
47	Lower Keys	Upper Sugarloaf
48	Lower Keys	Upper Sugarloaf
49	Lower Keys	Lower Sugarloaf
50	Lower Keys	Saddle Bunch
51	Lower Keys	Saddle Bunch

Project Area No.	Area	Key	Subdivision	Total Length (Feet)	Total Length (Miles)	% Distribution based on Total Length*
52	Lower Keys	Big Coppitt Key	GULFREST PARK / BAYVIEW PARK / COPPITT SUBDIVISION AMENDED / JOHNSONVILLE / GULFVIEW / SIMILAR SOUND SECTION	26,081.00	4.940	5.06%
53	Lower Keys	Big Coppitt Key	PORPOISE POINTSECTION 2 / BOCA CHICA RD	5,855.00	1.109	
54	Lower Keys	Geiger Key	BOCA CHICA OCEAN SHORES	5,174.40	0.980	0.82%
55	Lower Keys	East Rockland		1,920.00	0.364	0.38%
56	Lower Keys	East Rockland	ROCKLAND HAMMOCK	475.20	0.090	
57	Lower Keys	Key Haven/Racoon Key		19,008.00	3.600	3.01%
58	Lower Keys	Stock Island	MALONEY / SUNCREST / LINCOLN GARDENS / BALIDO 1 AND 2 / LINCOLN MANNER ESTATES / LINCOLN GARDENS / ROBYN / SHRIMP RD	40,550.40	7.680	6.42%
59	Lower Keys	Key West	Eaton Street / Palm Avenue / Flagler Avenue	14,150.40	2.680	2.53%
60	Lower Keys	Key West	Atlantic Boulevard	1,795.20	0.340	
Total:				631,217.02	119.549	100.00%



Roadway Conceptual Design

Roadway Design

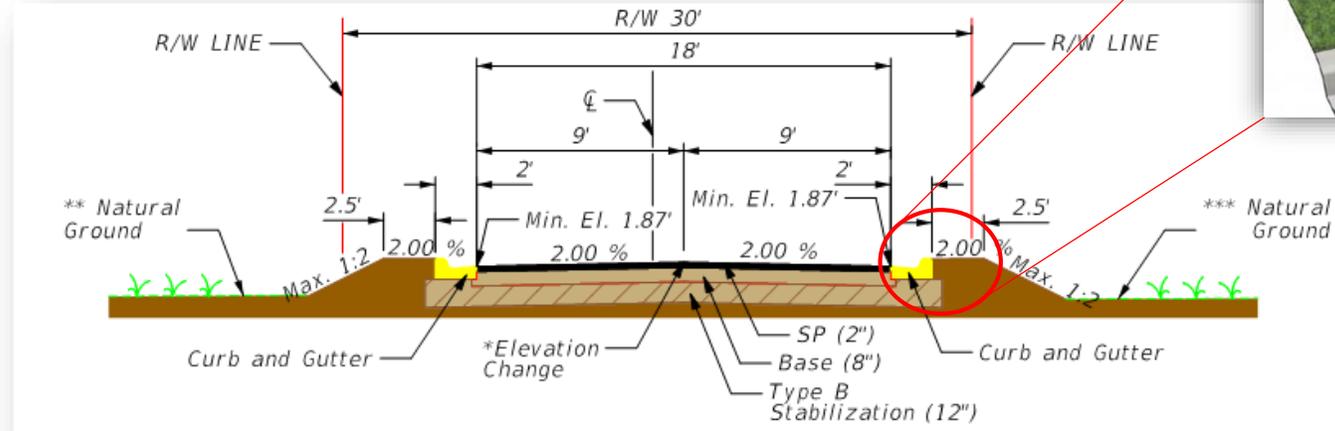


Geotextile Reinforcement



Asphalt "Black" Base Course

Roadway Typical Sections



Curb & Gutter

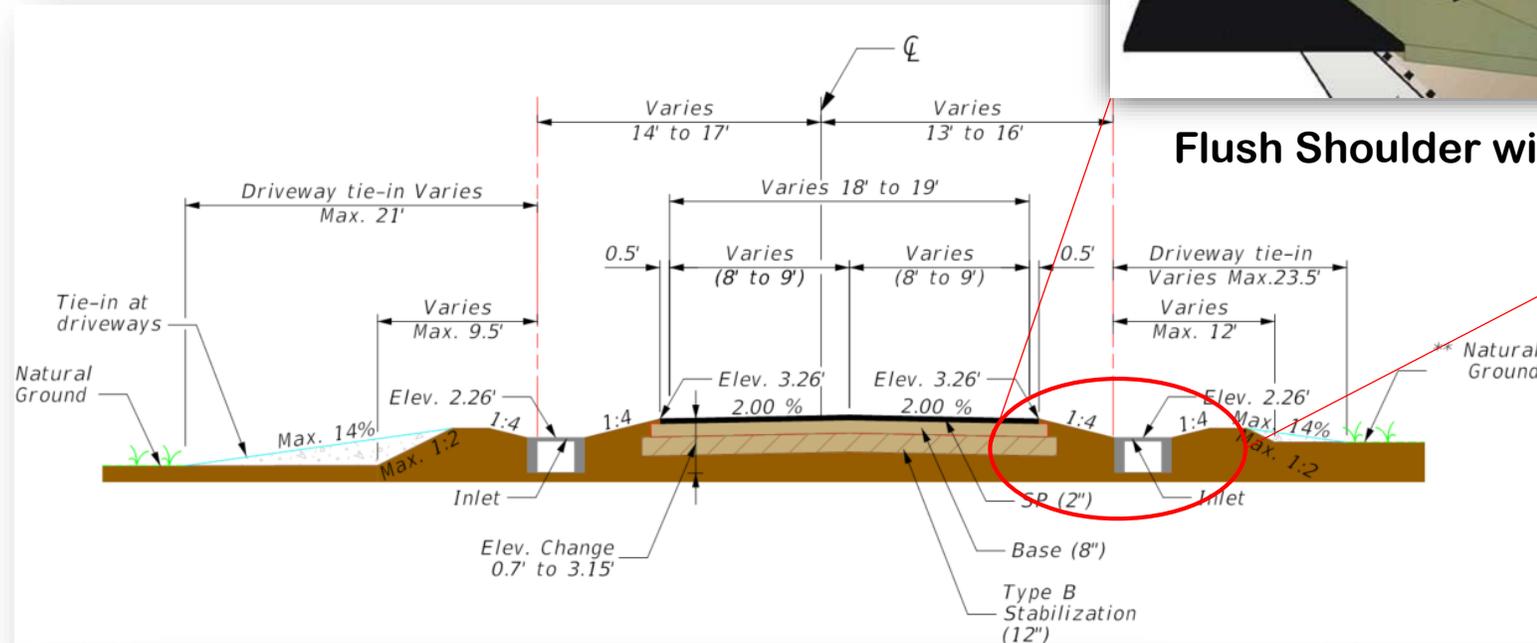


Considered at Stillwright Point – North Drive



Typical Section Example Location

Roadway Typical Sections

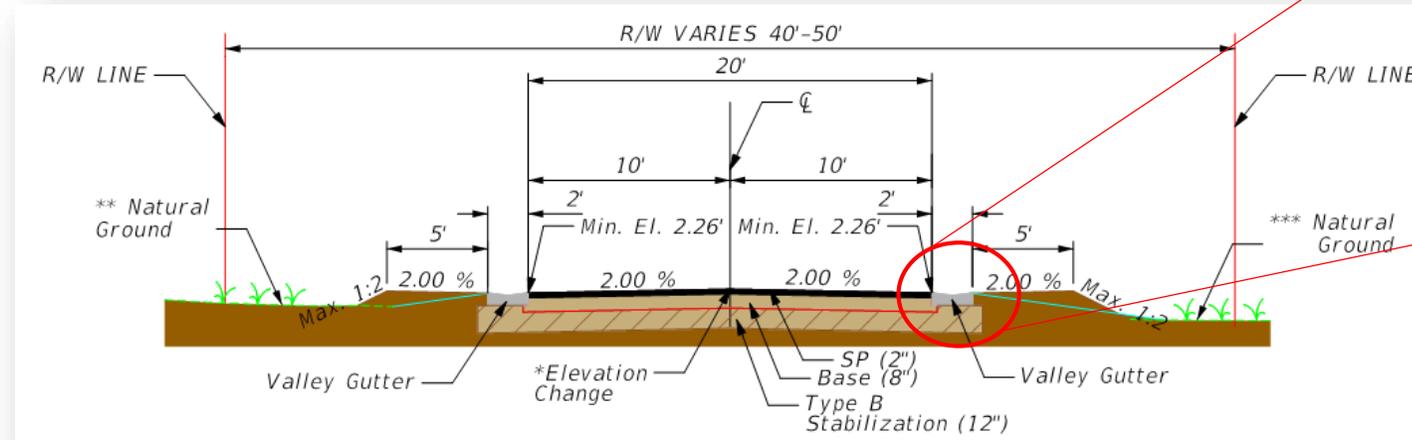


Flush Shoulder with Swales



Typical Section
Example Location

Roadway Typical Sections



Valley Gutters

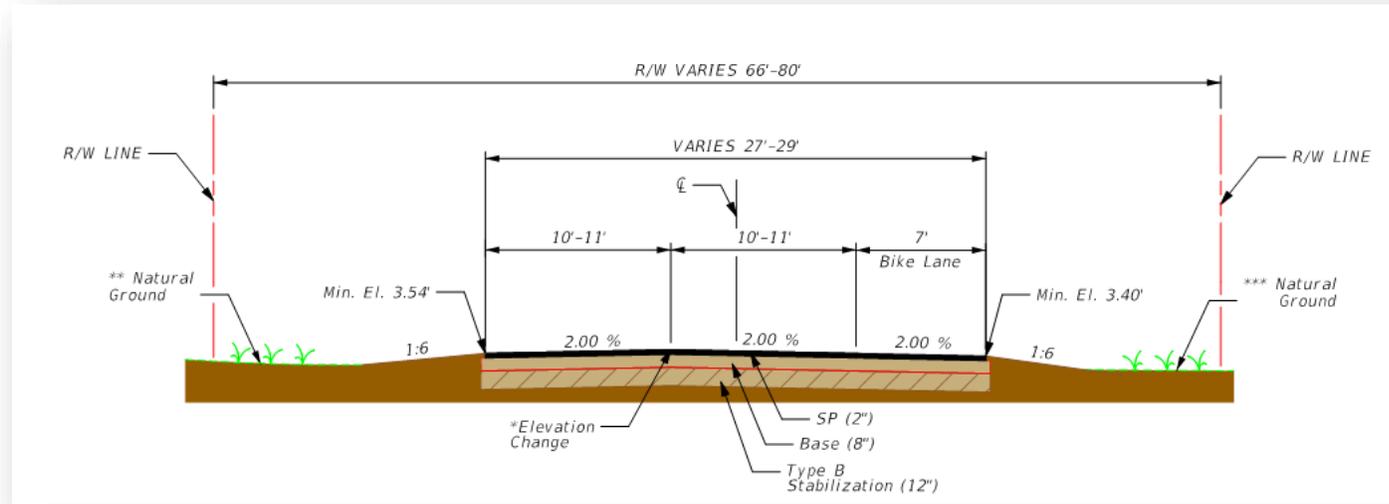


Considered at Hammer Point Park – Cromwell Court



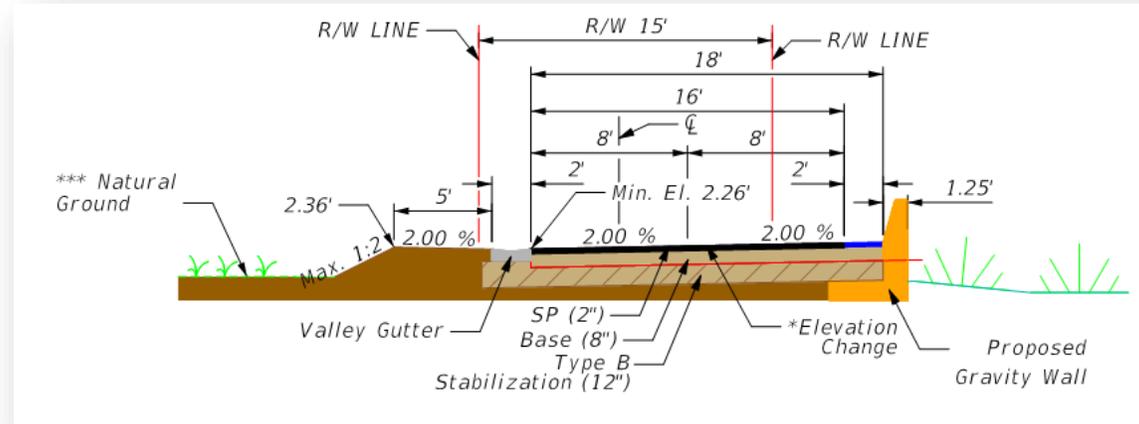
Typical Section Example Location

Roadway Typical Sections



**Big Pine Key –
Key Deer Boulevard**

Roadway Typical Sections

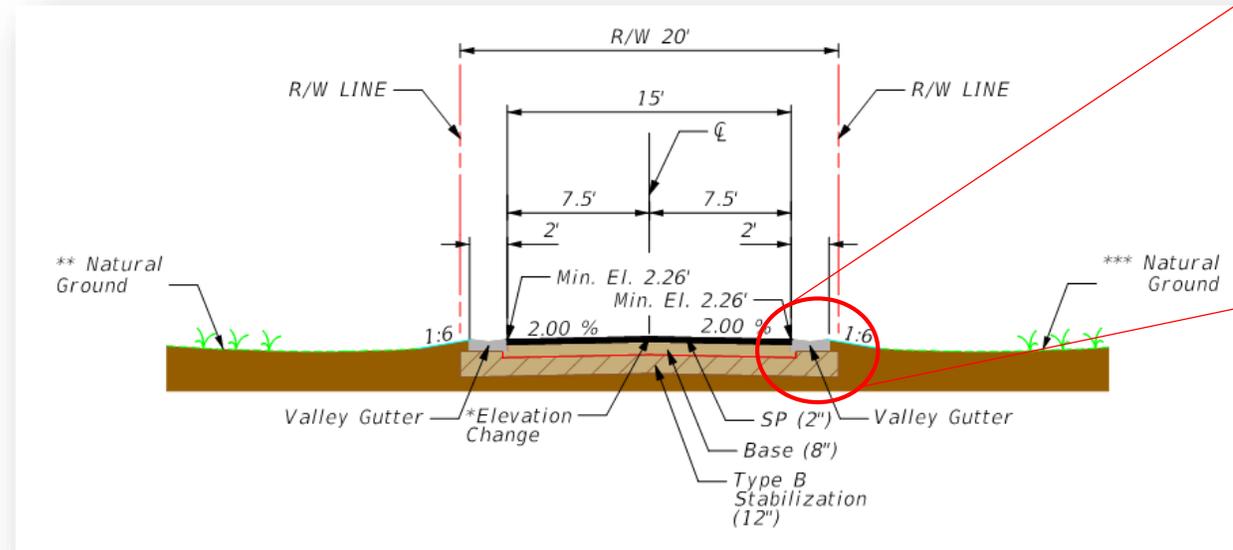


Winston Waterways – Valencia Road



Stillwright Point – South Blackwater Lane

Roadway Typical Sections

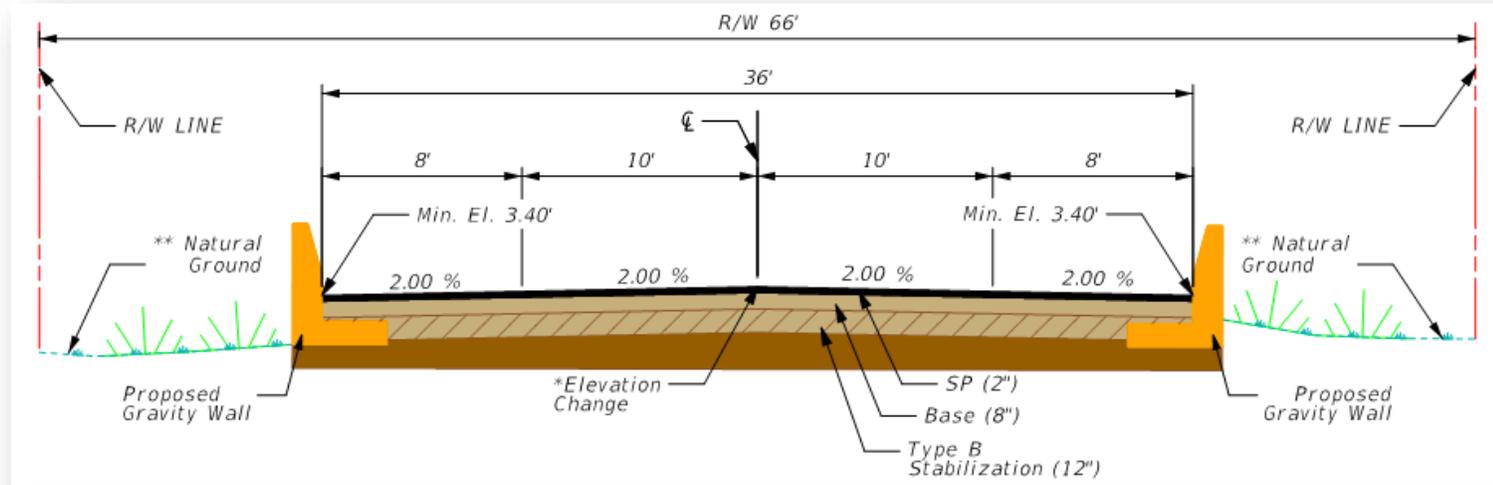


Valley Gutters



Sugarloaf Shores –
Sugarloaf Drive

Roadway Typical Sections

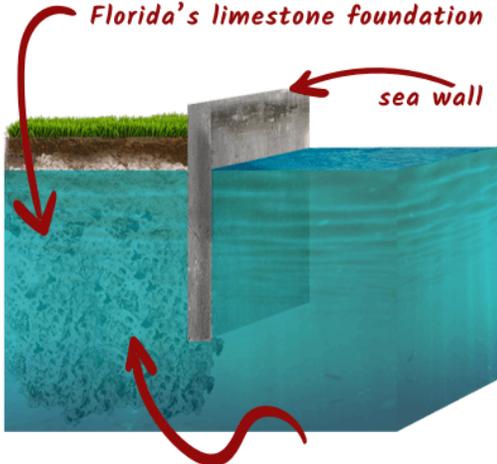


Little Torch Key – State Road

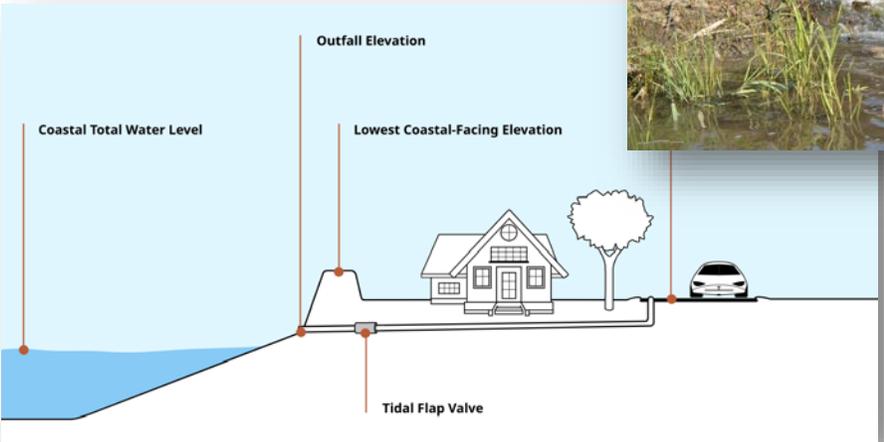


Typical Section Example location

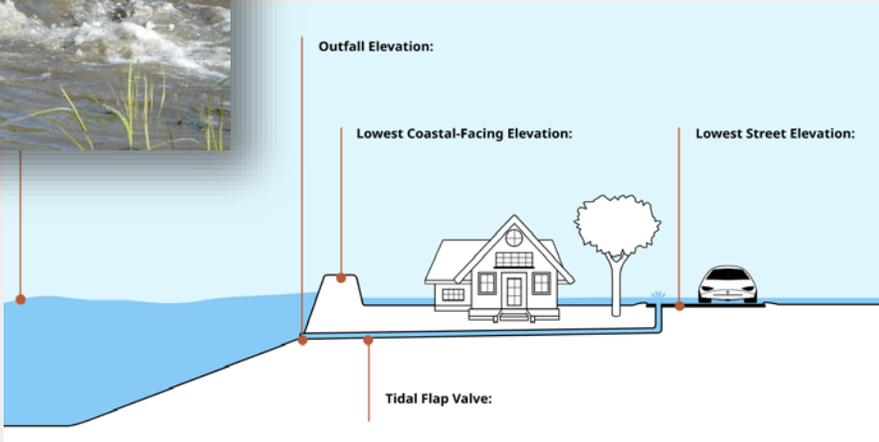
Storm Drain Design – Exfiltration and Outfalls



salt water seeps under sea wall through limestone
(sealevelrise.org)

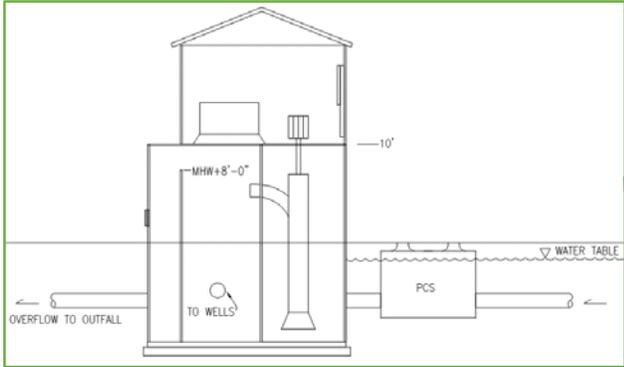


(noaa.org)

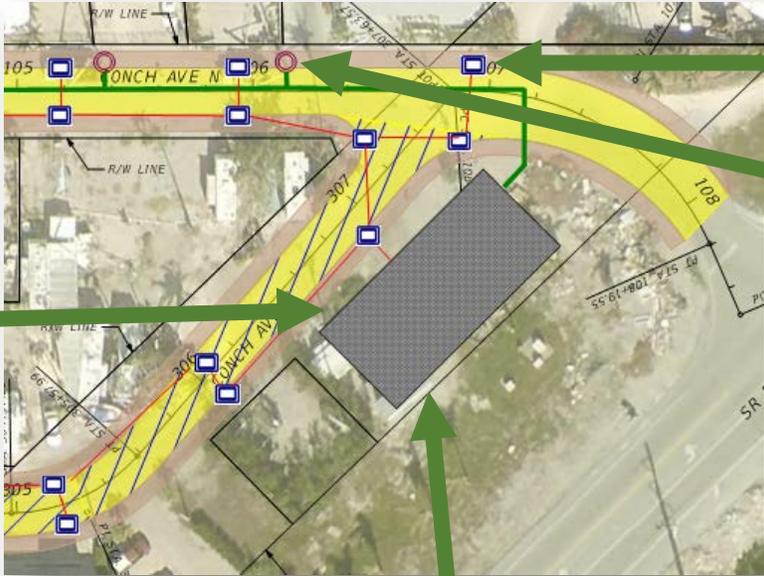


(noaa.org)

Storm Drain Layout

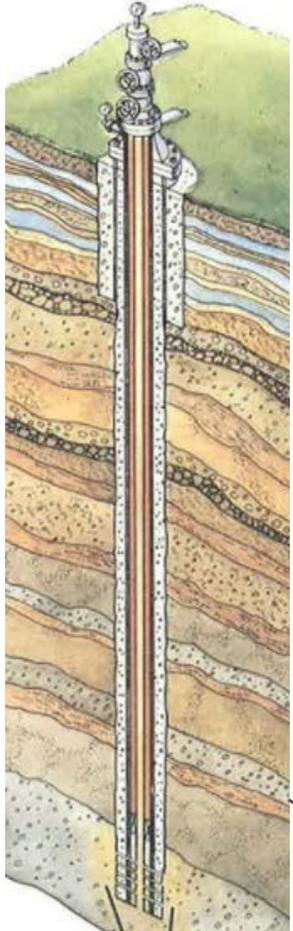


Pump Station



Catch Basins / Inlets
(Gravity Collection System)

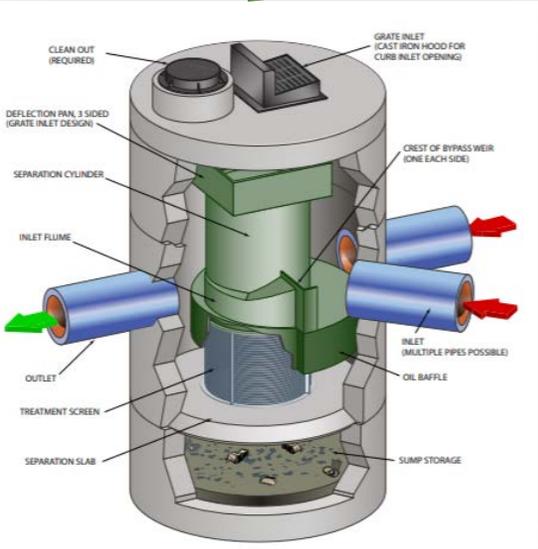
Injection Wells



(mid-wayenvironmental.com)

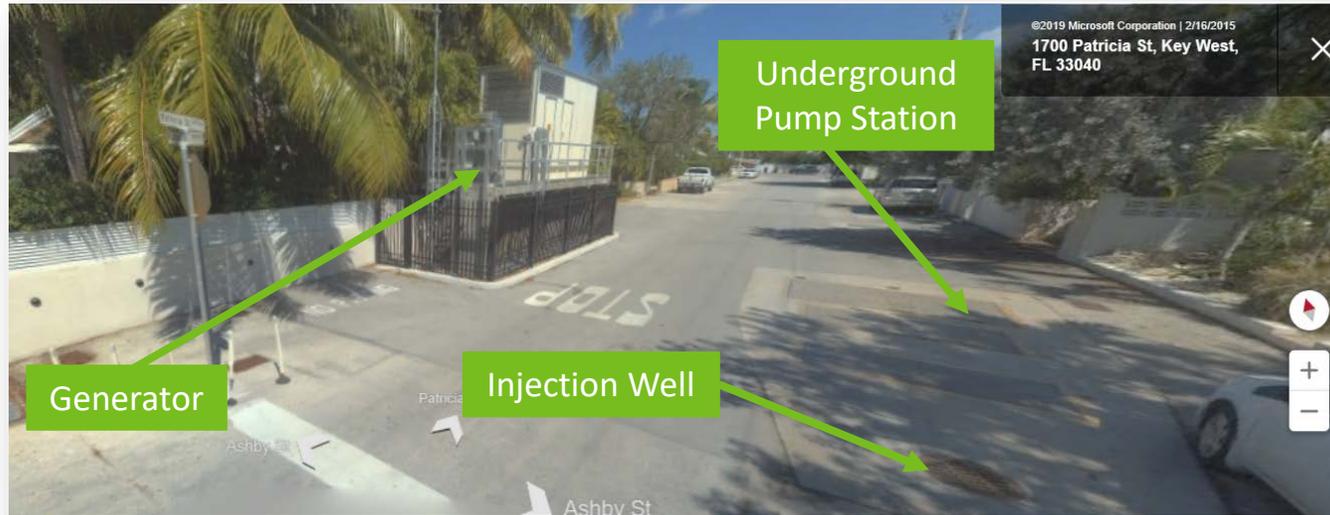


(conteches.com)



Hydrodynamic Separator

Storm Drain Layout - Examples



Underground Pump Station Injection Well on Patricia Street, Key West



Housed Pump Station
(precastbuildings.com)



Underground Pump Station Injection Well
(No Pump Station building)
(Romtecutilities.com)

DRAINAGE ALTERNATIVES MEMORANDUM

Sea Level Rise Pilot Project –
Big Pine Key and Key Largo

Prepared For:

Monroe County

Project No. 193618

Prepared By:

WSP USA, Inc.



7650 Corporate Center Drive
Suite 300
Miami, FL 33126

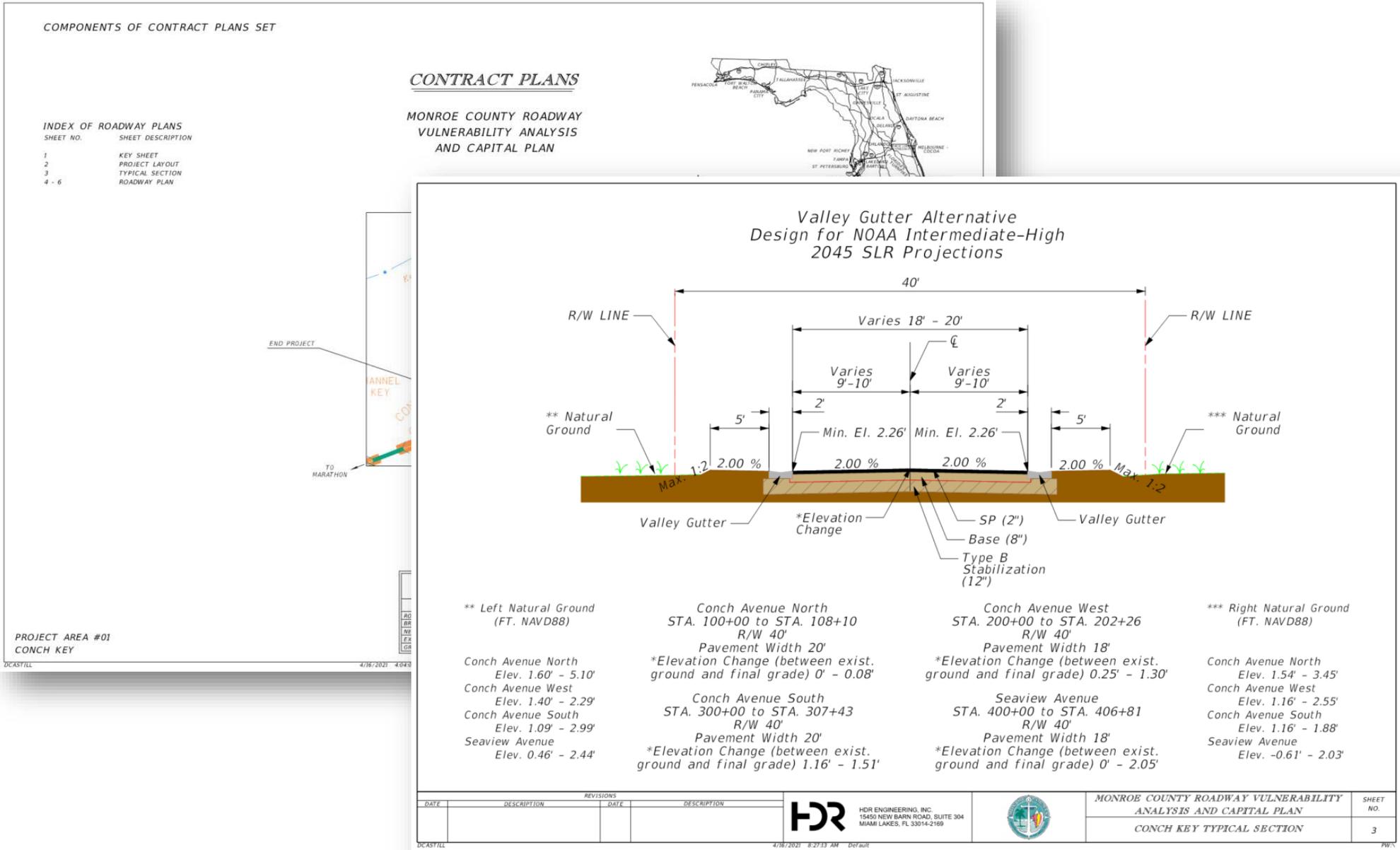
June, 2021

Werner J. Reinefeld, P.E., ENV SP
FL. License # 63042

Memo

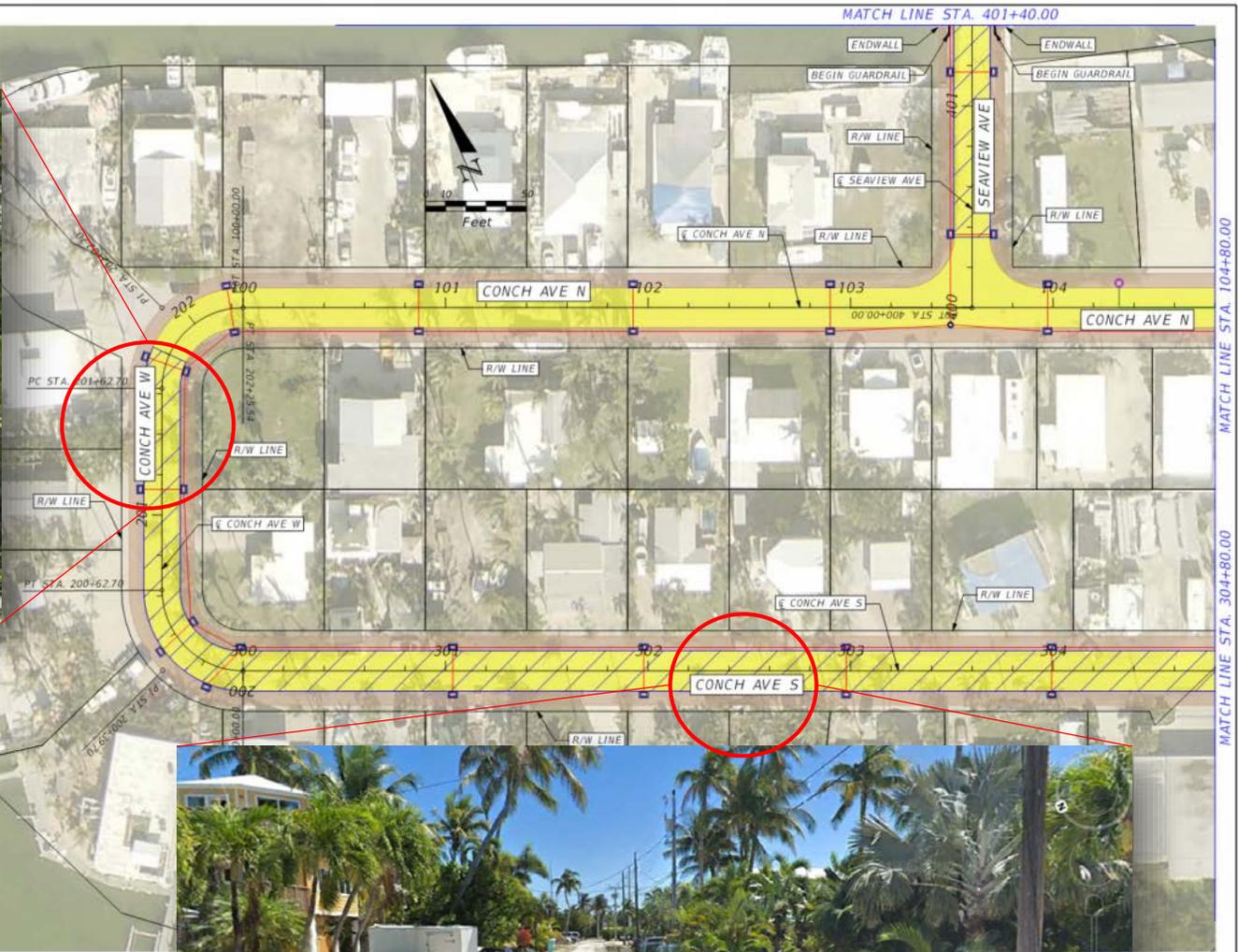
Project Examples – Ramrod Key and Conch Key

Project Area Plan Sets – Conch Key

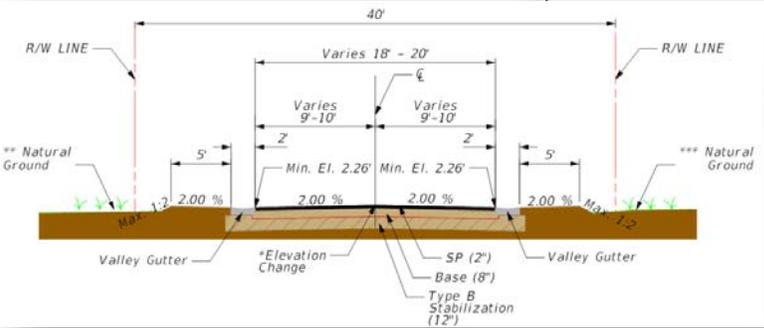


Proposed Roadway Elevation Change





- LEGEND**
- STORM INLETS
 - MANHOLES/JUNCTIONS
 - INJECTION WELLS
 - STORM DRAIN
 - FORCE MAIN
 - PAVEMENT RECONSTRUCTION LIMITS
 - ▨ PAVEMENT RECONSTRUCTION LIMITS WITH ROADWAY ELEVATION CHANGE
 - ROADSIDE RECONSTRUCTION LIMITS



REVISIONS	DATE	DESCRIPTION



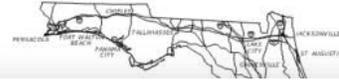
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MATCH LINE STA. 104+80.00

P.W.

Project Area Plan Sets – Ramrod Key

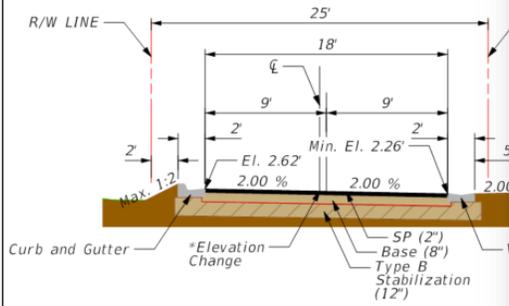
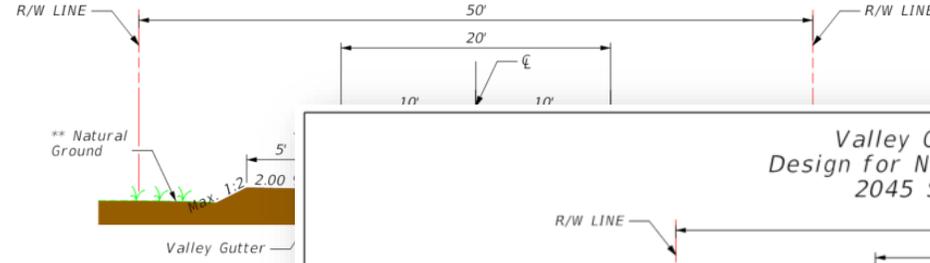
CONTRACT PLANS



INDEX OF ROADWAY PLANS

SHEET NO.	SHEET DESCRIPTION
1	KEY SHEET
2	PROJECT LAYOUT
3 - 4	TYPICAL SECTIONS
5 - 26	ROADWAY PLAN

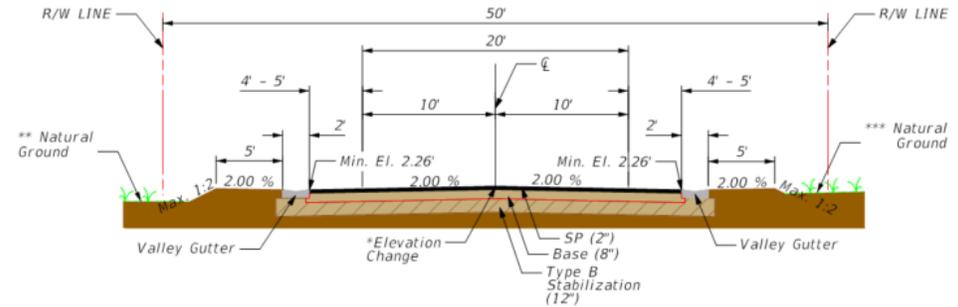
Valley Gutter Alternative Design for NOAA Intermediate-High 2045 SLR Projections



Typical Section 2
Dominica Ln
Sta. 8000+00 to Sta. 8003+00

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

Valley Gutter Alternative Design for NOAA Intermediate-High 2045 SLR Projections



Typical Section 4
W Indies Dr
Sta. 204+85 to Sta. 266+14

RAMROD KEY ELEVATIONS SUMMARY

ROADWAY SEGMENT	ELEVATION CHANGE * (Between exist. ground and final grade)	LEFT NATURAL GROUND ** (FT. NAVD88)	RIGHT NATURAL GROUND *** (FT. NAVD88)
INDIES DR	0.00' - 1.11'	N/A	0.69' - 4.08'
W INDIES DR	0.00' - 0.58'	0.69' - 4.08'	0.42' - 4.02'
ANTIGUA LN	0.00' - 1.17'	0.14' - 4.00'	0.67' - 3.18'
GUADALOUPE LN	0.15' - 0.91'	0.40' - 2.60'	0.09' - 2.35'
MARTINIQUE LN	0.29' - 1.10'	0.35' - 3.86'	0.44' - 2.65'
ST VINCENT LN	0.01' - 0.94'	0.35' - 2.52'	0.64' - 2.95'
BARBADOS LN	0.00' - 1.01'	0.48' - 2.94'	1.07' - 2.74'
ST MARTIN LN	0.09' - 1.00'	0.65' - 4.27'	1.00' - 2.87'
ST LUCIE LN	0.00' - 0.79'	0.63' - 2.88'	1.00' - 2.70'
TOBAGO LN	0.00' - 0.84'	1.27' - 2.19'	1.32' - 3.16'
JAMAICA LN	0.14' - 0.97'	1.33' - 2.69'	1.36' - 3.59'
ST CROIX LN	0.12' - 0.92'	1.14' - 2.75'	1.35' - 2.99'
ANGUILA LN	0.18' - 1.05'	1.11' - 2.15'	1.39' - 2.45'
BARBUDA LN	0.00' - 0.62'	1.06' - 3.04'	0.74' - 3.16'
CAYMAN LN	0.00' - 1.05'	0.45' - 2.91'	0.97' - 3.19'
HAITI LN	0.21' - 0.96'	0.81' - 2.67'	1.30' - 3.55'
DOMINICA LN	0.00' - 0.97'	0.79' - 2.98'	0.76' - 3.65'

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION



MONROE COUNTY ROADWAY VULNERABILITY
ANALYSIS AND CAPITAL PLAN
RAMROD KEY TYPICAL SECTIONS

SHEET
NO.
4

PROJECT AREA #02
RAMROD KEY

DCASTILL

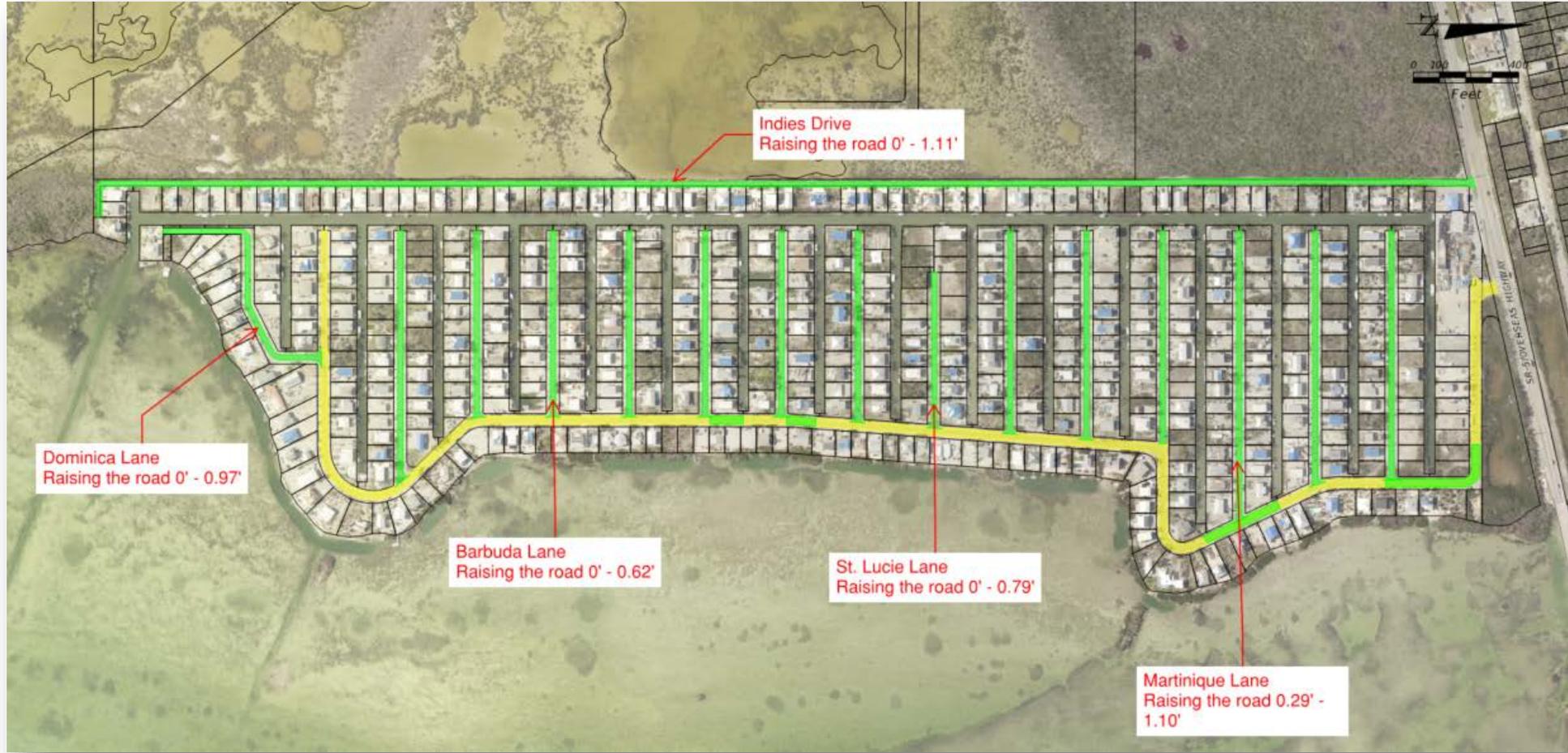
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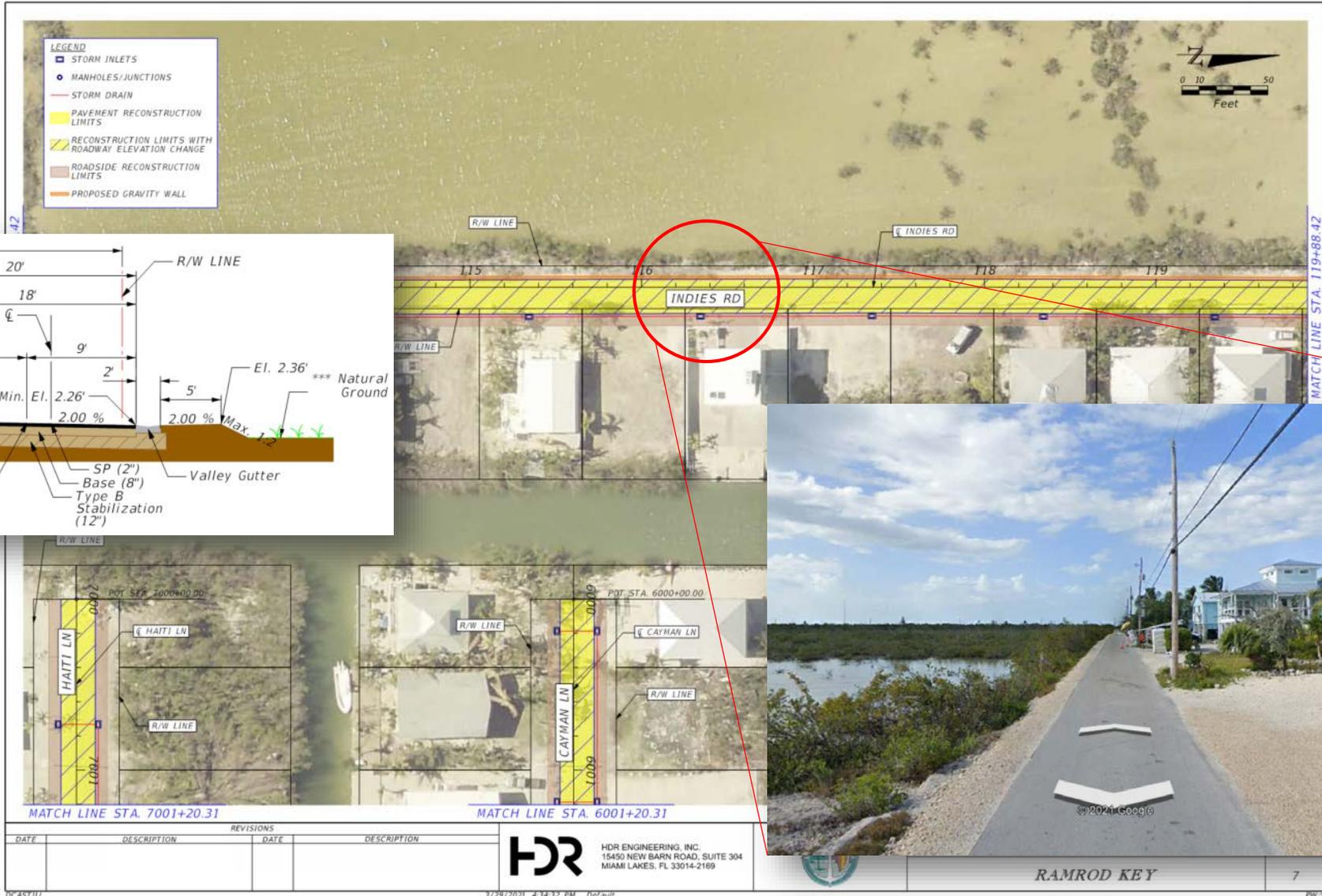
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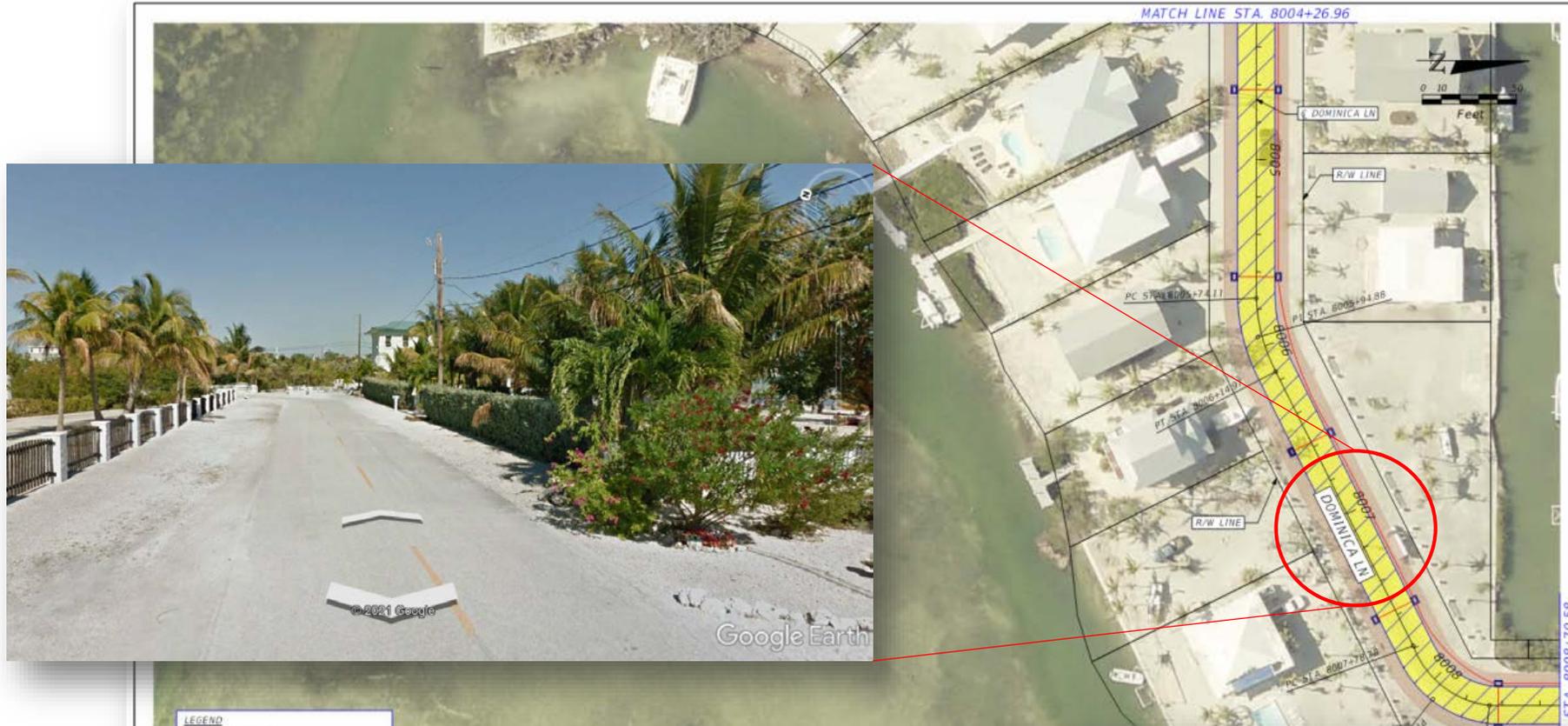
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PHYS

Proposed Roadway Elevation Change





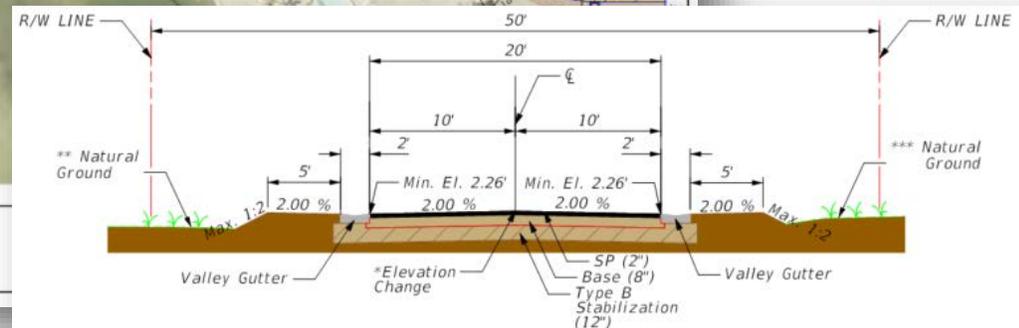


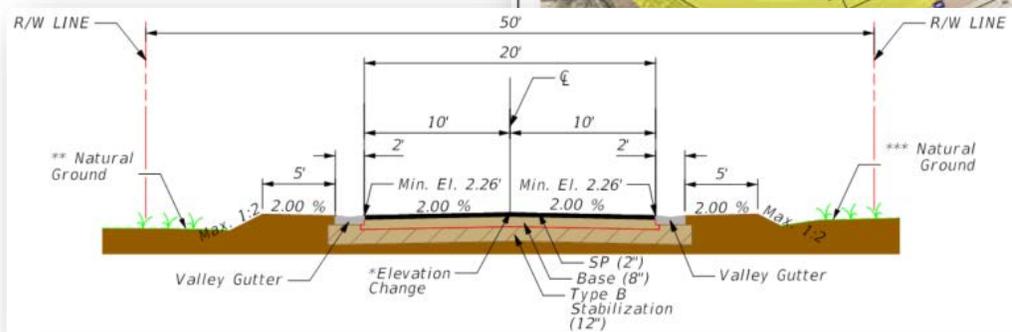
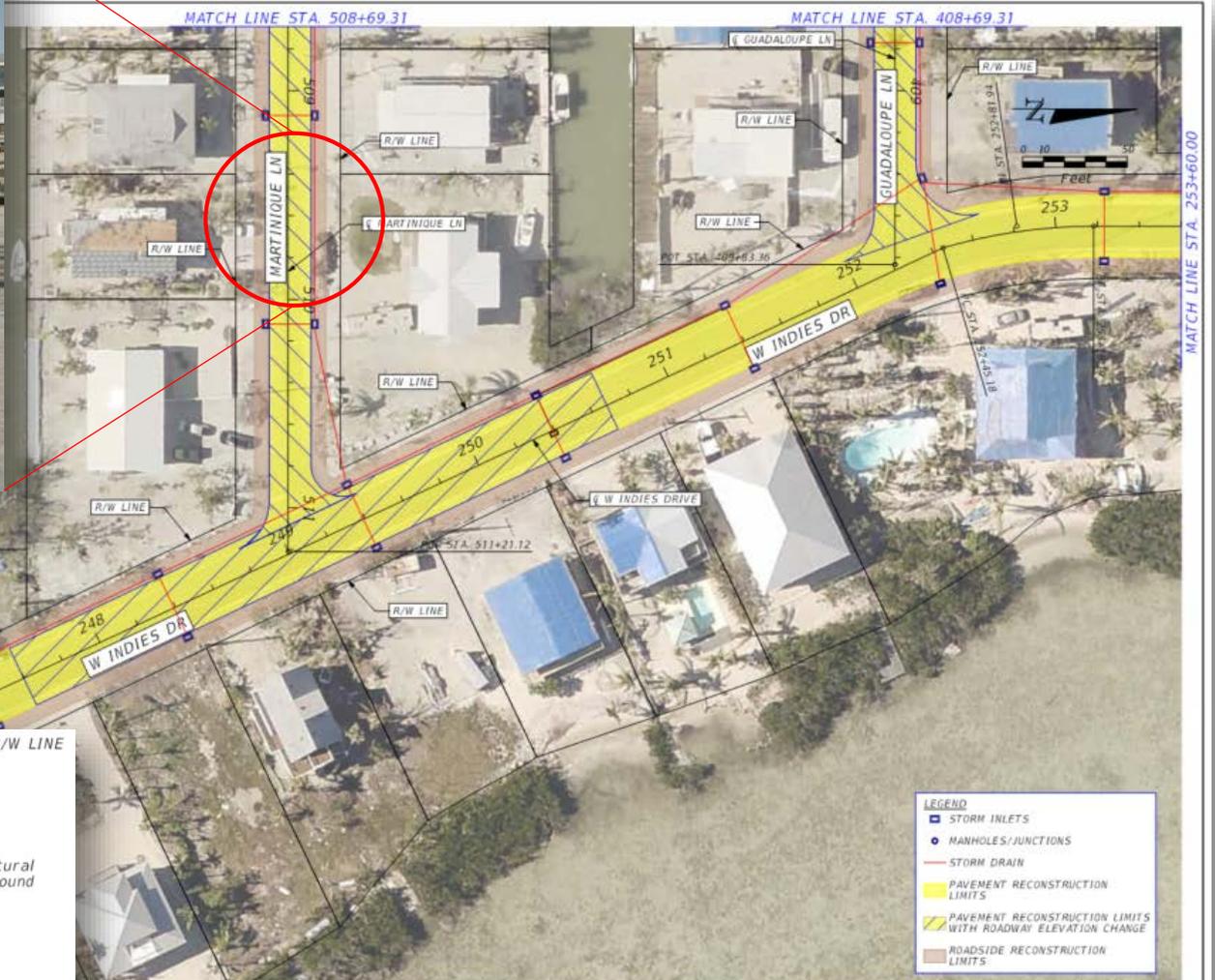
- LEGEND**
- STORM INLETS
 - MANHOLES/JUNCTIONS
 - STORM DRAIN
 - PAVEMENT RECONSTRUCTION LIMITS
 - ▨ PAVEMENT RECONSTRUCTION LIMITS WITH ROADWAY ELEVATION CHANGE
 - ROADSIDE RECONSTRUCTION LIMITS

		REVISIONS	
DATE	DESCRIPTION	DATE	DESCRIPTION

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

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



MONROE COUNTY ROADWAY VULNERABILITY
ANALYSIS AND CAPITAL PLAN

RAMROD KEY

SHEET
NO.
25

DCASTILL

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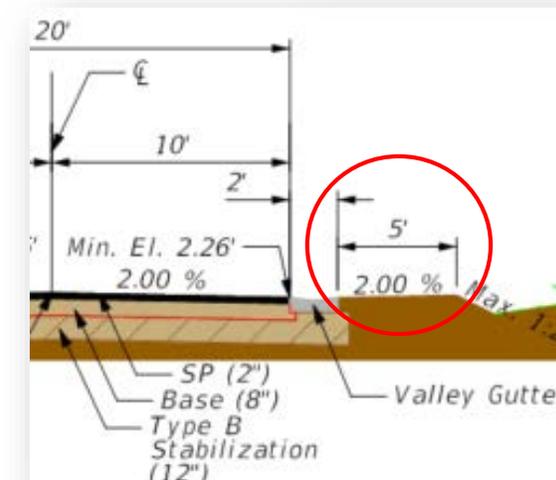
PKV

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.

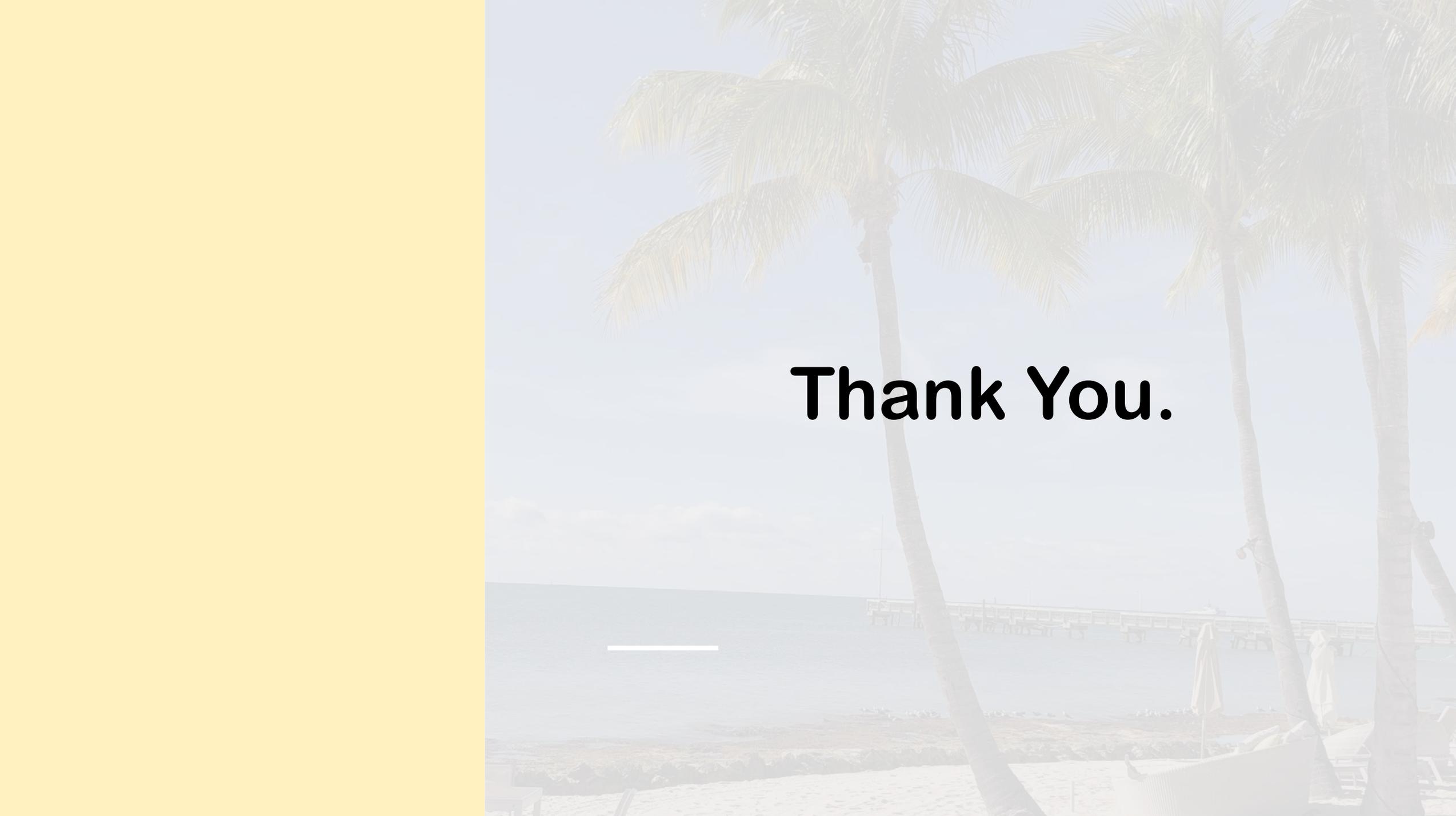


Next Steps

Date	Task
August 2021	Finalize Cost Estimates and Financial Analysis
August 2021	Conduct Permitting Coordination with Permitting Agencies based on proposed improvements
August 2021	Finalize Policy, Regulatory, Legal and Funding Documents
August 2021	Develop Adaptation Plan – Focus on the projects that need to be prioritized in the first 10 years
July - November 2021	Public Outreach
September 2021	Next BOCC update
December 2021	Final Report and Presentation



Discussion & Questions



Thank You.