Case Study in Roads Response
Monroe County Pilot Roads Project
Sands and Twin Lakes Communities

Prepared for:

Monroe County, Florida

Prepared By:

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WSP | PARSONS BRINCKERHOFF

It’s the End of the Road

- Overview of Report
- Recommendations for Pilot Communities
- Summary of Policy Response
  - Interim Design Standard
  - Draft Ordinance
- Resolutions for Consideration

Purpose of the Pilot Project Effort

- Address flooding impacts in two communities focused on ro
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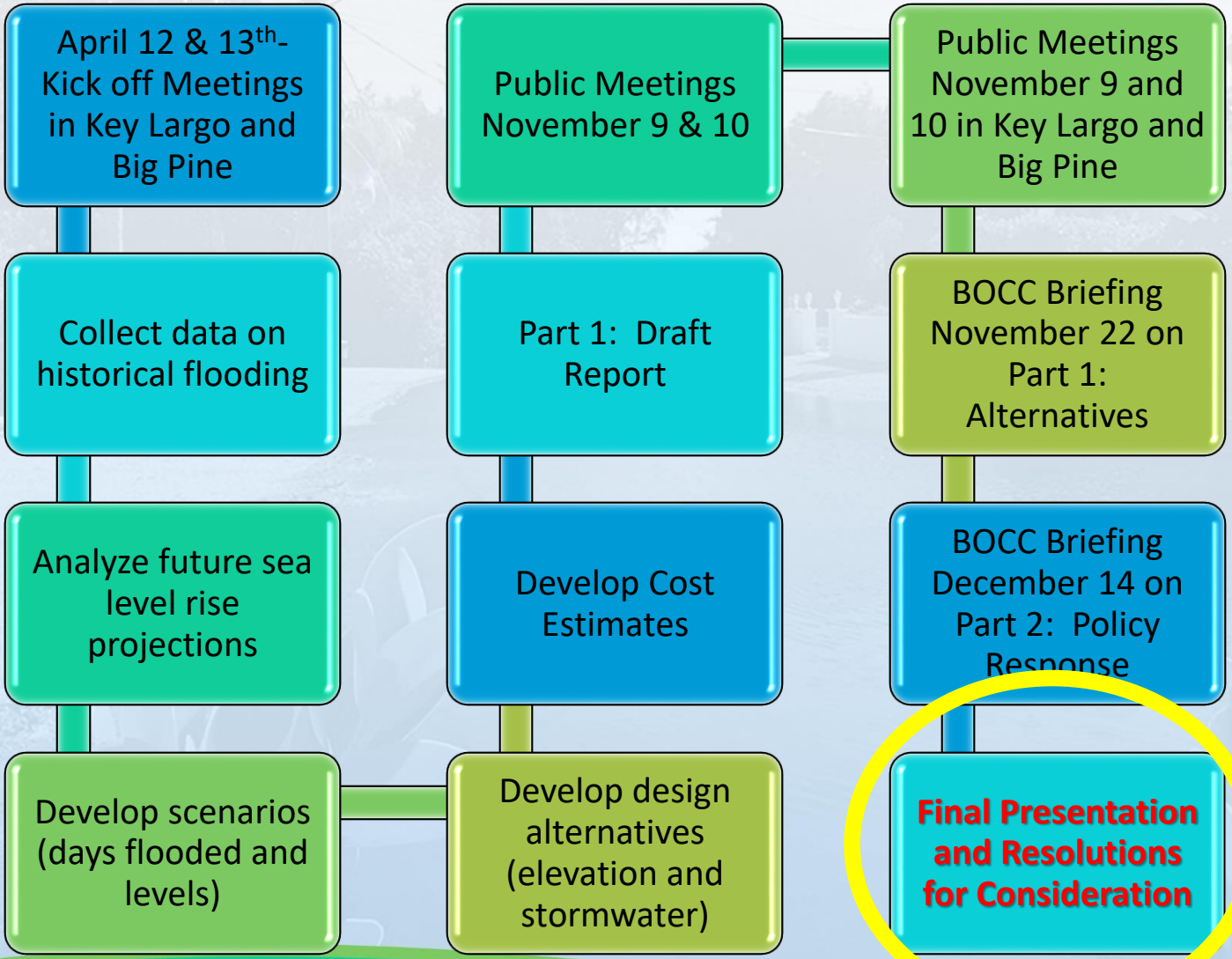
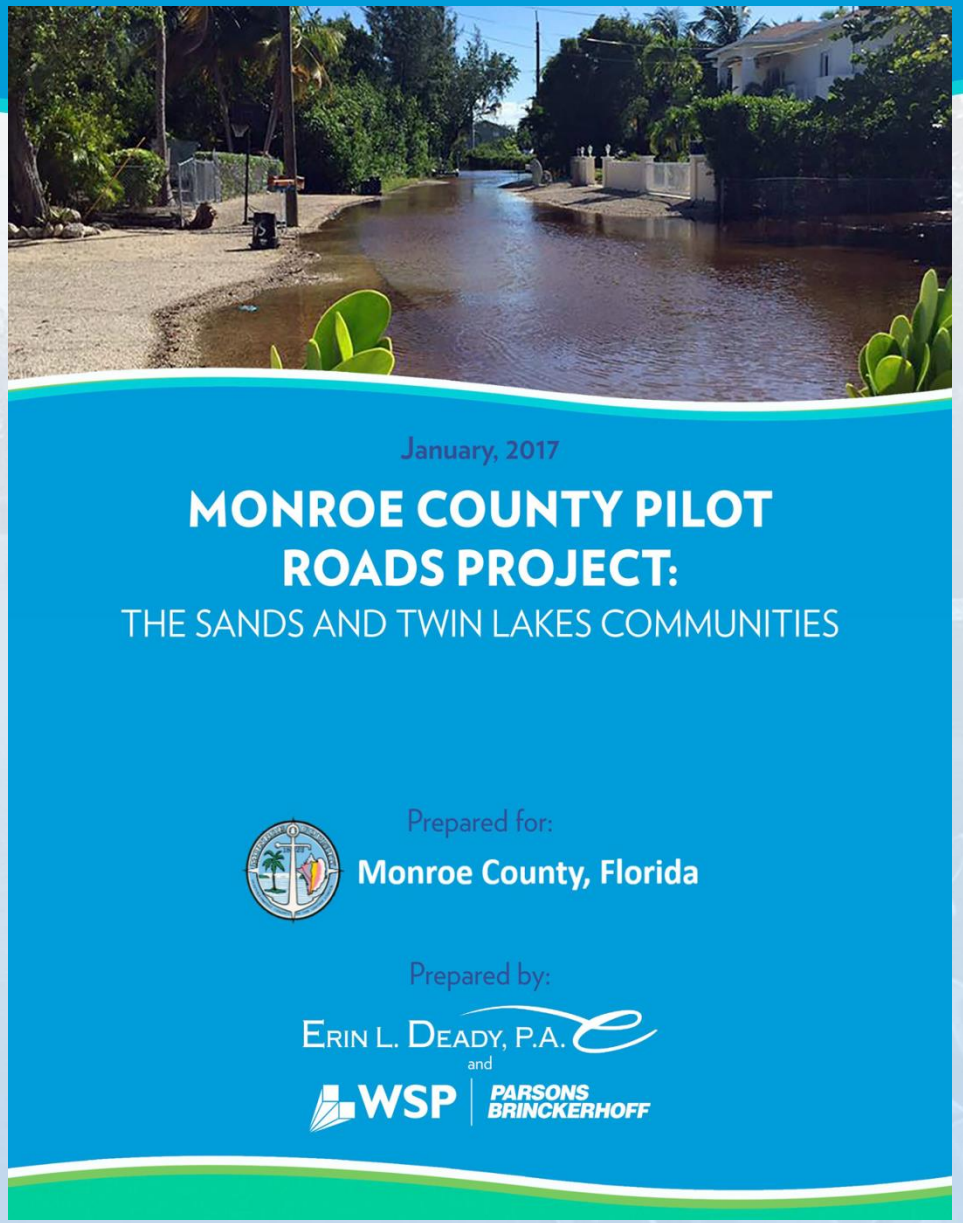
Project Work to Date

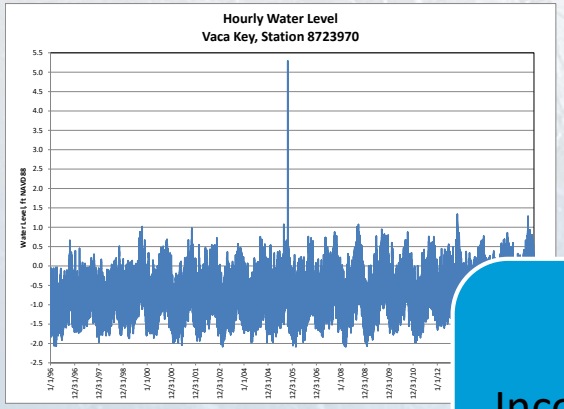


Report Contents

- Executive Summary
- Introduction
- Part I: Methodology and Technical Background
- Recommendations
- Part II: Legal and Policy Analysis
- Conclusions
- Appendices
- Appendix 1 – Methodology for development of flood level estimates for the two communities
- Appendix 2 – Draft Ordinance



Project Technical Assessment Process



1

Assess 20 Year Tidal Record and 2015 Event

2

Incorporate Sea Level Rise Estimates

3

Develop Possible Design Scenarios and Estimate Costs

4

Assess Neighborhood Access Benefits for Investments

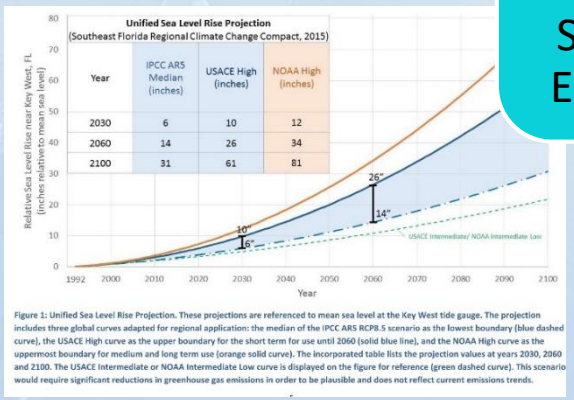
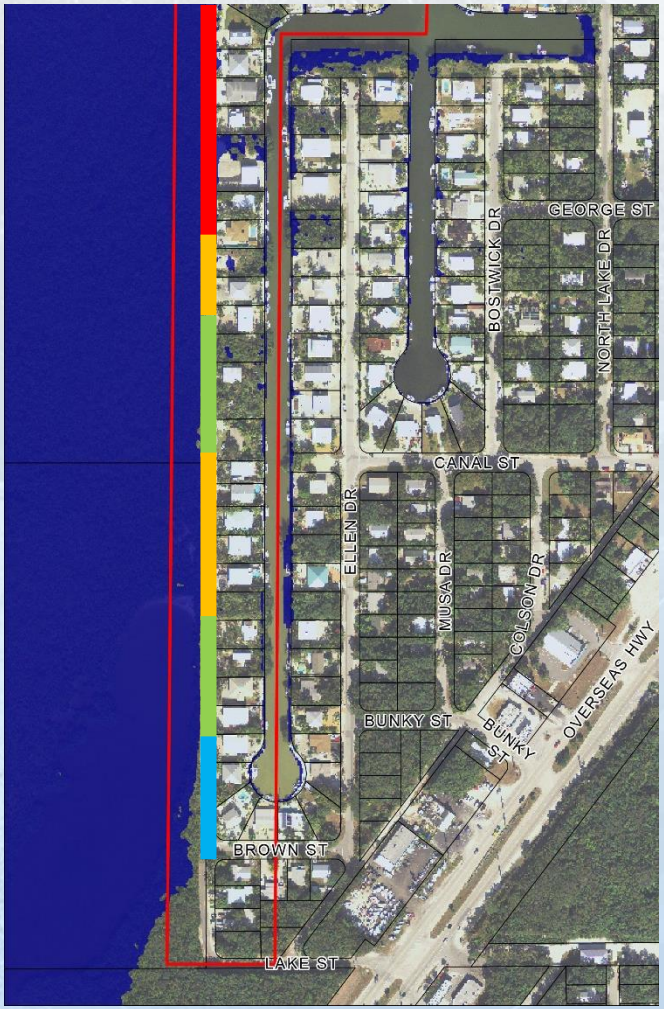
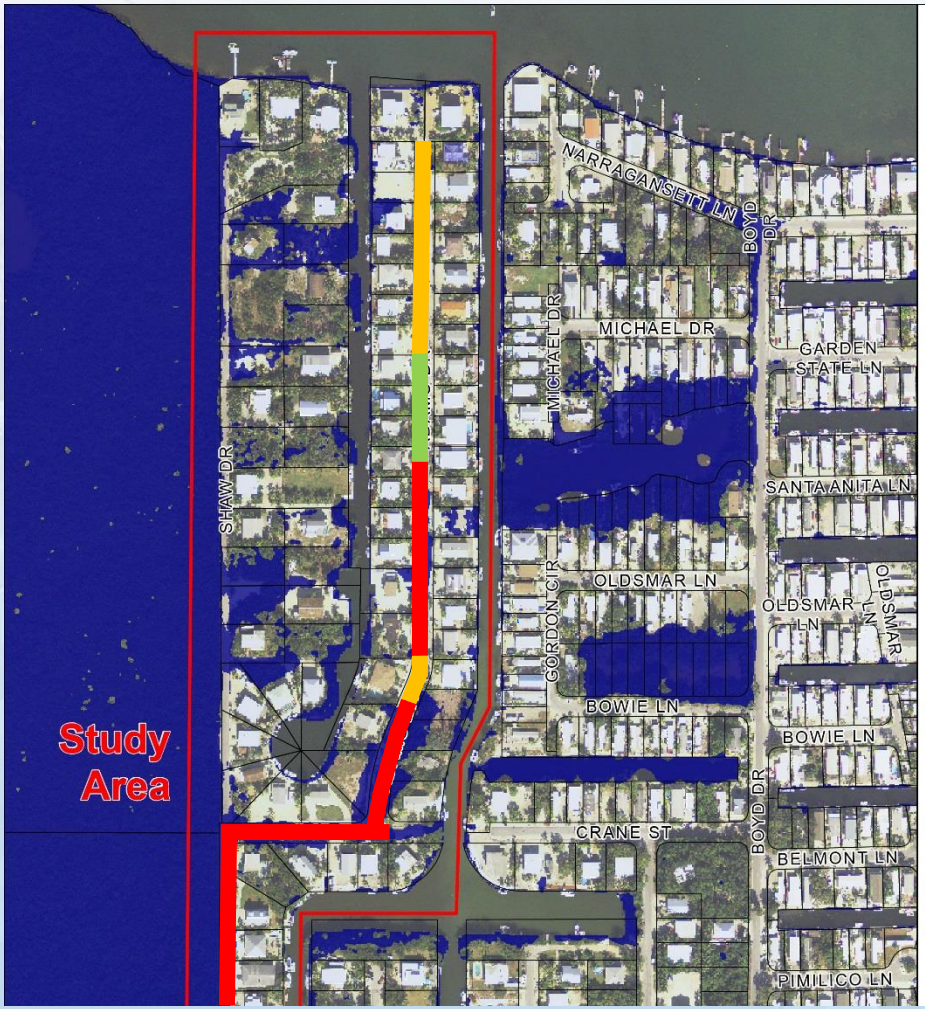


Figure 1: Unified Sea Level Rise Projection. These projections are referenced to mean sea level at the Key West tide gauge. The projection includes three global curves adapted for regional application: the median of the IPCC AR5 RCP8.5 scenario as the lowest boundary (blue dashed curve), the USACE High curve as the upper boundary for the short term for use until 2060 (solid blue line), and the NOAA High curve as the uppermost boundary for medium and long term use (orange solid curve). The incorporated table lists the projection values at years 2030, 2060 and 2100. The USACE Intermediate or NOAA Intermediate Low curve is displayed on the figure for reference (green dashed curve). This scenario would require significant reductions in greenhouse gas emissions in order to be plausible and does not reflect current emissions trends.

Roadway Elevation – Twin Lakes Community





Potential Flood Water Inundation

Vicinity of Shaw Drive

Key Largo
Monroe County, FL

Roadway Elevation
Inches NAVD88

- <6”
- 6-12”
- 12-18”
- 18-28”

Roadway Elevation – Sands Community

Design That Can Adapt to Changing Conditions

It is possible to build to one future condition and adjust if conditions change; includes road bed and drainage system now but allows future elevation of pavement

Adaptive and Resilient Design for Stormwater

Adaptive and Resilient Design for Stormwater

Implementation of Alternative Road/Stormwater Designs

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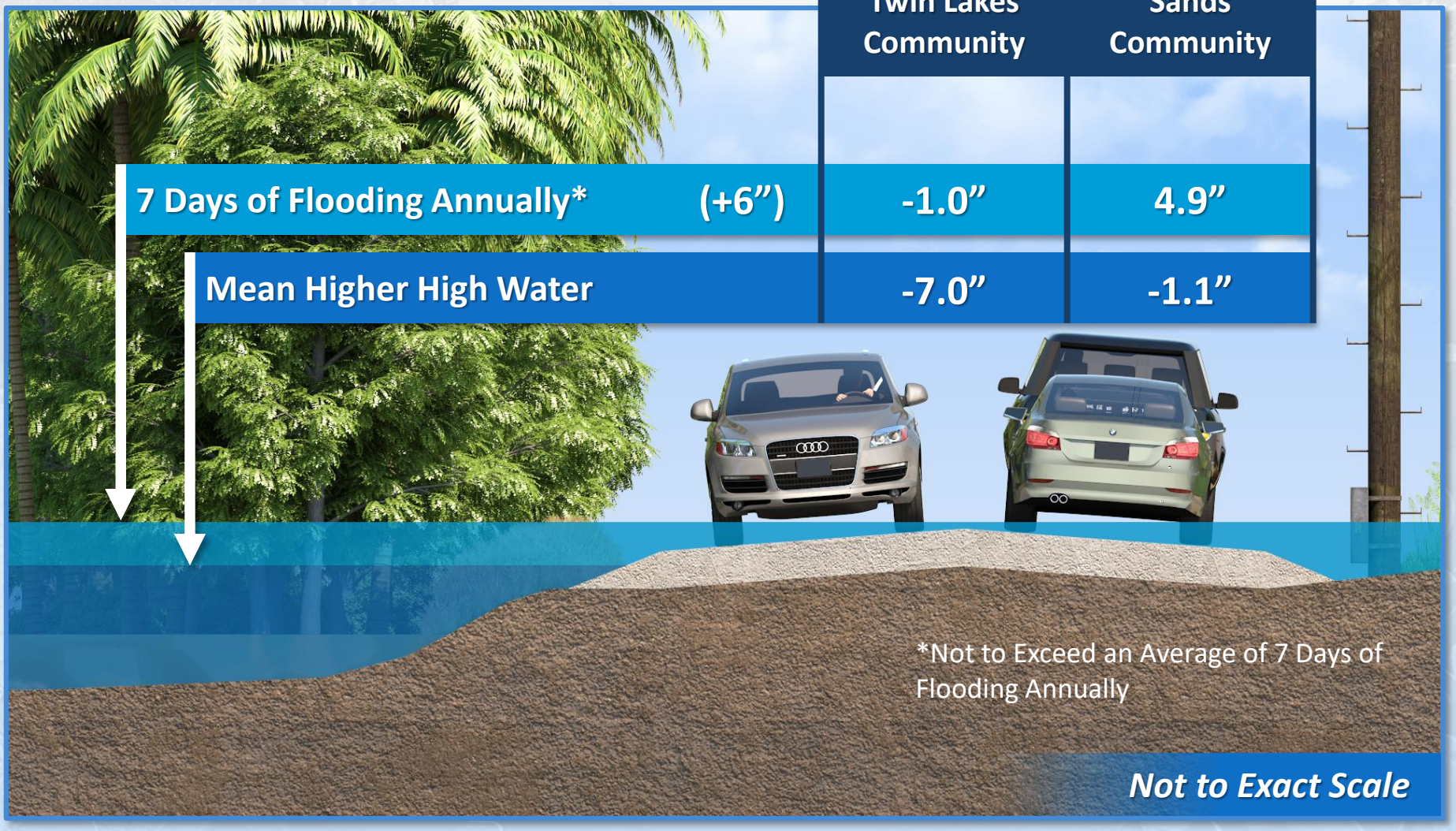
Sharpe, Hakluyt Lane, Cudjoe October 2016

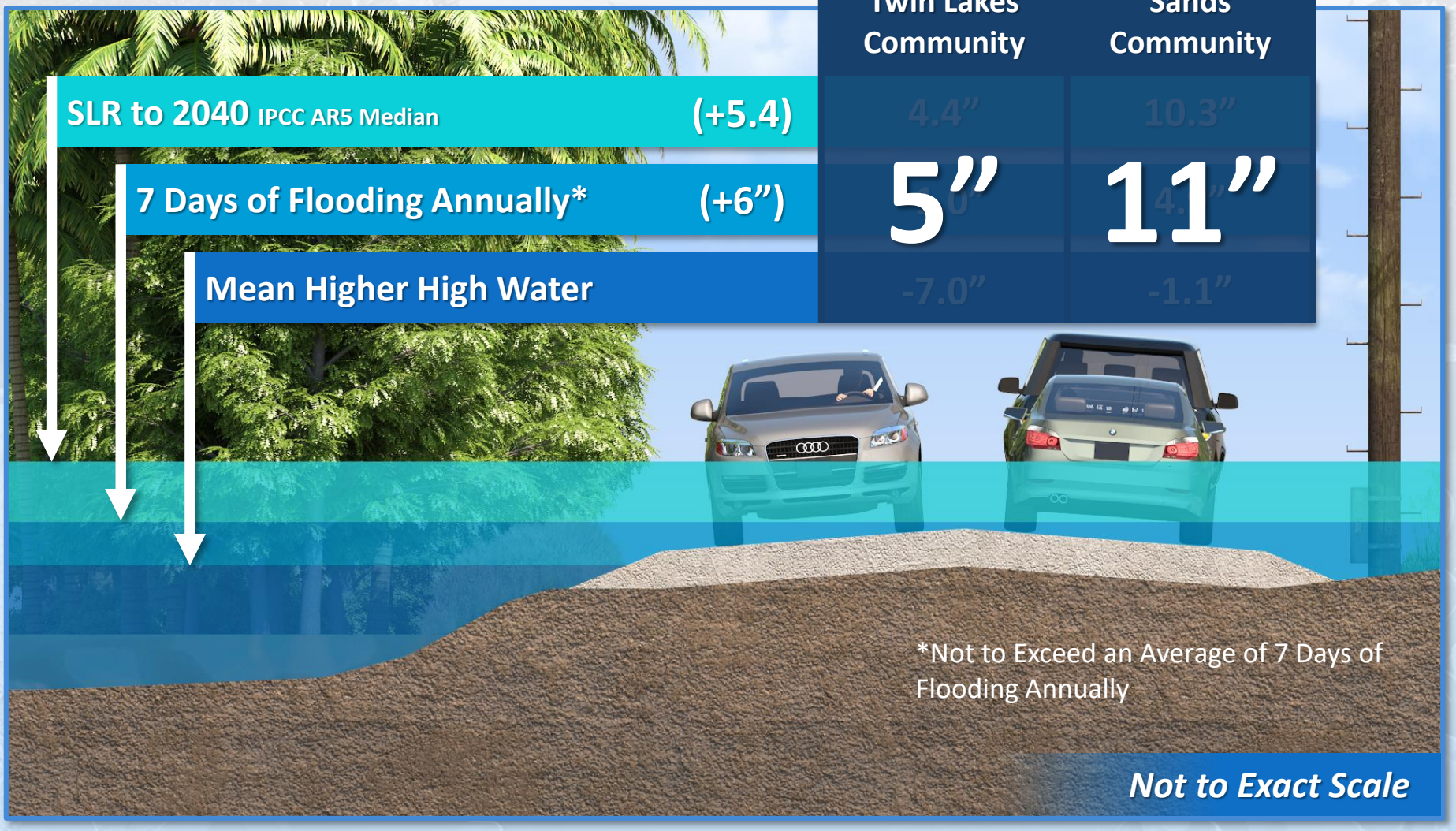
Technical Recommendations for Elevation

Technical Recommendations for Elevation

Technical Recommendations for Elevation



Technical Recommendations for Elevation



Design Alternatives for Community Response

Design Scenario: Raise the Roadways to 5” of Elevation in Twin Lakes

With Five Inches of Elevation Added to Lowest Roadway Points:

Time Period		Today	2040 Median SLR	2040 High SLR
Impacts from the 2015 Event	Average	☑	=~ 4"	=~ 9”
	Highest	=~ 9"	=~ 15"	=~ 19"
Return Period Conditions	< 30 days	☑	☑	=~ 1”
	< 7 days	☑	☑	=~ 4”
	< 1 day	☑	=~ 3"	=~ 7”
ROW Considerations		No expected ROW needs		
Cost		=~ $920K in Twin Lakes (at 6”)		

Numbers Represent Water Depths on Improved Roadway

Design Alternatives for Community Response

Design Scenario: Raise the Roadways to 11” of Elevation in the Sands Community

With Eleven Inches of Elevation Added to Lowest Roadway Points:

Time Period		Today	2040 Median SLR	2040 High SLR
Impacts from the 2015 Event	Average	☑	☑	=~ 4"
	Highest	=~ 5"	=~ 11"	=~ 15"
Return Period Conditions	< 30 days	☑	☑	=~ 1”
	< 7 days	☑	☑	=~ 4”
	< 1 day	☑	=~ 3”	=~ 7”
ROW Considerations		ROW may be needed		
Cost		=~ $2.6M in the Sands Community (at 12”)		

Numbers Represent Water Depths on Improved Roadway

Initial Results – Conceptual Cost Estimates for Design Scenarios

	Twin Lakes – Key Largo		Sands Community – Big Pine	
Elevation	Length of Roadway Elevated	Total Roadway and Drainage Cost	Length of Roadway Elevated	Total Roadway and Drainage Cost
6"	0.25 miles	$0.92 million	0.3 miles	$2.22 million
12"	0.7 miles	$4 million	0.35 miles	$2.63 million
18"	0.8 miles	$5.8 million	1.3 miles	$8.9 million
28"	0.9 miles	$7.3 million	1.5 miles	$10.5 million

Costs factored in: Maintenance of traffic, mobilization, design, construction, 15% of costs for construction engineering and inspection, 25% contingency and stormwater features.

Costs not factored in: right-of-way (~12" is threshold), driveway improvements

Policy Approach

- Interim Standard
- Ordinance
- Countywide Analysis

Appendix 1: Road Design Methodology

Appendix 1 narratively describes the steps in the process so they can be applied in other areas	Tidal datum based on current tidal epoch MHHW (NAVD88)		Elevation addition to not exceed 7 days of flooding annually based on 2015 sea level		Sea level rise estimate using IPCC AR5 Median (2015 to 2040)		Resulting target minimum elevation for roads (2040)** (NAVD88)
Sands Community	-1.1”	+	6.0”	+	5.4”	=	10.3”
Twin Lakes Community	-7.0”	+	6.0”	+	5.4”	=	4.4”

The negative values are in relation to the NAVD88 datum, where zero is a point approximately equal to the low point of the roadways in the two communities.

Appendix 2: Draft Ordinance

- 1. Describes Design Methodology from Appendix 1 and adopt … new road …
- 2. Ev…
- 3. If t… impro… et, but the local … be econo… et it, the Coun… an Envir…
- 4. De… ccess" (flooc… e closed or impacted)

Draft Ordinance Process Flow for Road Design

Sea Level Rise

- Determine project life (Year: ie, 2015-2040)
- Incorporate Median or Low sea level rise projection and "not to exceed" duration (30, 7 or 1)

Local Factors Evaluation

- Existing and future conditions
- Environmental Considerations
- Space Considerations
- Impact Evaluation

Decision: Can Road Meet Median or Low Sea Level Rise Projection with Design Criteria?

If no, further evaluation

If Yes, Design Criteria Evaluation Complete

Special Designation for Environmentally Challenging Locations

- Identify which local factors are problematic
- Identify how design criteria will differ

Meaningful Access Determination

- Determine the types of access issues
- Present to Board of County Commissioners

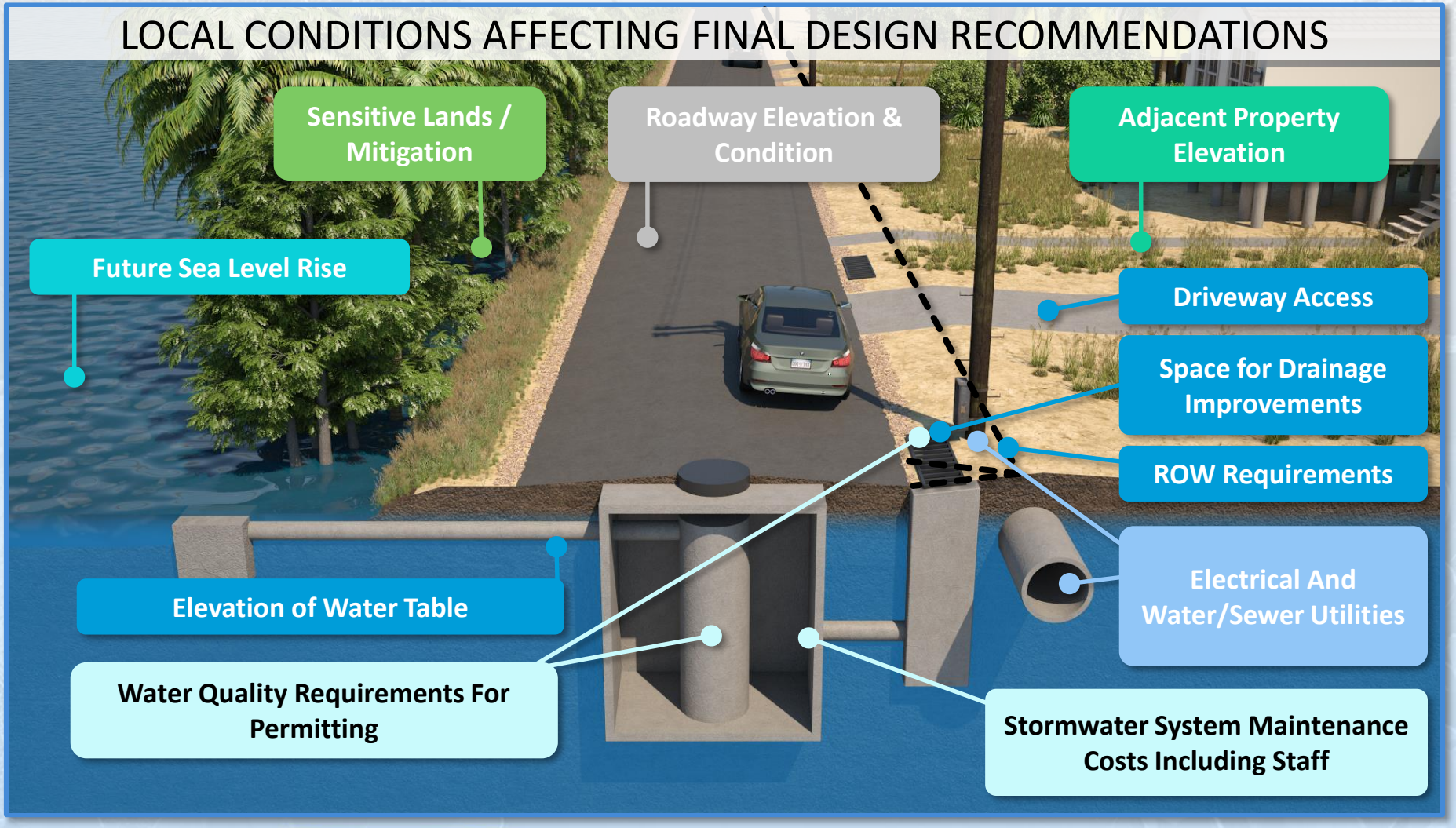
Local Conditions Analysis/Evaluation

- Physical site constraints;
- Current road conditions an
- Current elevation of adjace
- Sensitivity of the land or m
- Water quality requirement
- Right of way needs;
- Availability of land to accor
- Elevation of water table in
- Impacts to access for priva
- Future maintenance needs requirements; and
- Number of developed properties that the subject road services as the sole means of access.

Photo by Rob O'Neal

Implementation Considerations

LOCAL CONDITIONS AFFECTING FINAL DESIGN RECOMMENDATIONS



Pilot Roads Project: One Piece of the Puzzle

- County awarded competitive bid for improved elevation data (LIDAR)
- County launching grant from NOAA to run new hazard models to better define threats from SLR and surge (can potentially run other scenarios needed for CRS)
- Grant applications to do sea level rise planning on certain at-risk facilities (Bayshore Manor & Harry Harris)

- Countywide roads analysis in the next year to identify priorities based on timeframe of vulnerability (144-188 road miles at risk by 2030)

- Starting to incorporate SLR considerations in capital improvements
- Adopting policy for specific criteria in road projects

Resolution #1: Approve Final Report and Move Forward with Pilot Communities Design

- The Bo… the Final R… oject: The Sa…
- The Bo… s staff to buc… ve forwa… Recom… he Final Repor… The Sands…
  - Rais… ig Pine
  - Esti… get item in R…
  - Cor… lion

Resolution #2: Standard and Undertake Cou

- Appendix 1 Me rt for the Monroe Count s and Twin Lakes Communities w erim Standard (not > 7 days ti roject year) for determining th nt project until a Revised Standa
- Move forward ysis project to identify near-te n risk, including nuisance flood
- The Board of C irects staff to budget funds i ountywide Roads Analysis projec
  - GreenKeys Pl project in 5 Year Work Plan

King Avenue, Key Largo
Rodriguez, 10/14/16

THIS IS THE END
OF THE TRAIL.