Grand Cayman National Roads Authority East-West Arterial Extension Transportation Modeling & Conceptual Design

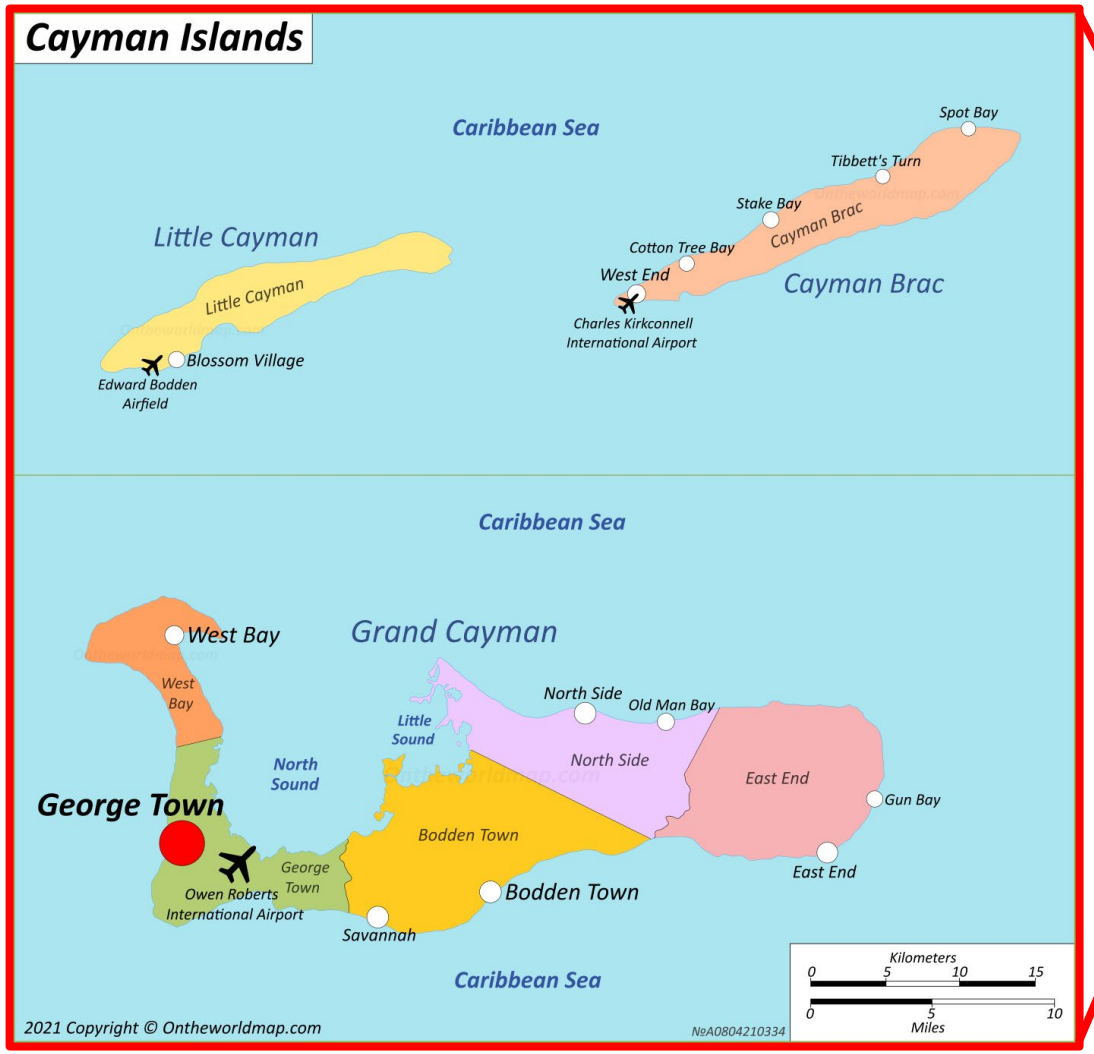
ASHE Harrisburg
19th Annual Joint Conference

April 29th, 2025

Agenda

- Grand Cayman Characteristics
- Overall Multi-Resolution Modeling Toolbox
- Modeling Applications – East-West Arterial (EWA) Extension
- EWA Extension Conceptual Design
- Proposed Project Characteristics
- Estimated Project Costs & Value Engineering

Where are the Cayman Islands?



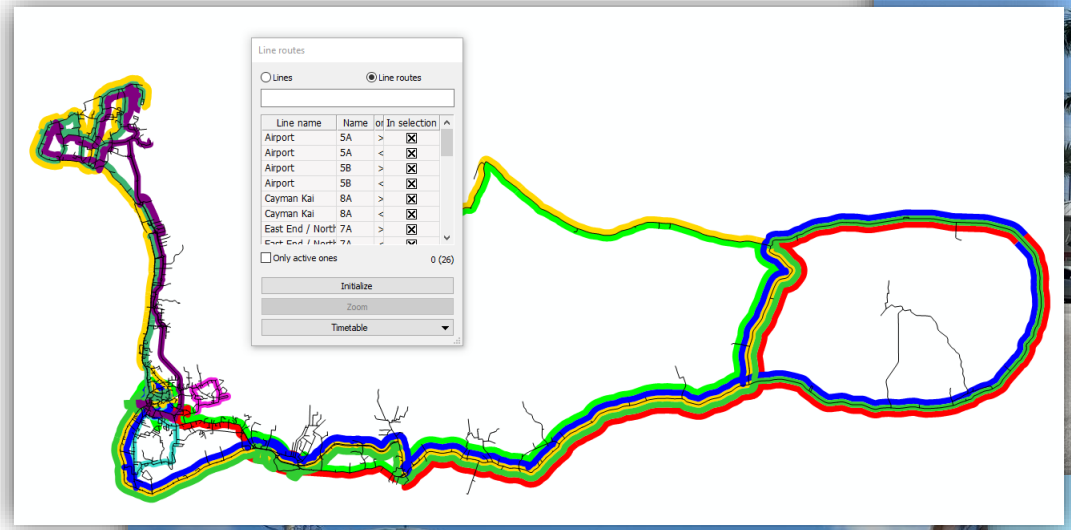
Grand Cayman Characteristics

Grand Cayman Characteristics

- **Largest of the three Cayman Islands**
  - Approximately 80,000 residents
  - Approximately 76 square miles
- **Congestion**
  - Extensive rush hour queuing and congestion
- **Anticipated Growth in Travel**
  - Rapid pace of development
  - Growth in tourism

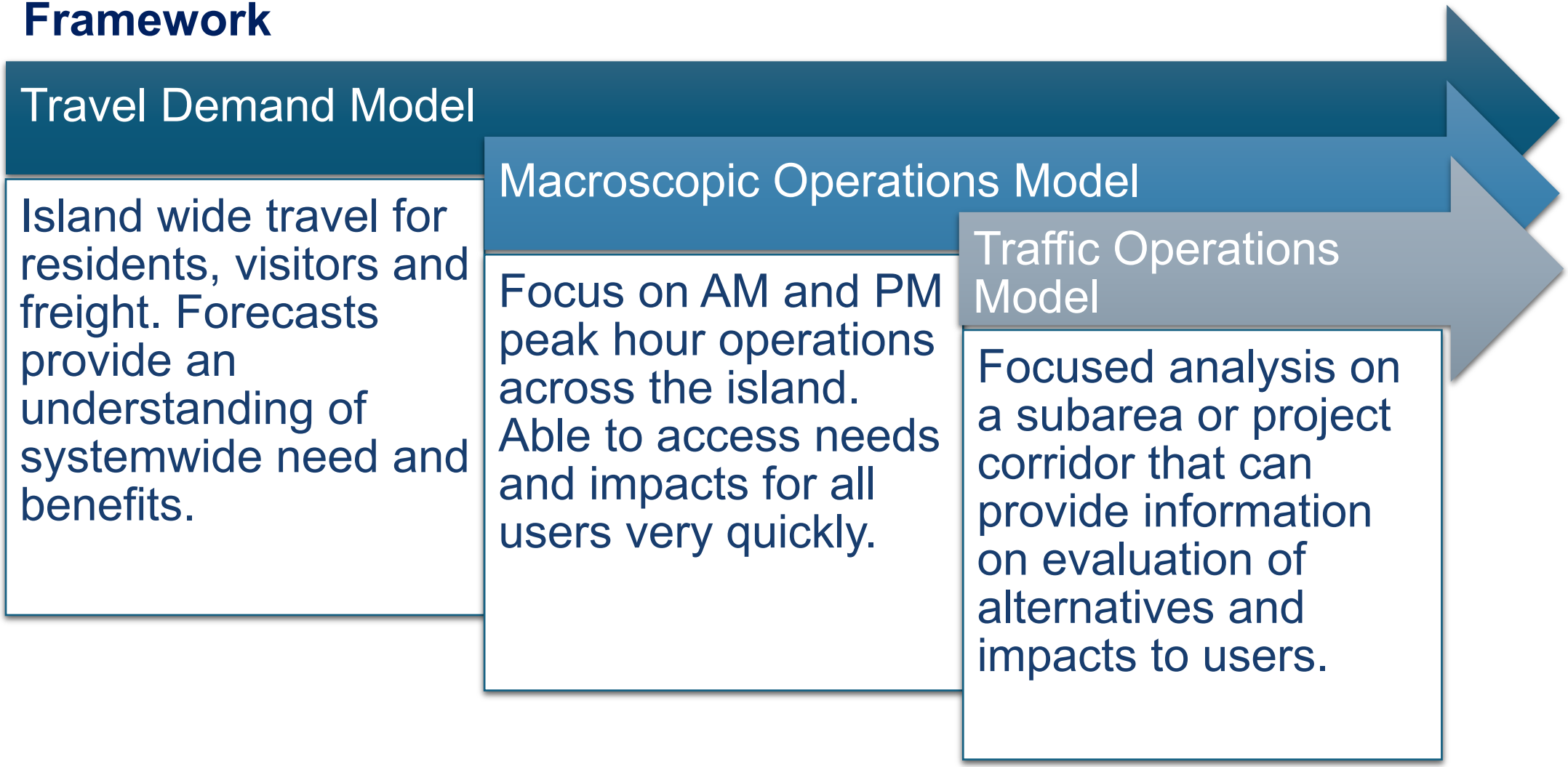
Grand Cayman Characteristics

- **Transit**
  - School Buses
  - Fixed Route Transit
- **External Stations**
  - Sea Port
  - Airport
- **Multimodal**
  - Auto, freight, pedestrians, bikes, transit, taxi
- **Mix of travelers**
  - Residents
  - Short-term visitors
  - Long-term visitors



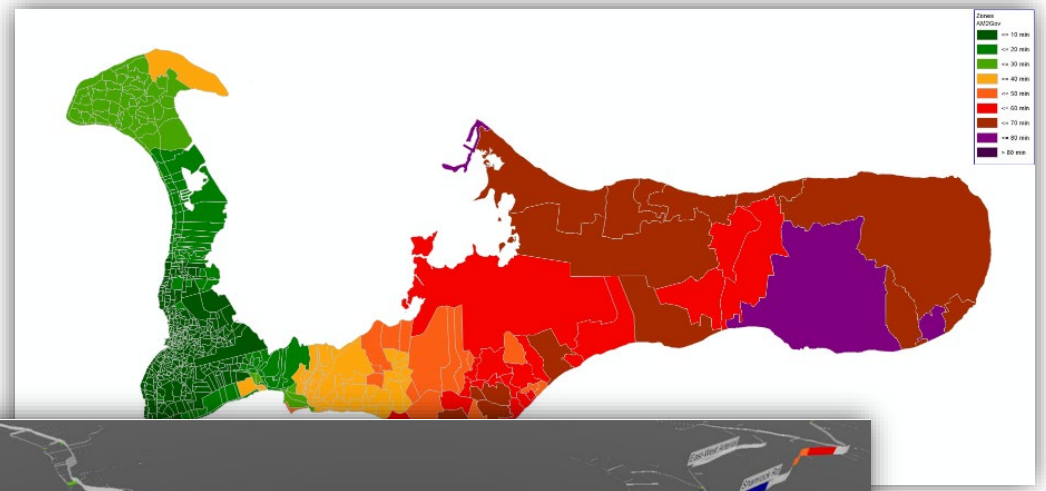
Multi-Resolution Modeling Toolbox

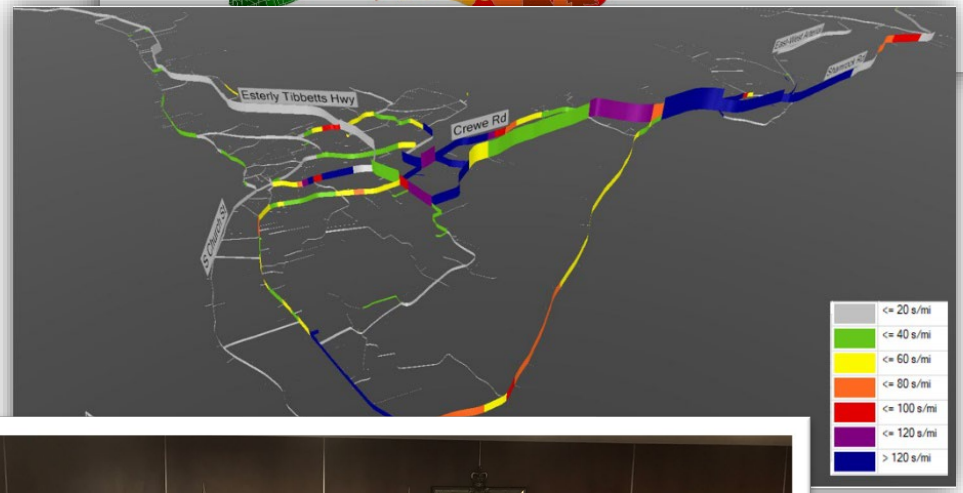
Framework



Decision Support

- ✓Provides both technical and non-technical audiences with several key answers **to help make better decisions <u>in a timely manner</u>**.
- ✓Provides analytical support for short- and long-term roadway projects:
  - ❖Roadway widening
  - ❖Roadway closures
  - ❖Mitigation strategies to restore baseline conditions
  - ❖Roundabout reconfigurations
  - ❖Roundabout metering
  - ❖Pedestrian access to/from development areas
- ✓Streamlined process **<u>saves time</u>**!





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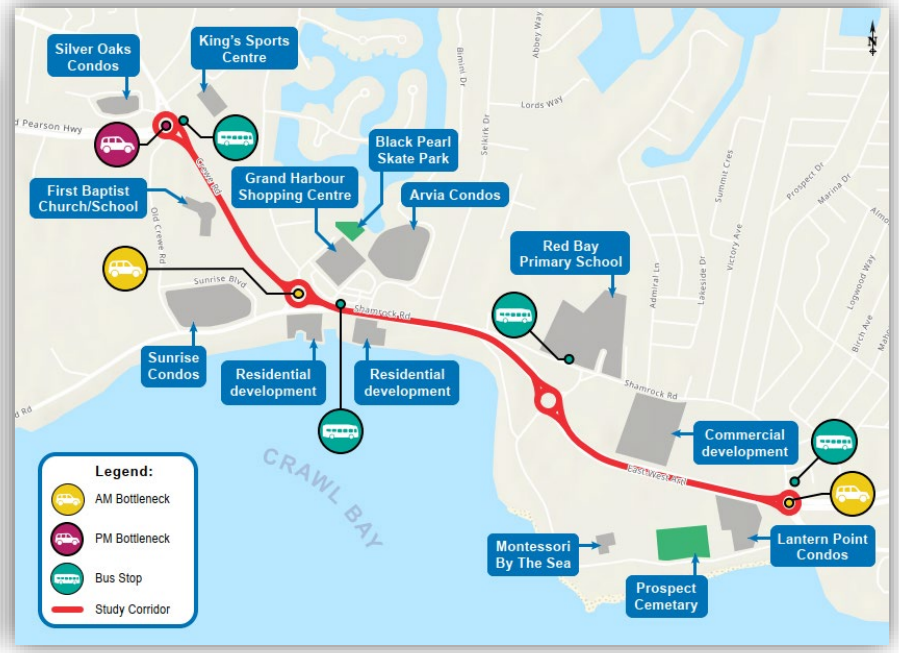
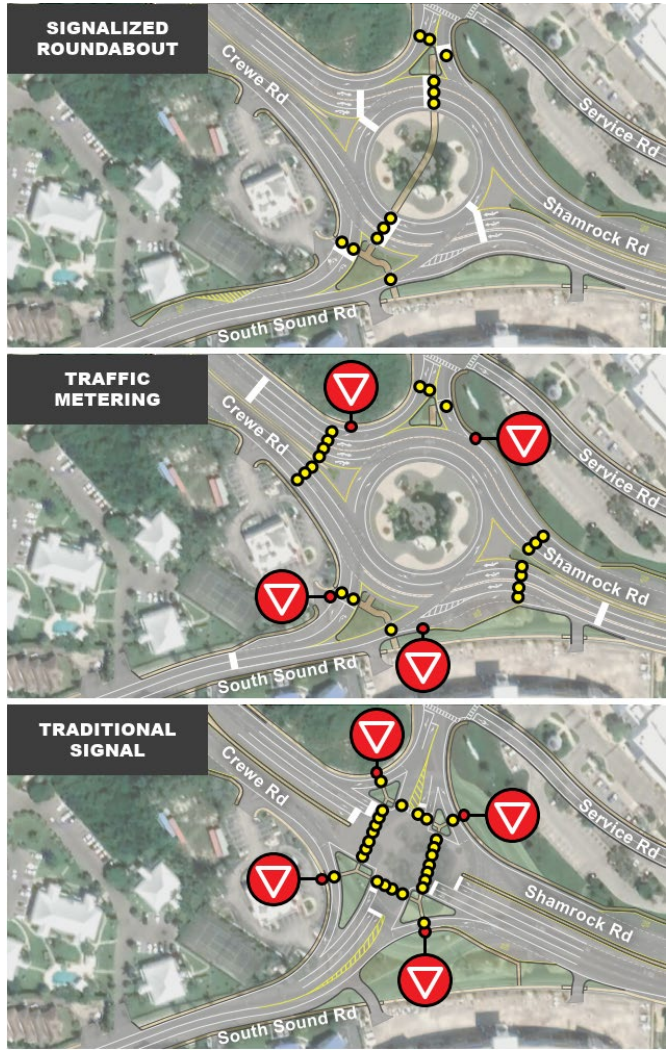
Transportation Modeling Application

Multimodal Corridor Plan

- **Purpose:** Provide concepts to improve multimodal access and safety
- Competing needs: Maximizing throughput while providing safe pedestrian crossings
- Developed public-facing planning document presenting intersection concepts



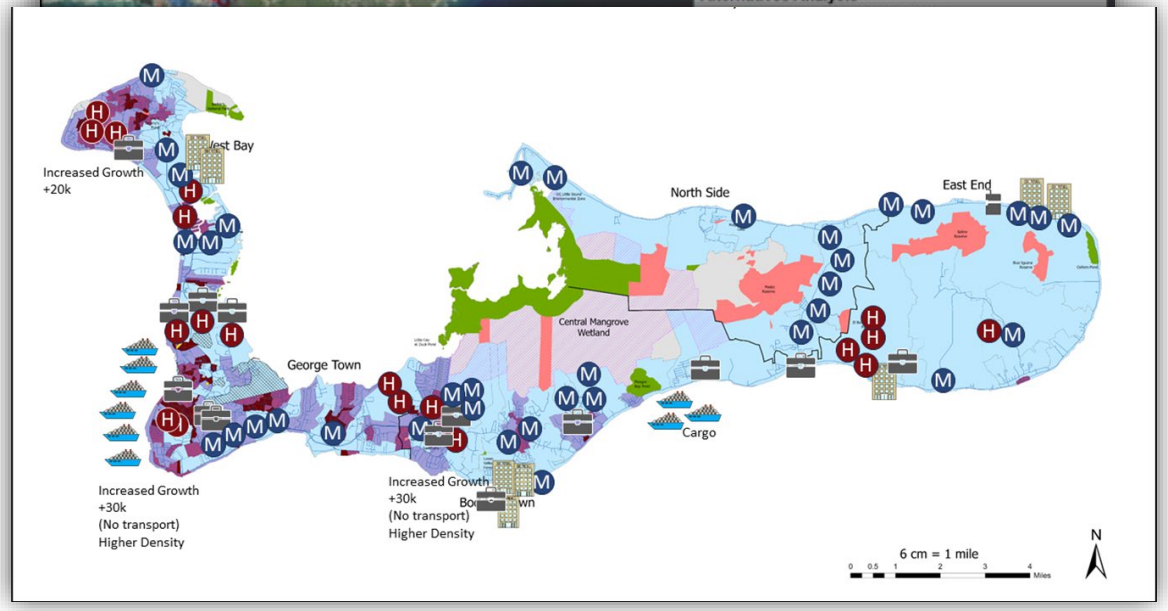
Pedestrian Insights



Transportation Modeling Application

East-West Arterial (EWA) Extension

- **Purpose:** Environmental Impact Assessment of proposed roadway
- Macroscopic model calibrated to travel time data for realistic future year travel time savings
- Included multiple land use, roadway network, and peak-specific scenarios
- Future land use scenarios with varying levels of anticipated tourism, employment, and population growth

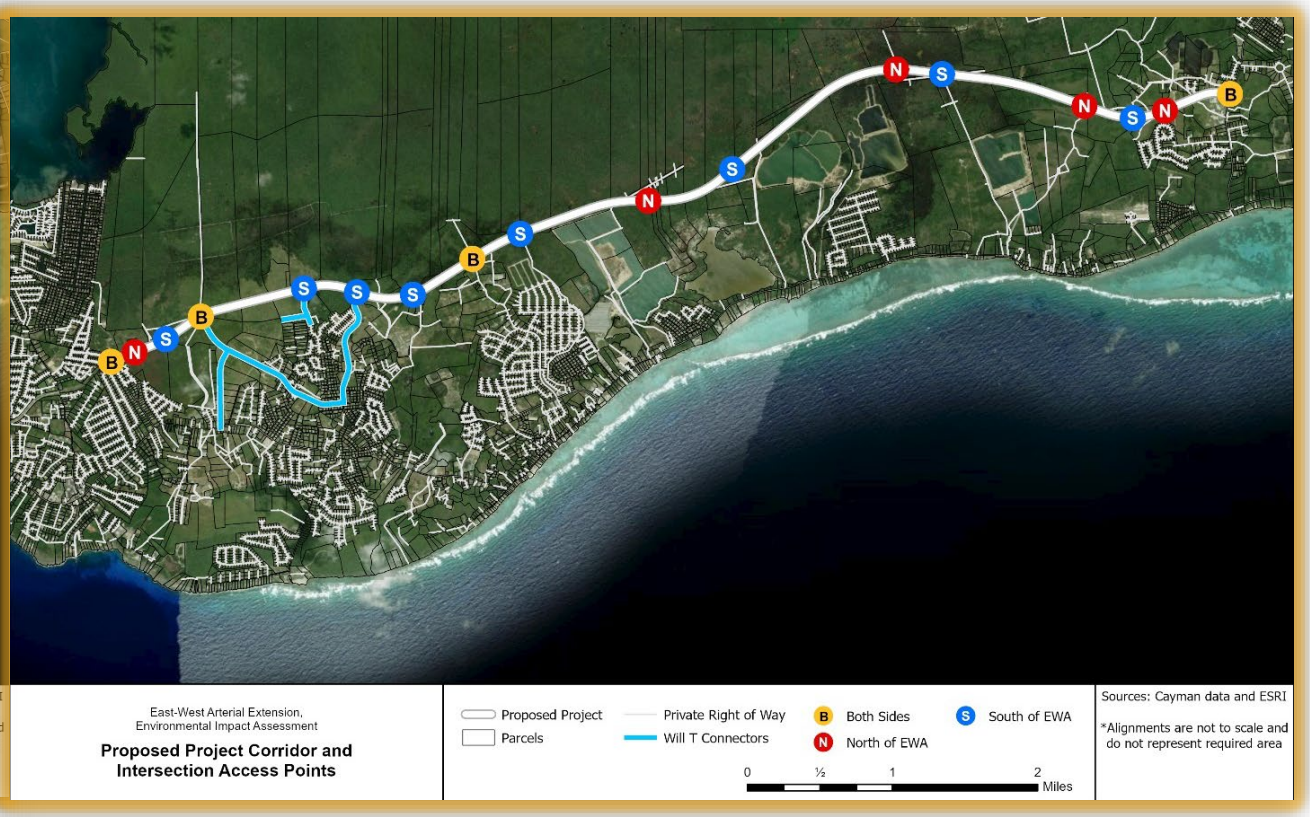


Transportation & Mobility

EWA Extension
Proposed Project Corridor & Intersection Access Points

Future Year 2026

Future Years 2036, 2046, & 2074

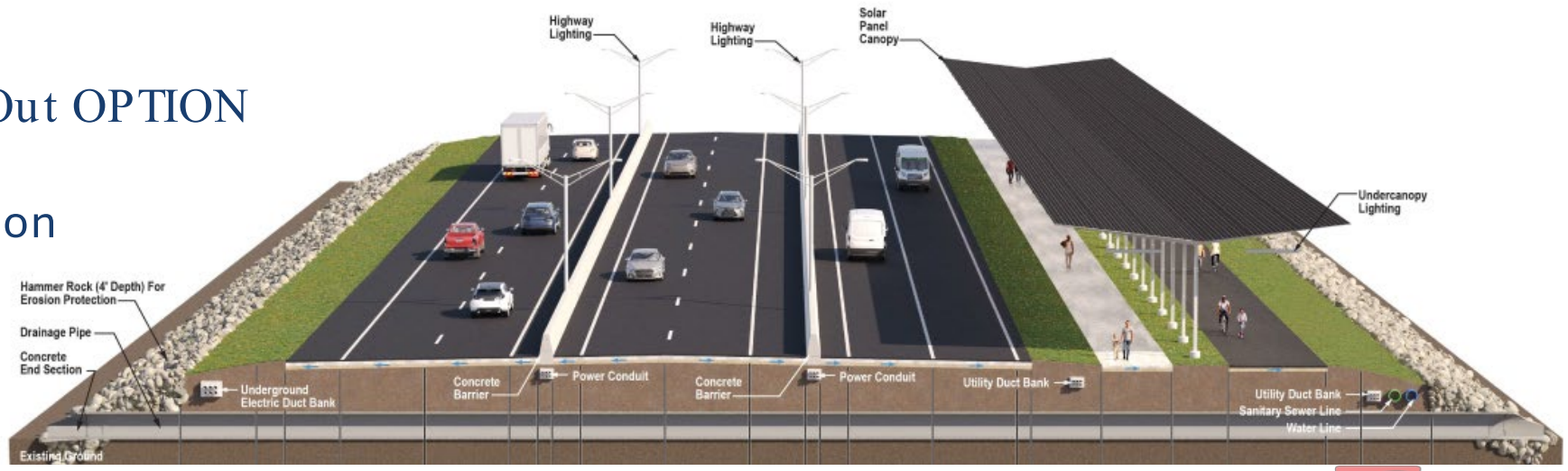


Transportation & Mobility

EWA Extension
Proposed Project Typical Sections

First Phase of the Project
Sections 2 & 3
2026 Typical Section

Potential Ultimate Build Out OPTION
Sections 2 & 3
2060 Typical Section



Transportation & Mobility

EWA Extension
Proposed Project Benefits

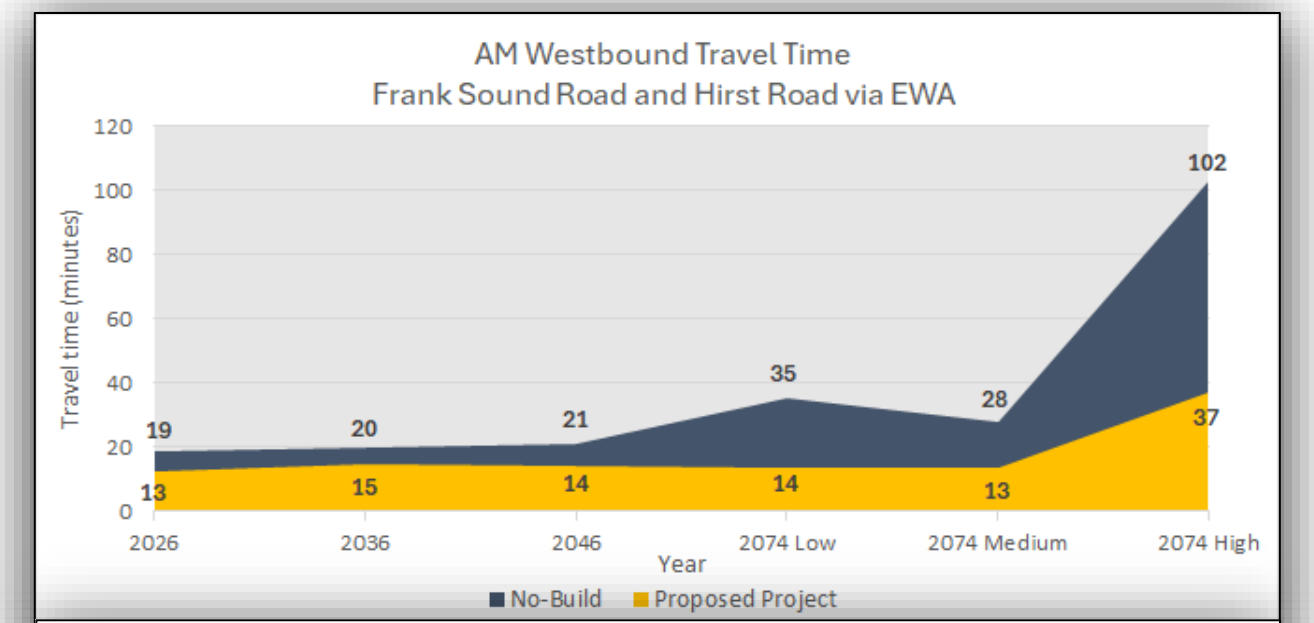
Provides alternate route for daily travel and in the event of road closures or flooding along the coastal road.

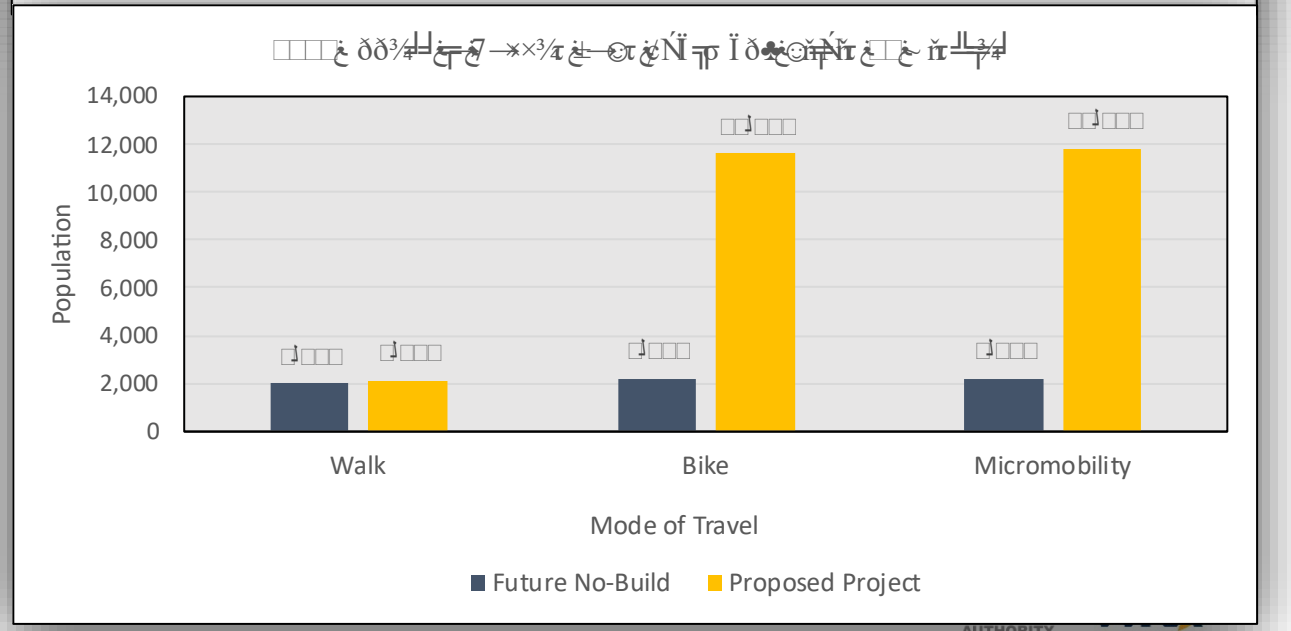
Provides resiliency to the coastal road by shifting traffic to the safer EWA facility, proportionally reducing crashes and resulting road closures.

Supports current/future traffic demand and improves travel times when compared to the Future No-Build condition.

Accommodates dedicated transit lanes.

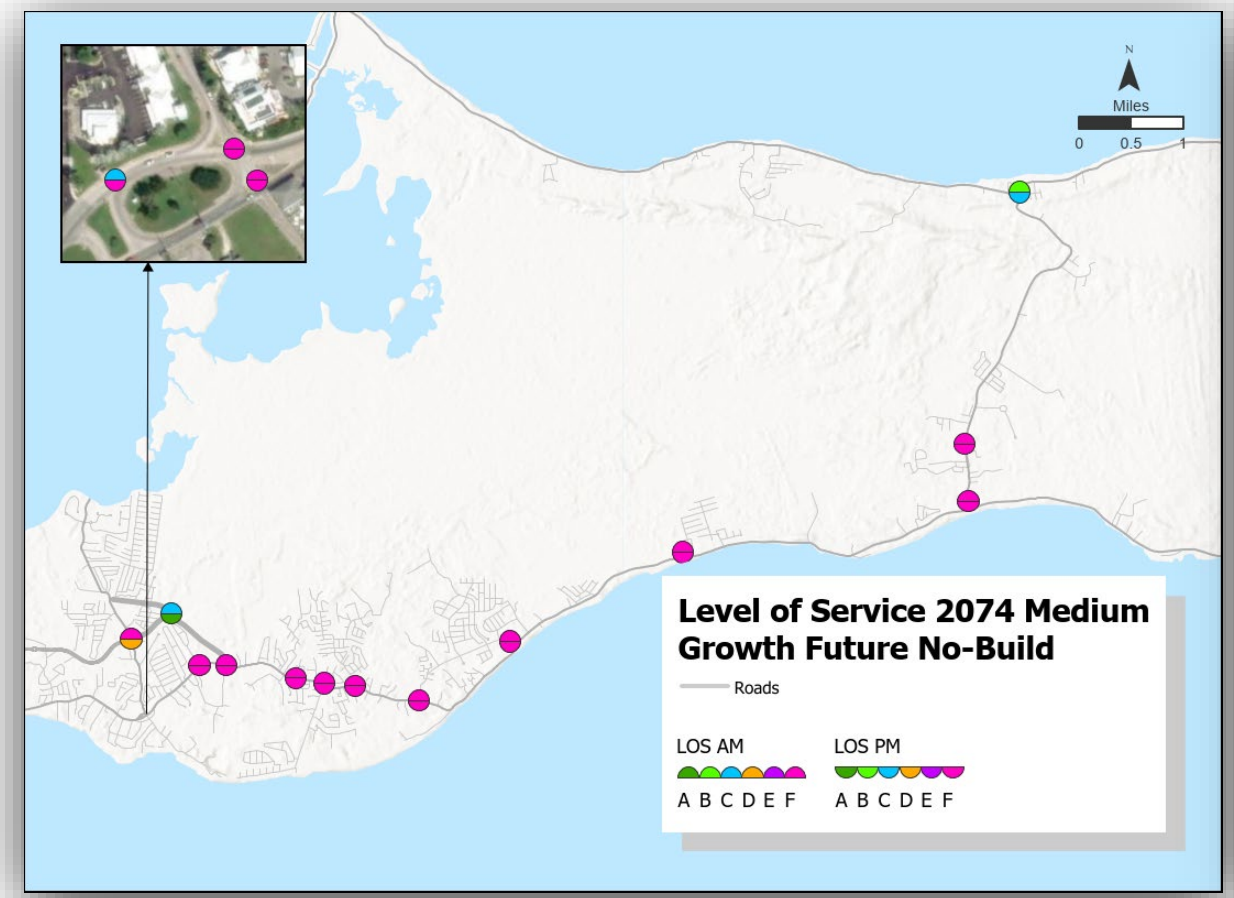
Improves nonvehicular access to key destinations.

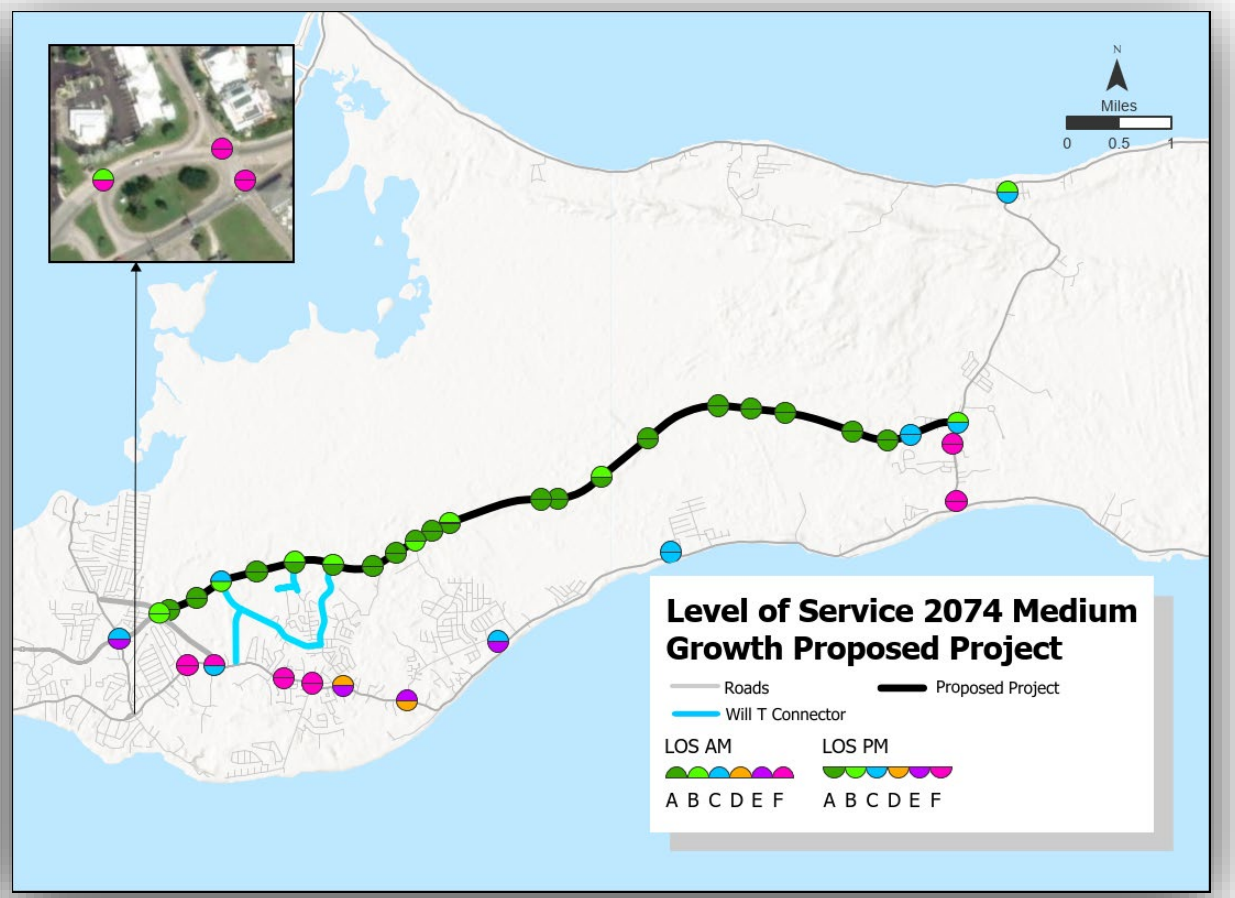




Transportation & Mobility

East-West Arterial Extension
Proposed Project Benefits – Intersection Level of Service





Transportation & Mobility

East-West Arterial Extension
Proposed Project Benefits – Bicycle Level of Traffic Stress

LEVEL OF TRAFFIC STRESS (LTS):

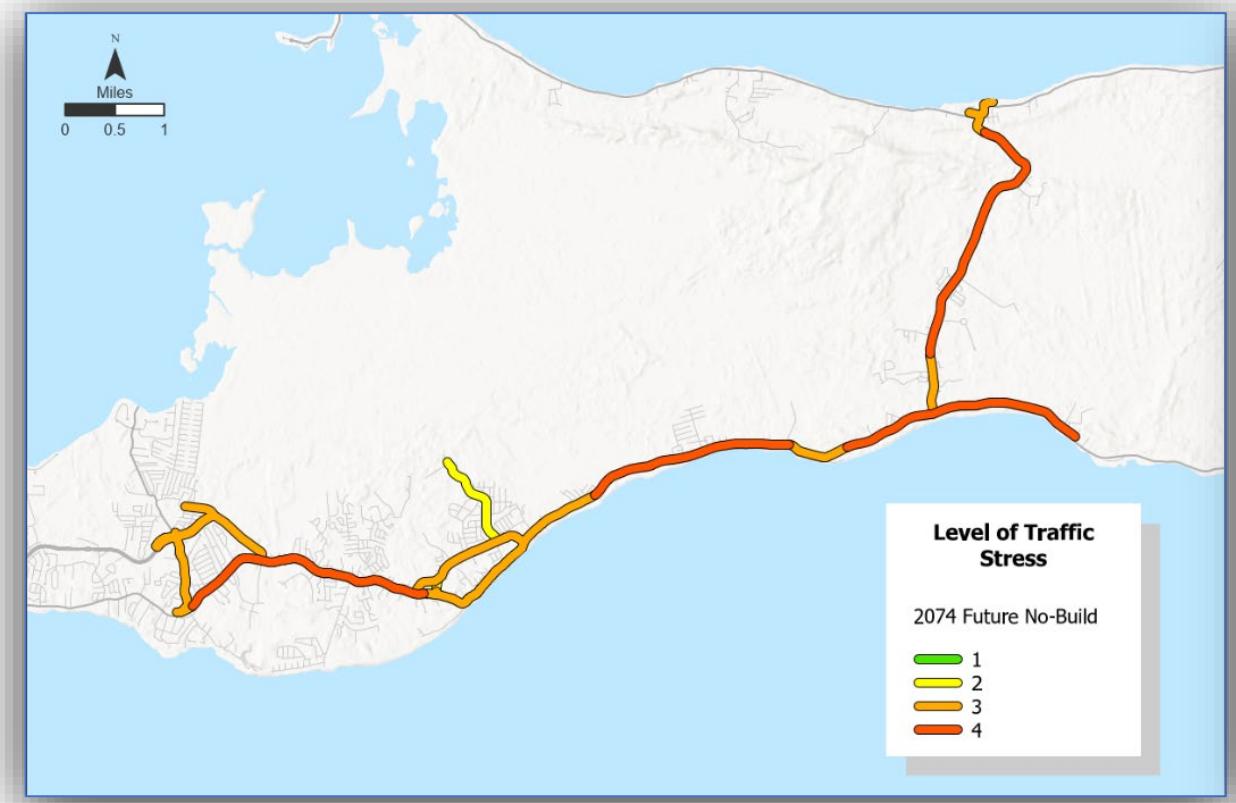
LTS 1 – suitable for children – there is physical separation from traffic or mixing with traffic on low speed, low volume roadways

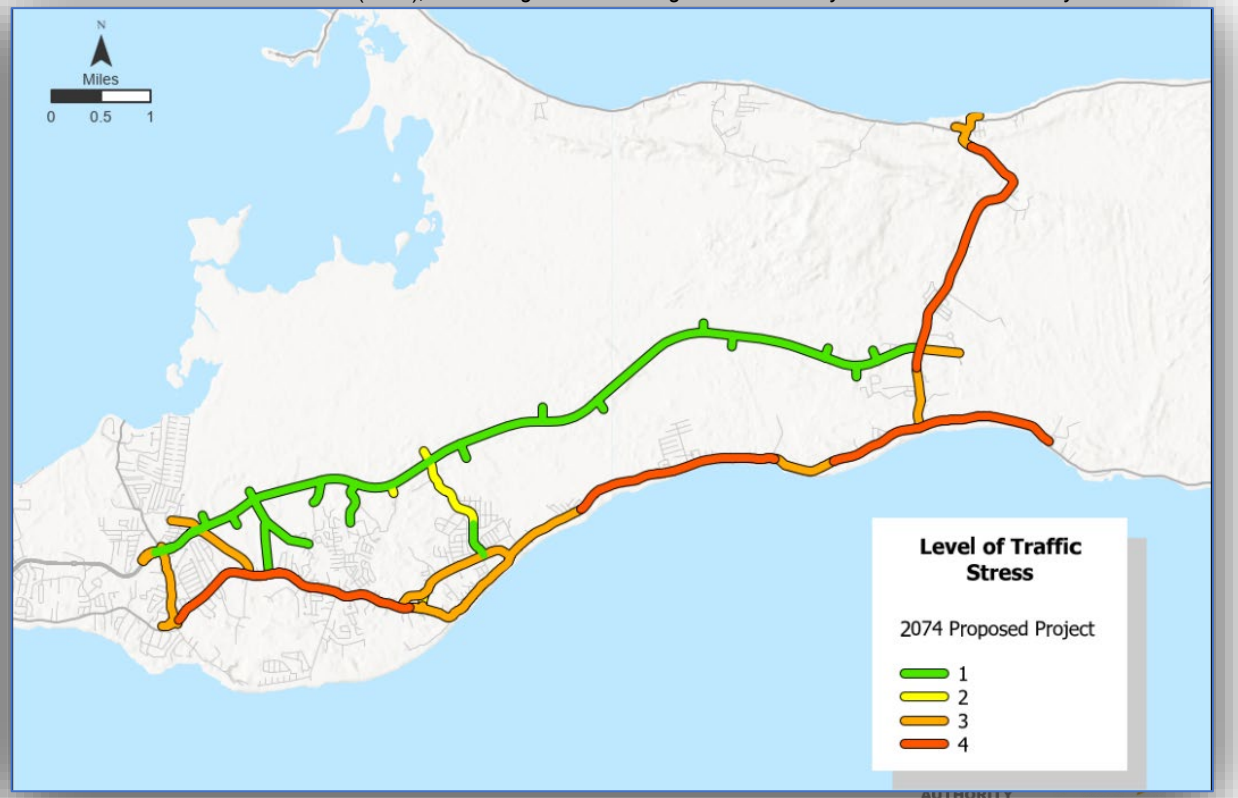
LTS 2 – suitable for the average adult – there is physical separation from high speed and multilane traffic or mixing with traffic on low, but higher than LTS 1, speed and volume roadways

LTS 3 – suitable for "enthusiastic and confident" riders – there is mixing with traffic on moderate speed, multilane traffic or mixing with high speed traffic with some separation

LTS 4 – suitable only for "strong and fearless" riders – there is mixing with high speed traffic with little separation

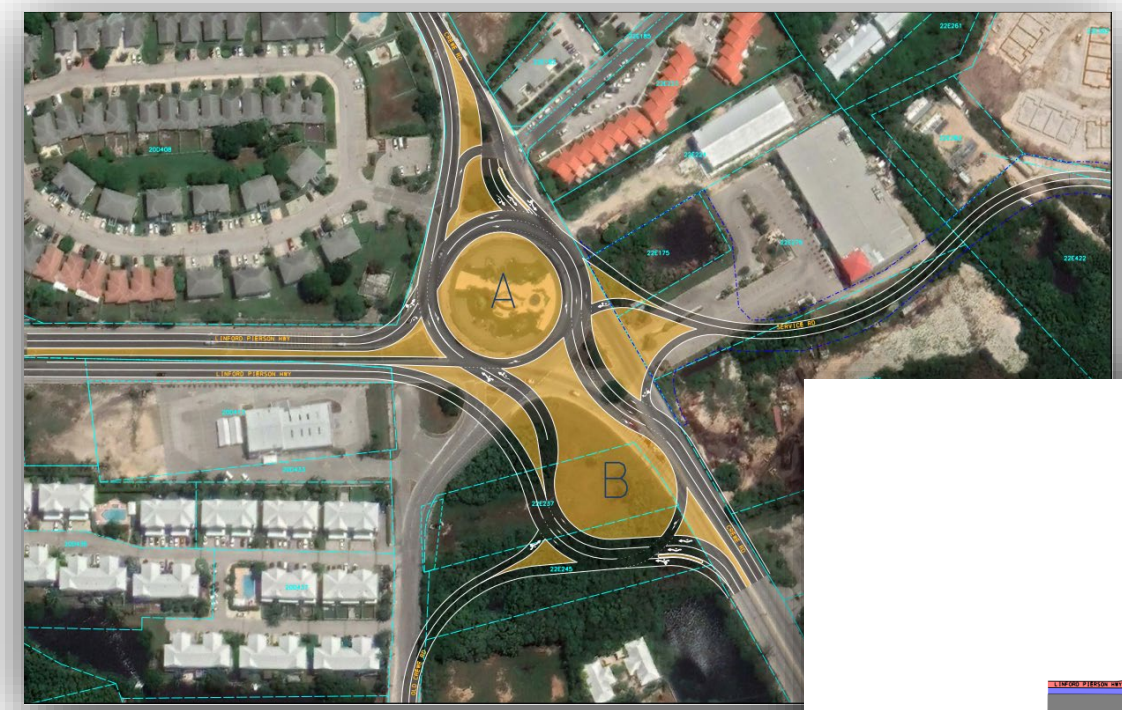
Source: Furth & Putta (2016), *Visualizing and Measuring Low-Stress Bicycle Network Connectivity in Delaware*

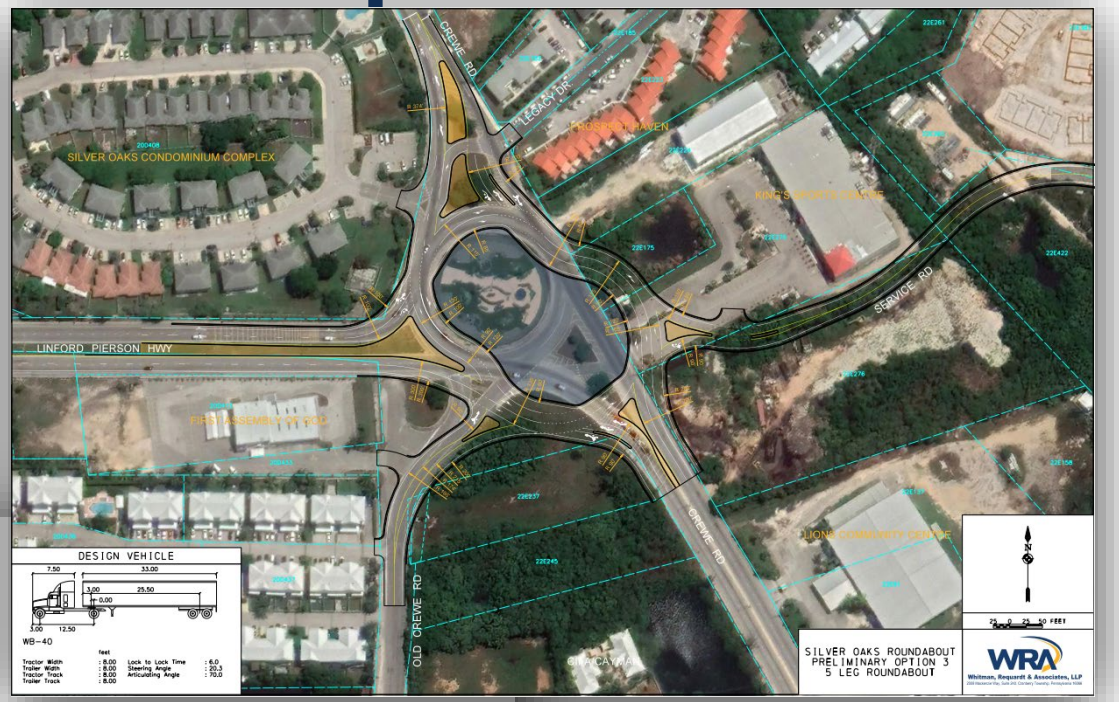


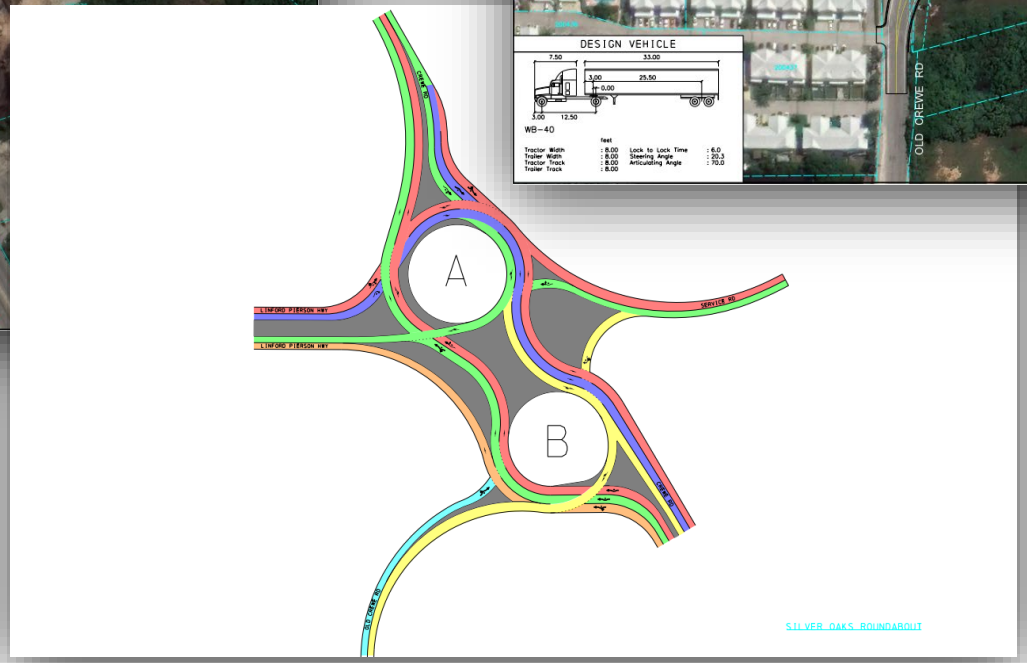


Cayman Roundabout Concepts

Silver Oaks Roundabout Concepts

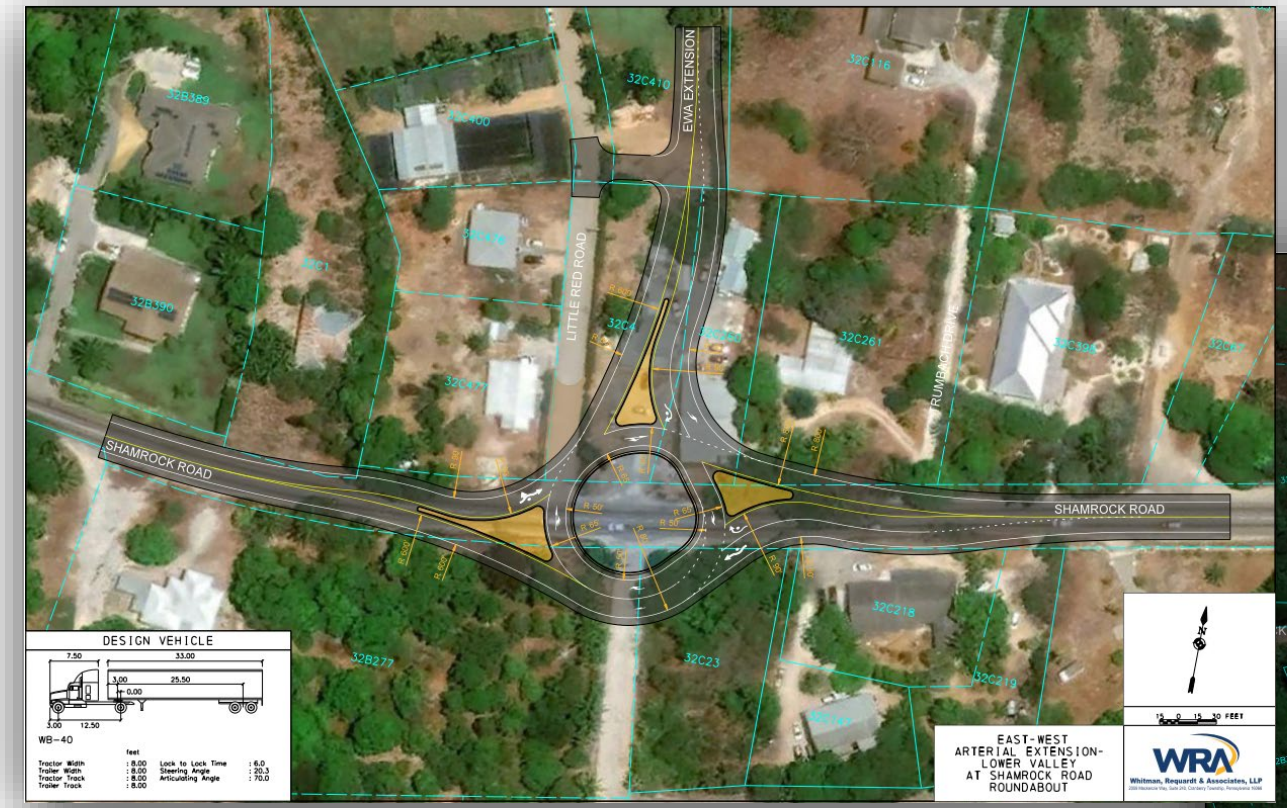




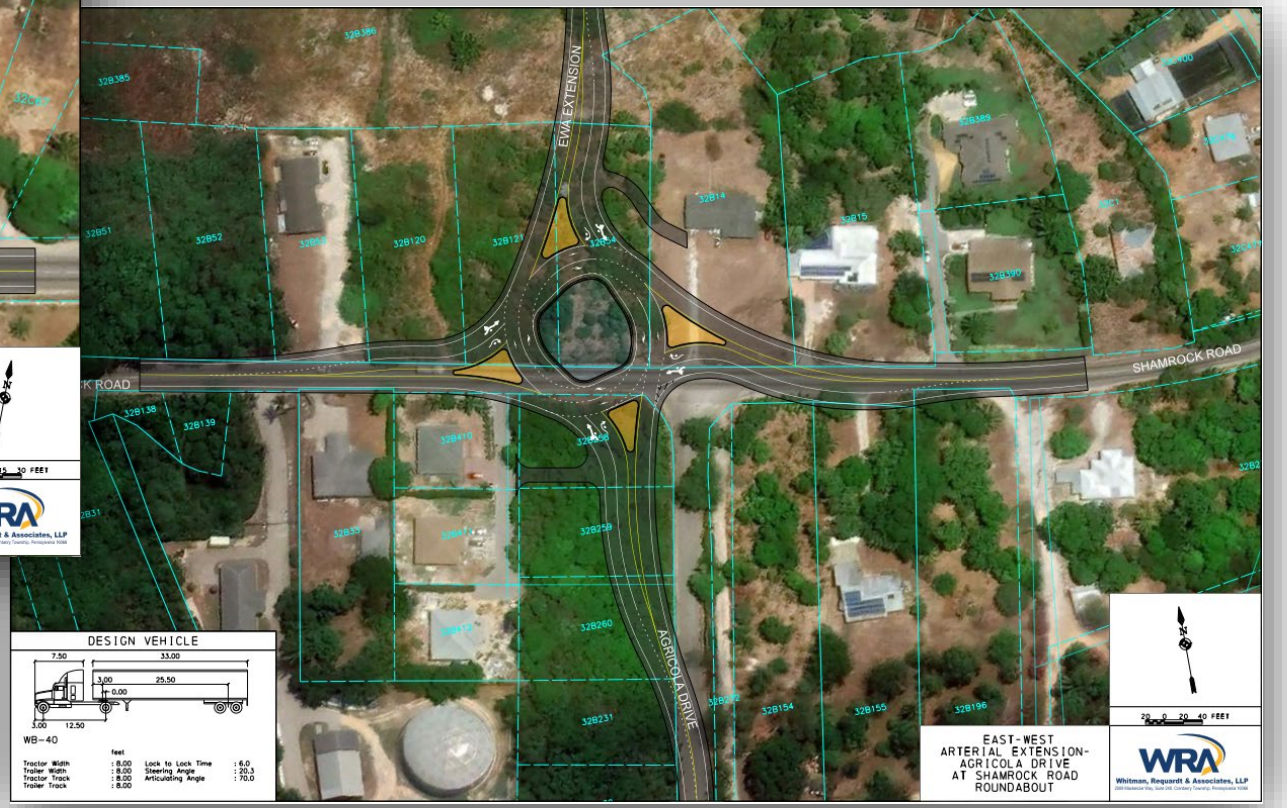


Cayman Roundabout Concepts

Lower Valley Roundabout Concept



Agricola/Shamrock Roundabout Concept



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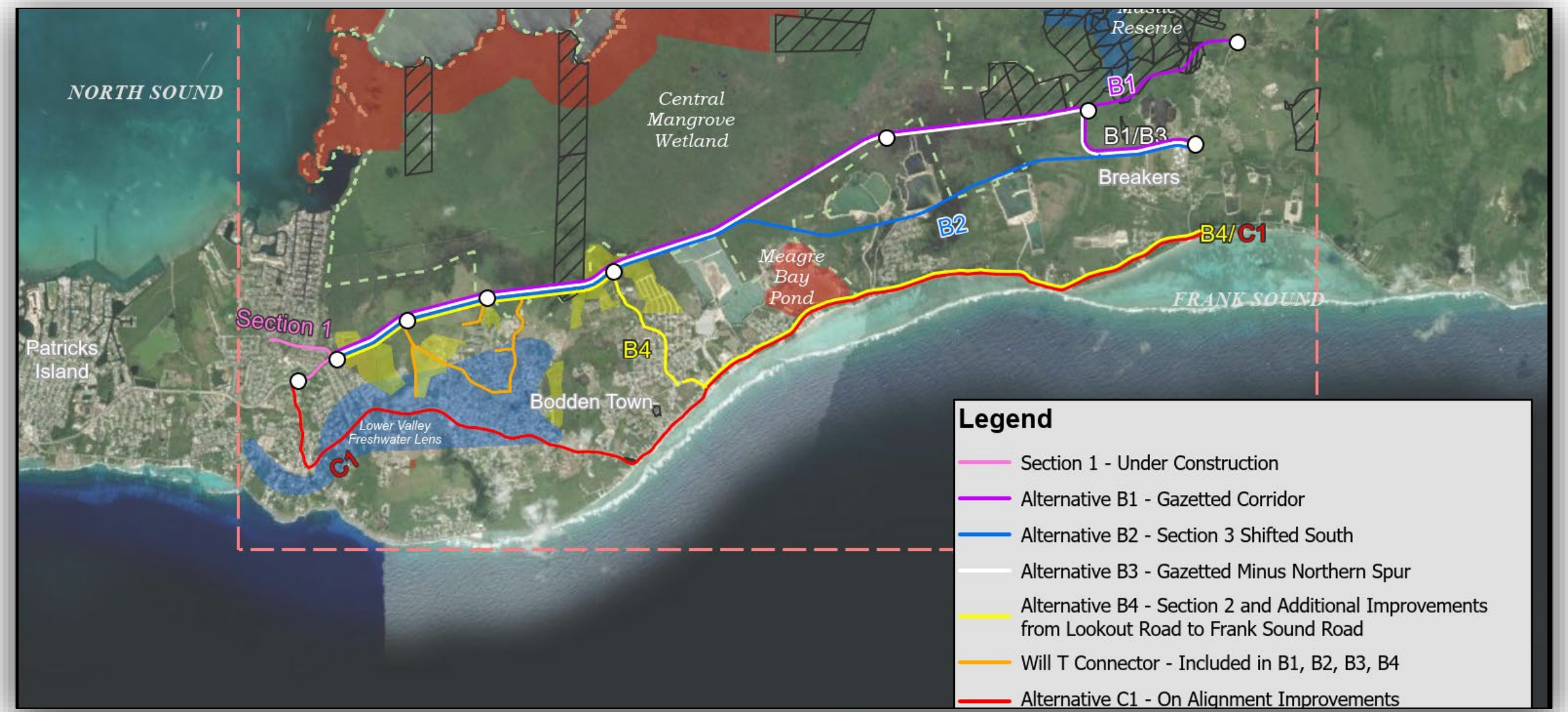
EWA Extension Improvement Options



EWA Section 1 (Under Construction)

- EWA Section 1
  - ~½ Mile 2-lane Arterial Road
  - Convert to 2 up to 3 lanes in the future (if required)
  - 2X1 Hybrid Roundabout
    - Design to convert to 3X1 Hybrid Roundabout when required.
- Newlands Connector
  - New ~ ½ mile 2-lane Collector Road

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EWA Section 1 (Under Construction)

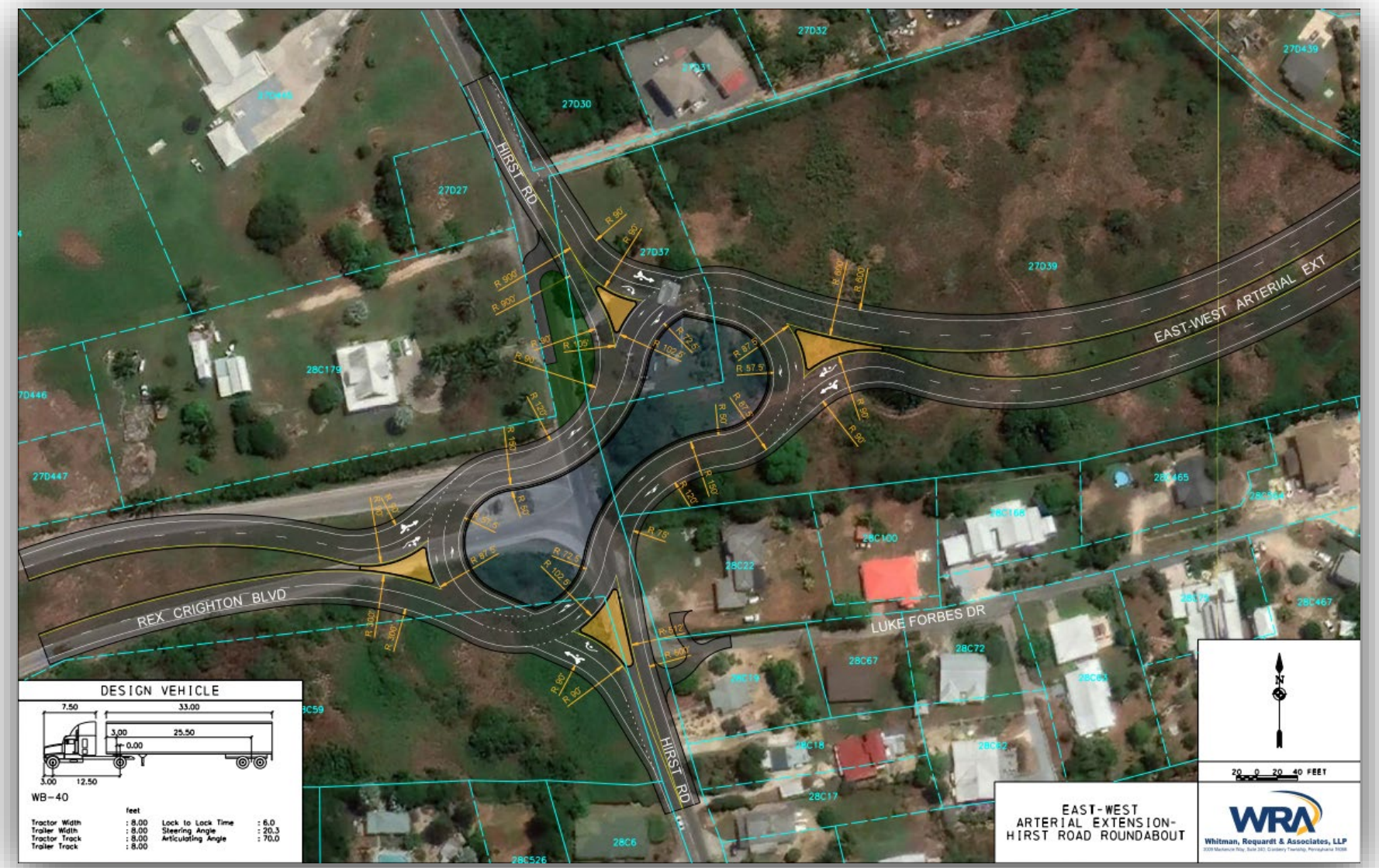
- EWA/Hirst Road 2x1 Hybrid Roundabout

EWA Section 1 (Under Construction)

- EWA/Hirst Road 2x1 Hybrid Roundabout
  - Convert to 3X1 Hybrid Roundabout (when required)
  - Convert to Grade Separation over Single Lane Roundabout (when required)

Hirst Road Bowtie Roundabout Option

- Minimizes Resident property impacts
- Did not work well for future grade separation



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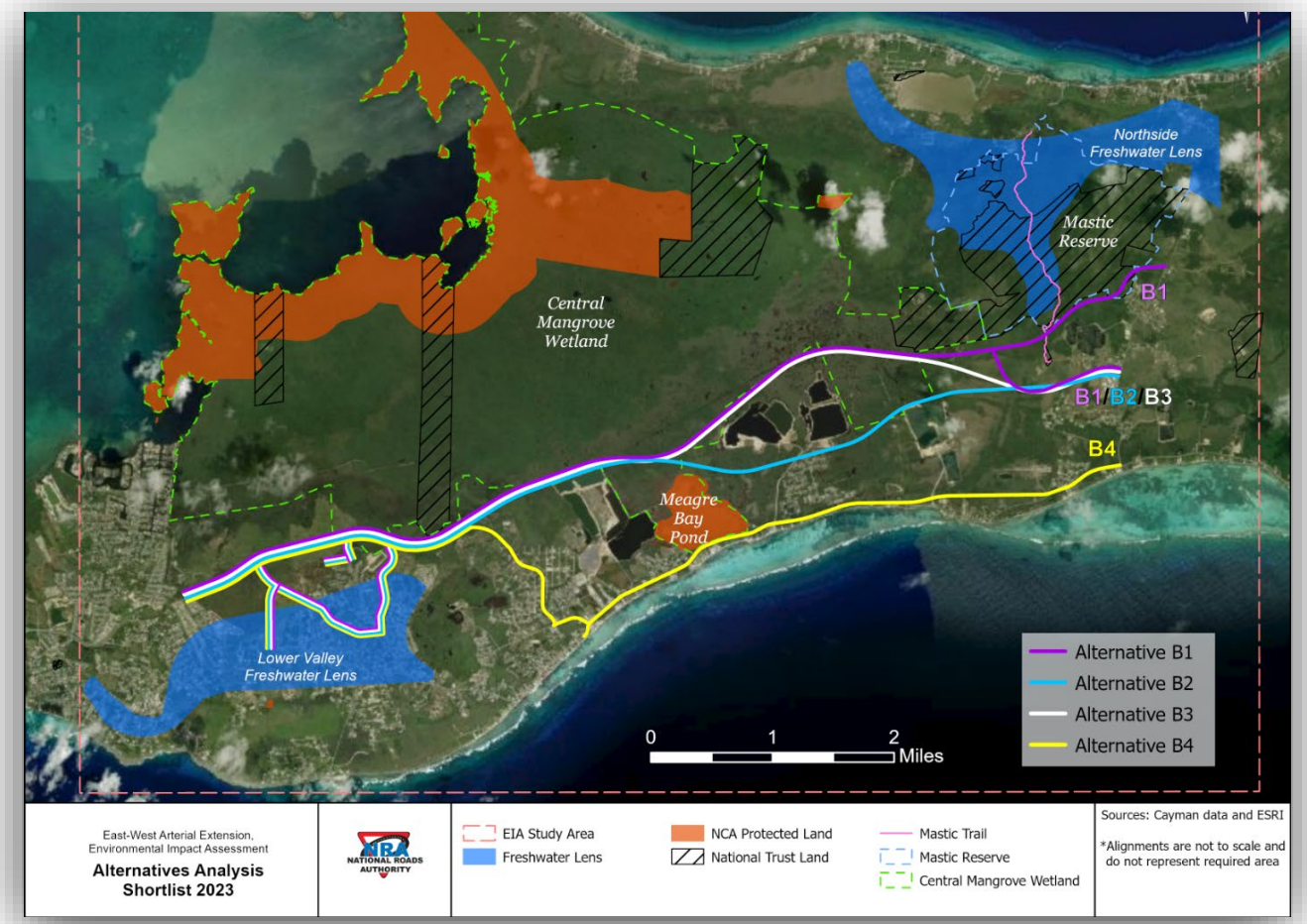
Environmental Impact Assessment for the EWA

- EWA Section 2 & Section 3

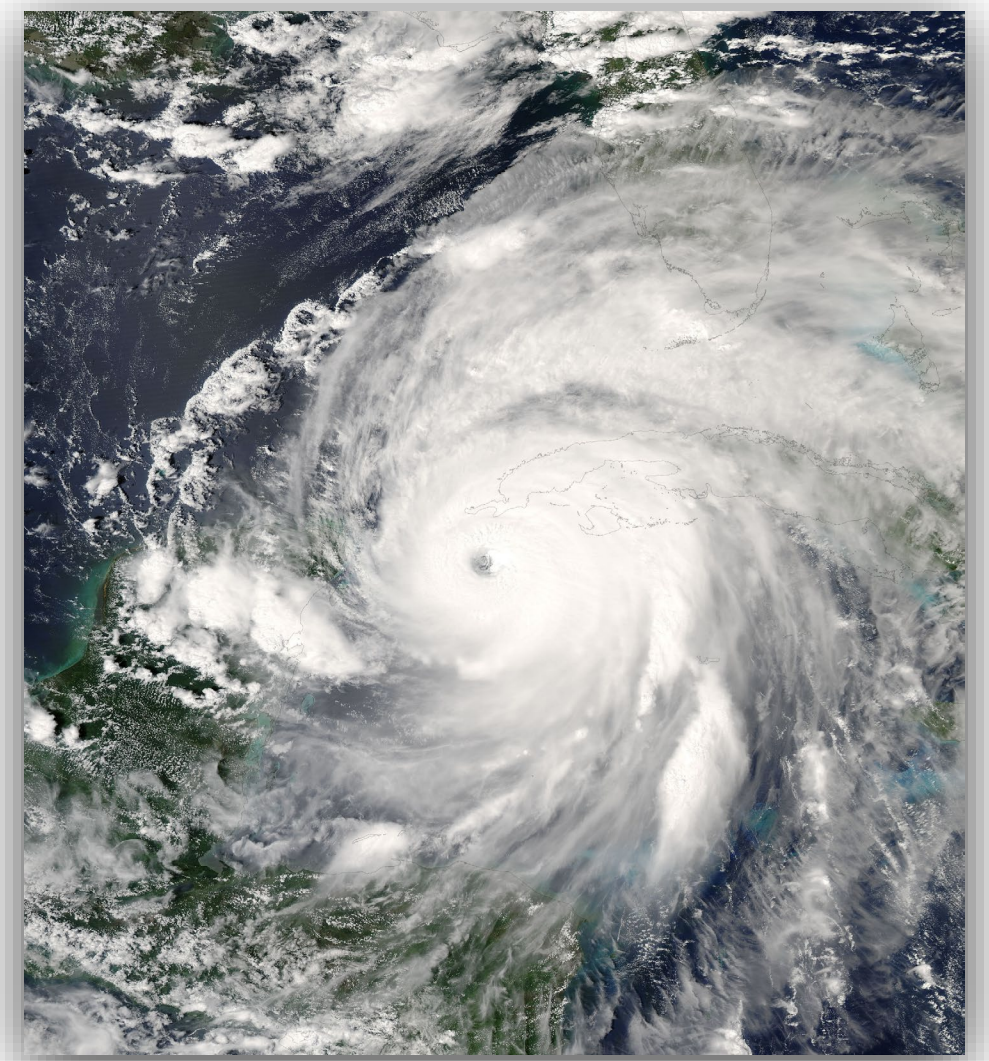


- B1 & B3 - Alternatives through the Central Mangrove Wetlands above the Roach Quarry's
- B2 - Below the Rock Quarry's
- B4 - Expansion along the existing Coastal Road

Existing Coastal Road

Images c/o Google Maps Street View

Critical Success Factors (CSFs)



Hurricane Ivan on Septebmer 13, 2004
NASA image courtesy Jacques Descloitres, MODIS Land Rapid Response Team at NASA GSFC (https://earthobservatory.nasa.gov/images/13860/hurricane-ivan)

Alternate Routes

- Goal: Provide an alternative route to Bodden Town Road
  Target: Enable travel in the event of roadway closure

Existing Roadway Resiliency

- Goal: Improve resiliency of existing routes
  Target: Reduce flooding risks from sea level rise, storm surge, rainfall

Future Traffic Demand

- Goal: Support current and future traffic demand
  Target: Add travel lanes; include controlled access points

Commuter Travel Times

- Goal: Shorten commute from North Side/East End to George Town
  Target: Improve projected travel times

Utilities

- Goal: Support utility corridor expansion
  Target: Reserve right-of-way for electricity, fiber, water, sewer

Public Transit Access

- Goal: Enable transit growth and reliability
  Target: Add transit facilities; improve bus time reliability

Tourist Travel Times

- Goal: Enhance access for visitors
  Target: Reduce travel times from Airport/Cruise Port to eastern districts

Safety & Non-Motorized Access

- Goal: Increase safety and support walking/biking
  Target: Minimize conflict points; add pedestrian/bike facilities

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Conceptual Design Evaluation

Excellent Fit vs. Good Fit vs. Acceptable Fit

Excellent Fit	Good Fit	Acceptable Fit
✓ **Most resilient to storms**	✓ **Resilient to storms**	✓ **Least resilient to storms**
✓ 50-year storm events	✓ 25-year storm events	✓ Storm event to be determined in Detailed design
✓ Largest cost	✓ Moderate cost	✓ Most cost-effective solution
✓ Bridge Structures for hydraulic connectivity	✓ Large Box Culverts for hydraulic connectivity	✓ Small 2'x4' Box culverts for hydraulic connectivity
✓ Profile height – 8' to 15'	✓ Profile height – 6' to 11'	✓ Profile height - 4' to 9'
✓ Minimal post-storm maintenance expected	✓ Moderate post-storm maintenance	✓ Higher post-storm maintenance burden

Hydraulic Structures

- Excellent Fit Bridge Openings
  - 7 Bridges 330’ in length
  - 8 Bridge 150‘ in length
  - 4’ Culverts installed at regular intervals between bridge structures
- Good Fit Box Culverts
  - TBD in detailed design
    - (if preferred option)
- Acceptable Fit Small Culverts
  - 90 minimum 2’H x 4’W box culverts

Project Constraints

Geographic Features

- Existing Rock Quarries
- Meagre Bay Pond
- Established Residential and Commercial Properties
- Mastic Trail

Environmentally sensitive areas

- Central Mangrove Wetland (CMW)
- The Mastic Reserve
- Parrot Nesting Habitats

Meagre Bay Pond (Photo courtesy of caymannature)

CMW (Photo courtesy of National Trust)

Grand Cayman parrots
Image c/o Department of Environment Cayman Island Government

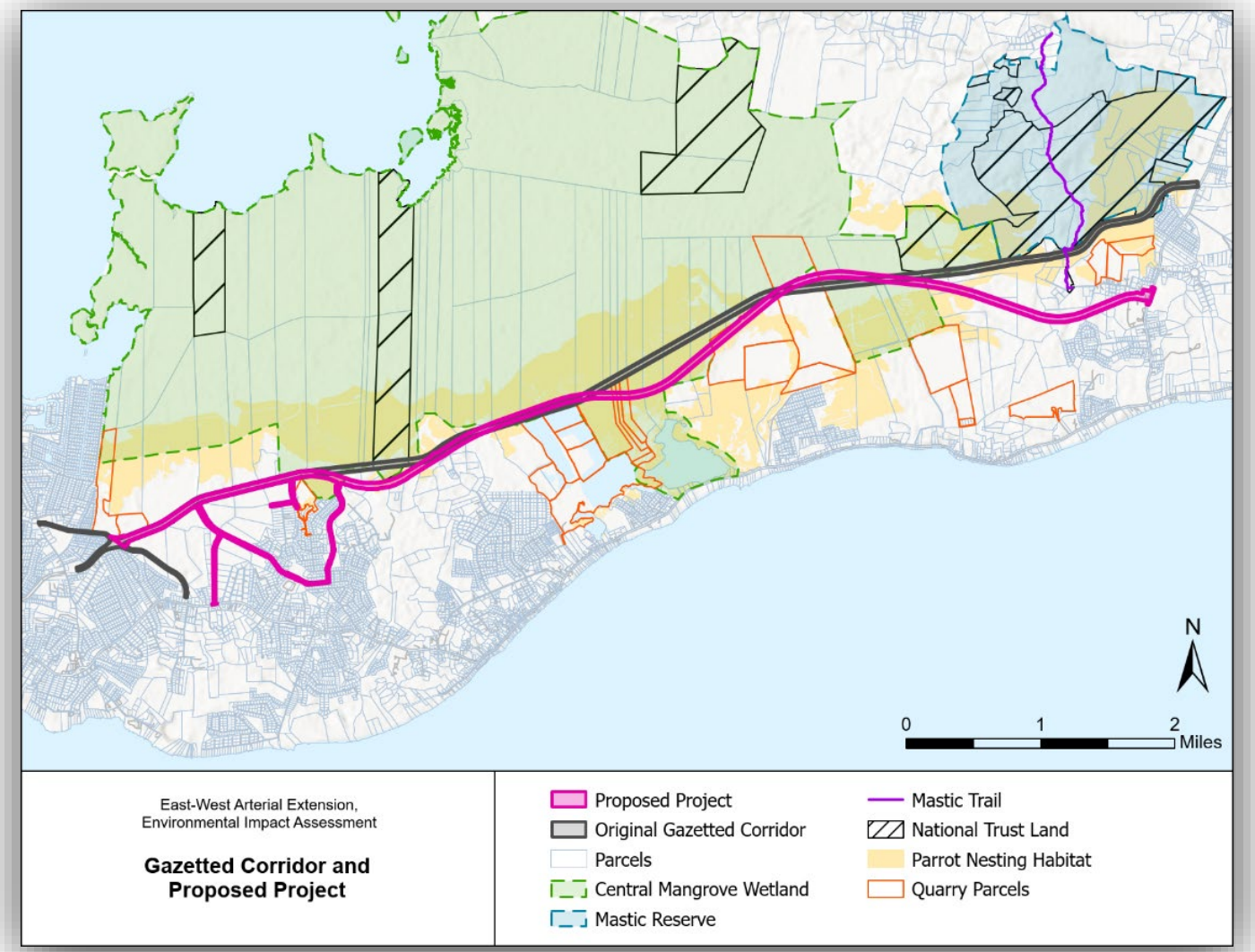
How the Project Avoids & Minimizes

Shift original alignment to Avoid Impacts to:

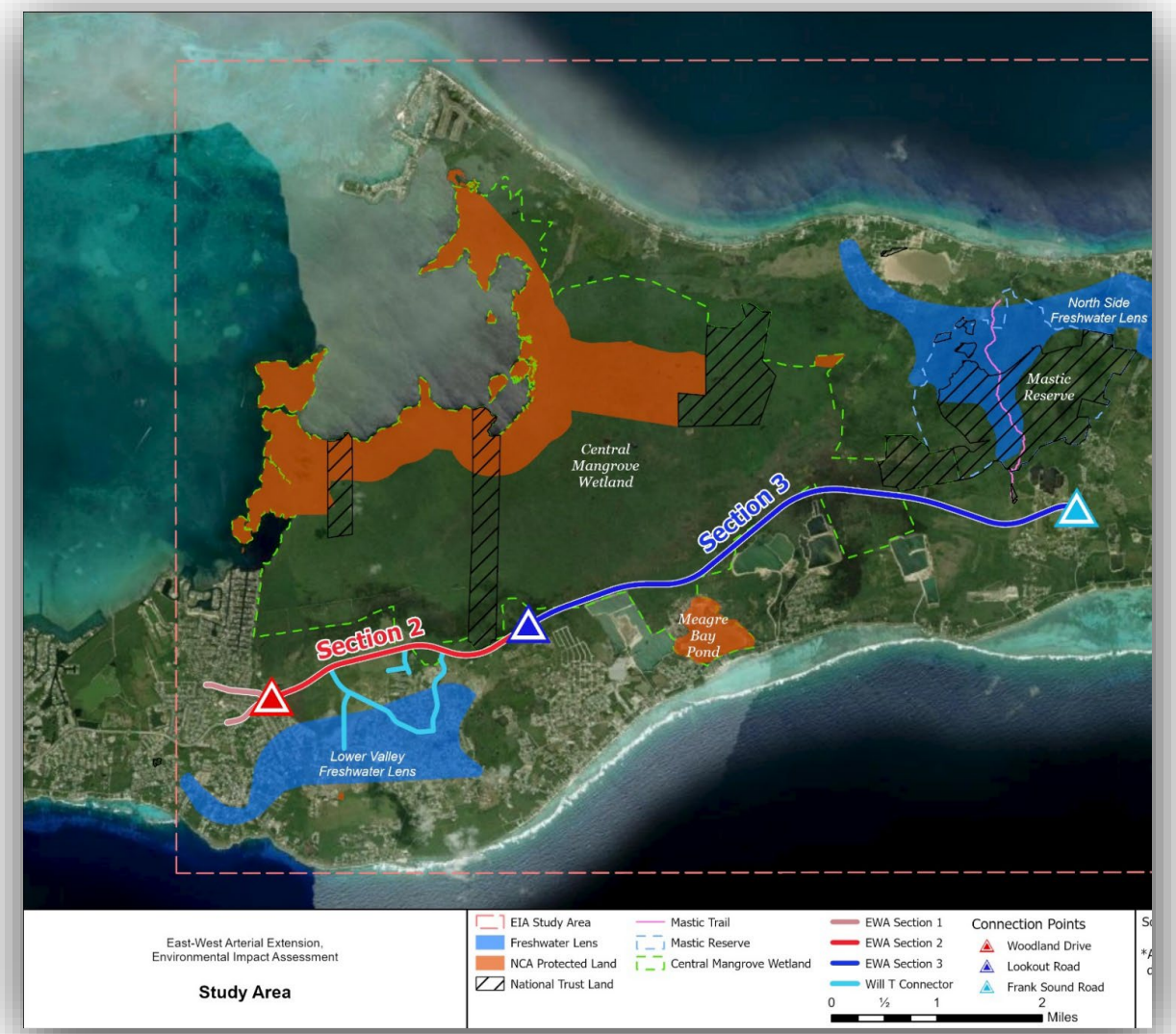
- National Trust Land
- Mastic Reserve
- Mastic Trail

Minimize impacts

- Parrot Nesting Habitat



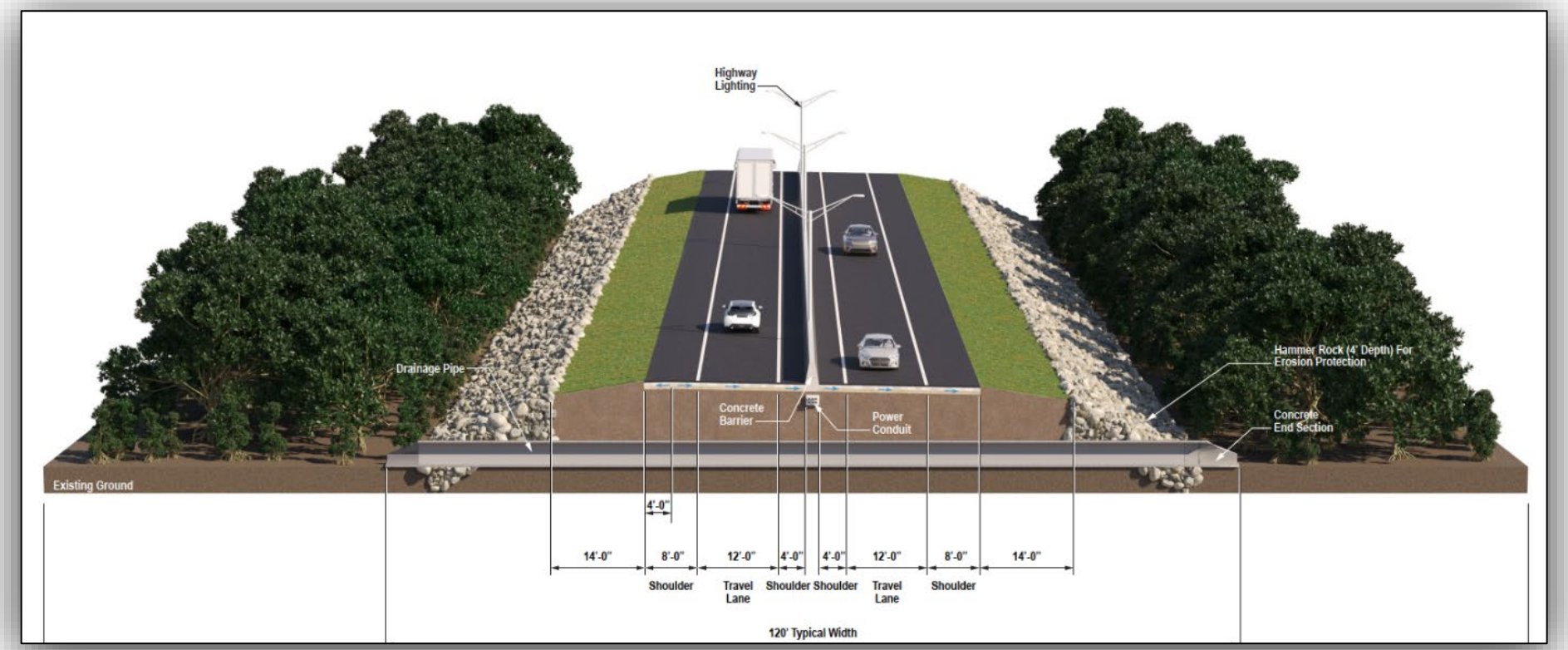
EWA Extension Proposed Project



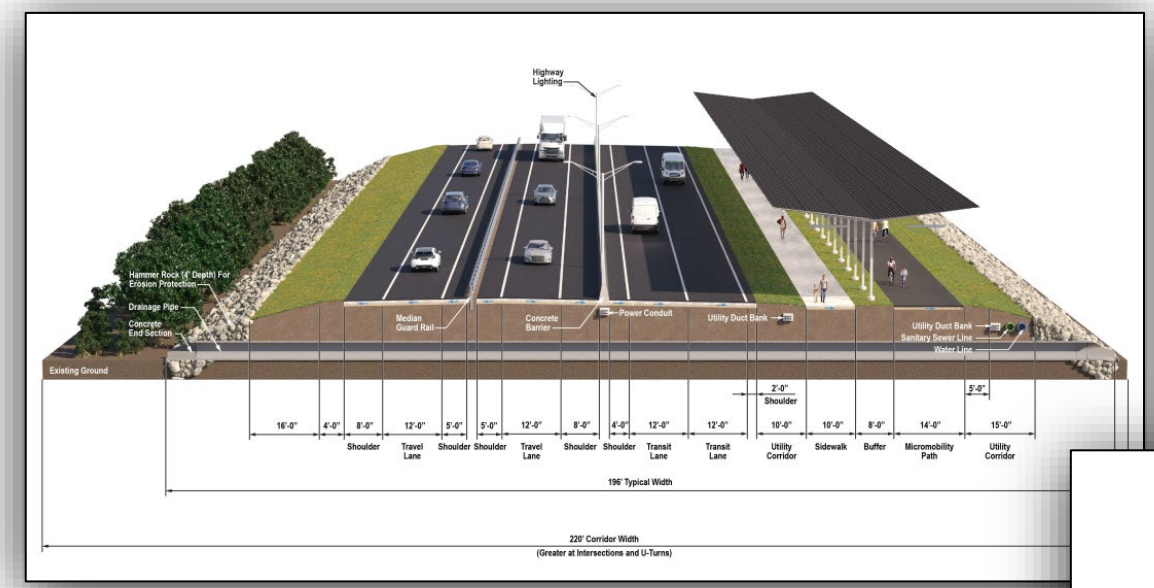
- Section 2
  - Woodland/Agricola Drive to Lookout Road
  - Length = 2.84 Miles
- Section 3
  - Lookout Road to Frank Sound Road
  - Length = 5.08 Miles
- Total EWA Length = 7.92 Miles
- Will T Connector
  - Connects neighborhoods to Section 2
  - Length = 2.86 Miles

Proposed Project (2026 Build Year)

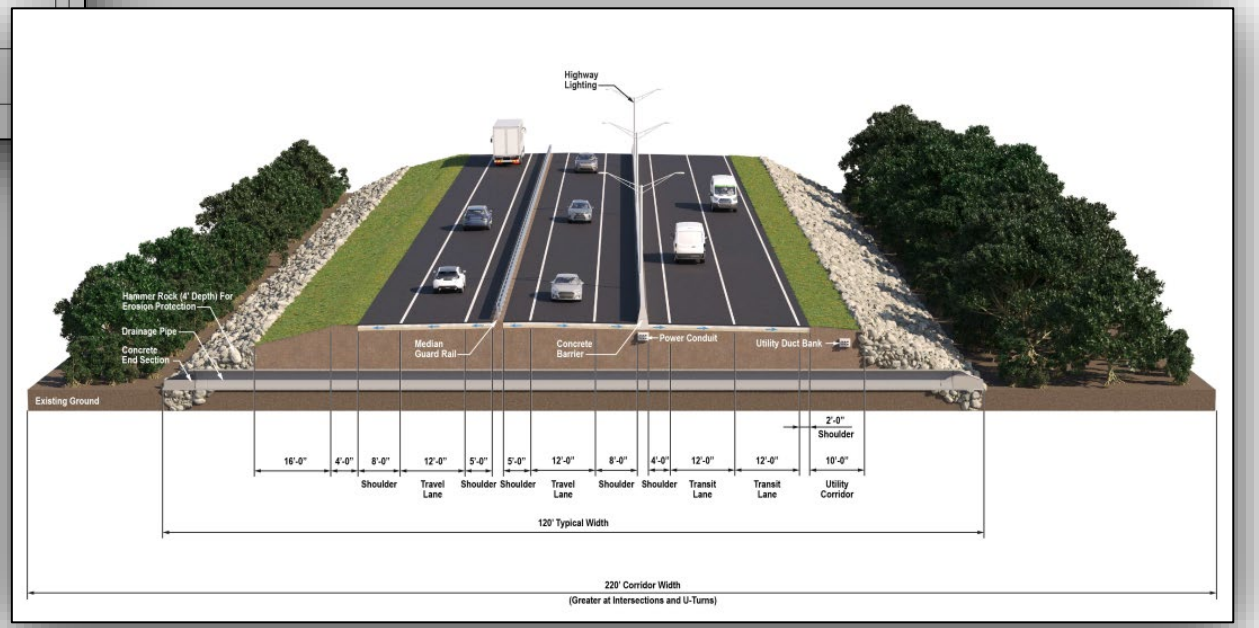
- Proposed Project – Sections 2 and 3 (Woodland Drive to Frank Sound Road)
- *Includes two travel lanes (one in each direction), shoulders, median barrier, and highway lighting.*



Proposed Project (2036 Build Year)

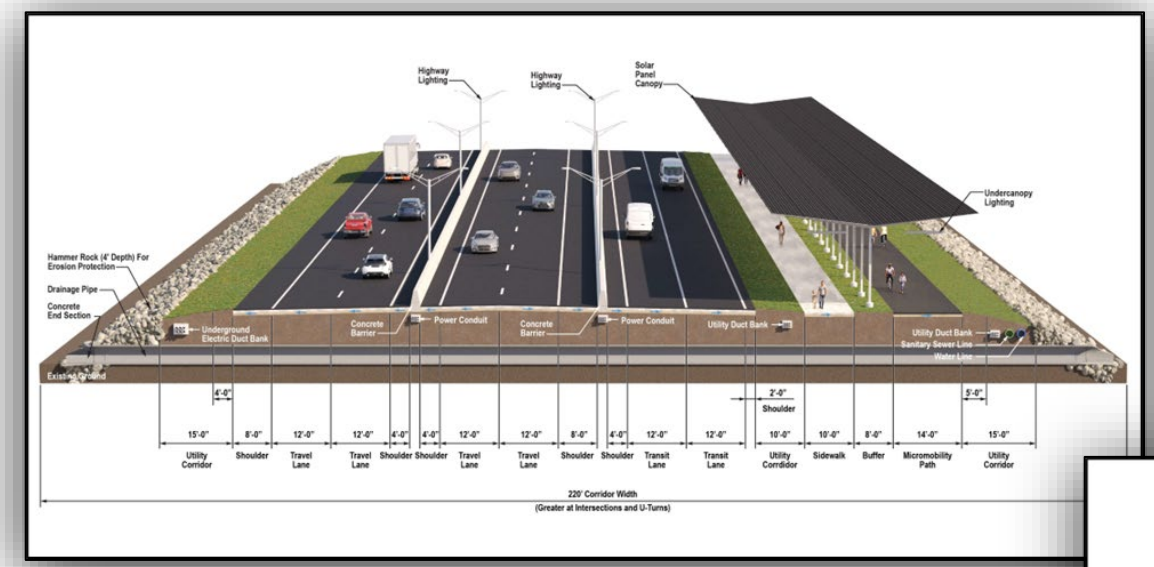


- **Section 2 (Woodland Drive to Lookout Road)**
- *Includes two travel lanes (one in each direction), shoulders, median barrier, highway lighting, transit lanes, sidewalk, micromobility path, solar array, and utility corridors.*

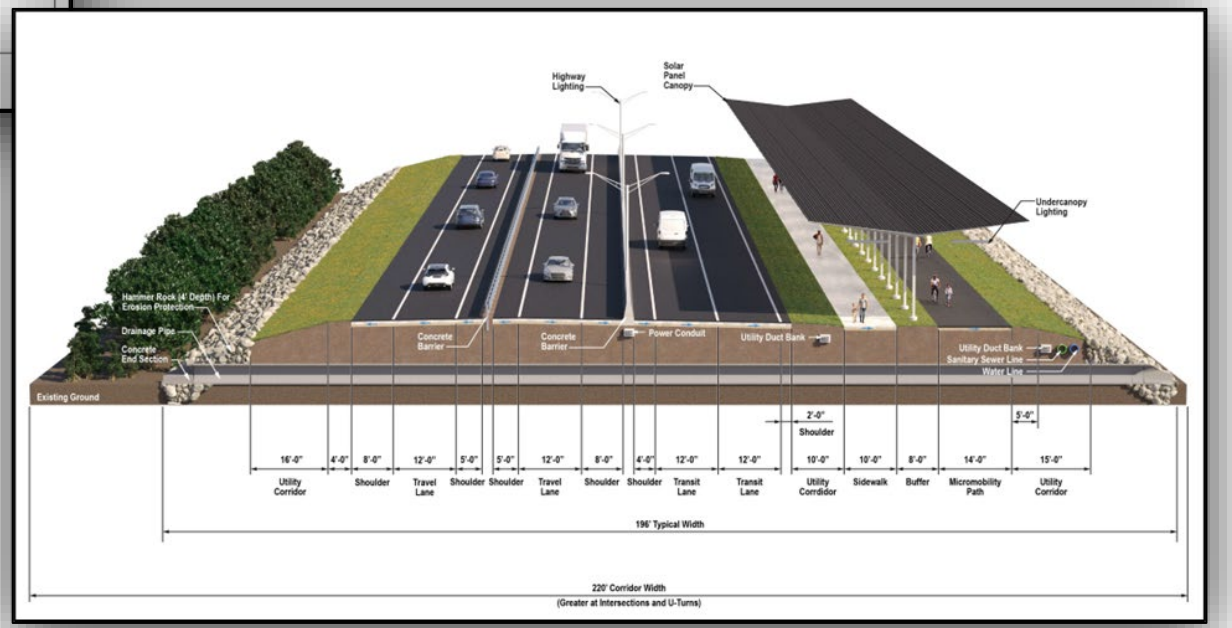


- **Section 3 (Lookout Road to Frank Sound Road)**
- *Includes two travel lanes (one in each direction), shoulders, median barrier, highway lighting, transit lanes, and a utility corridor.*

Proposed Project (2046 Build Year)



- **Section 2 (Woodland Drive to Lookout Road)**
- *Includes four travel lanes (two in each direction), shoulders, median barrier, highway lighting, transit lanes, sidewalk, micromobility path, solar array, and utility corridors.*



- **Section 3 (Lookout Road to Frank Sound Road)**
- *Includes two travel lanes (one in each direction), shoulders, median barrier, highway lighting, transit lanes, sidewalk, micromobility path, solar array, and utility corridors.*

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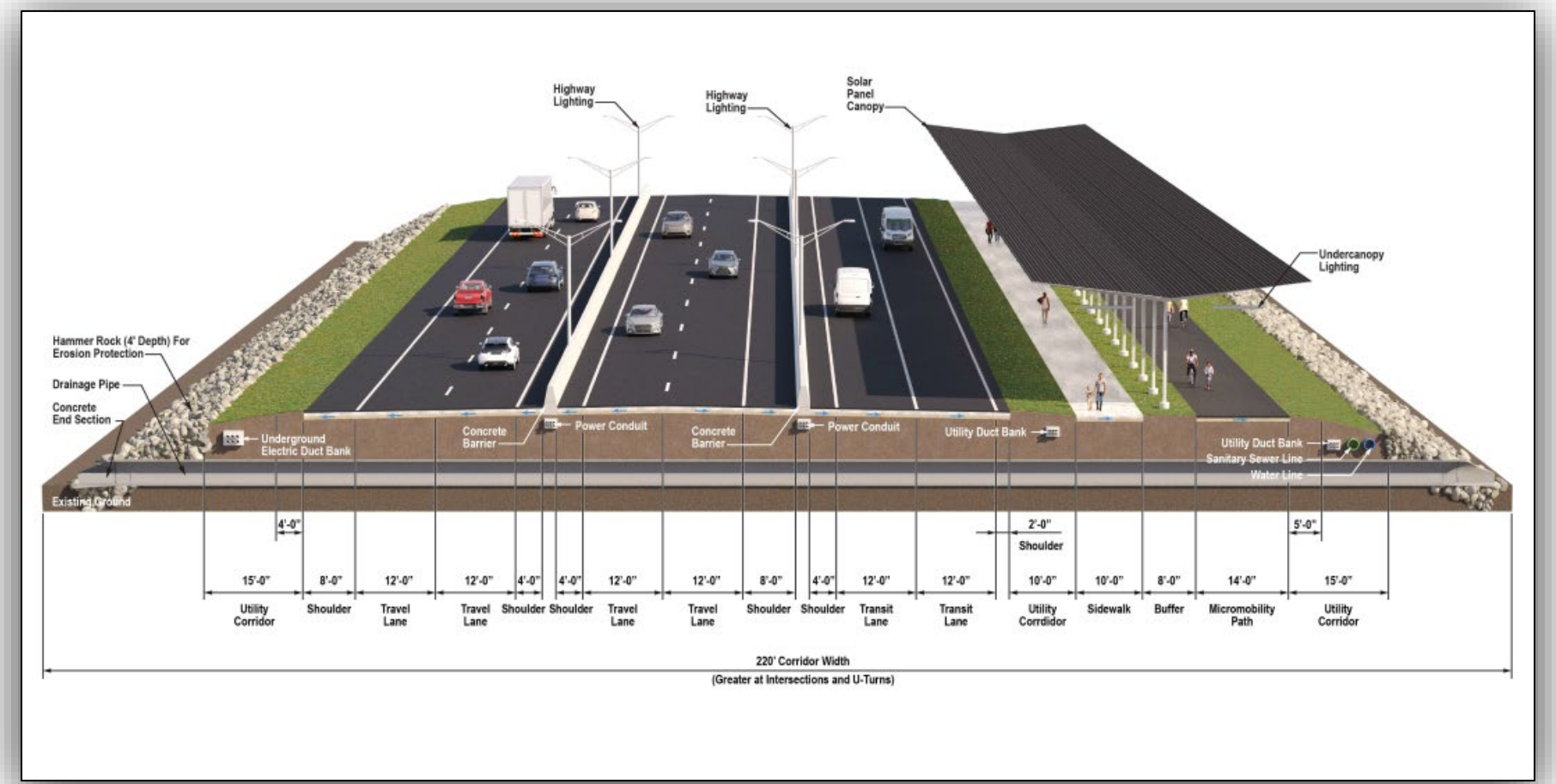
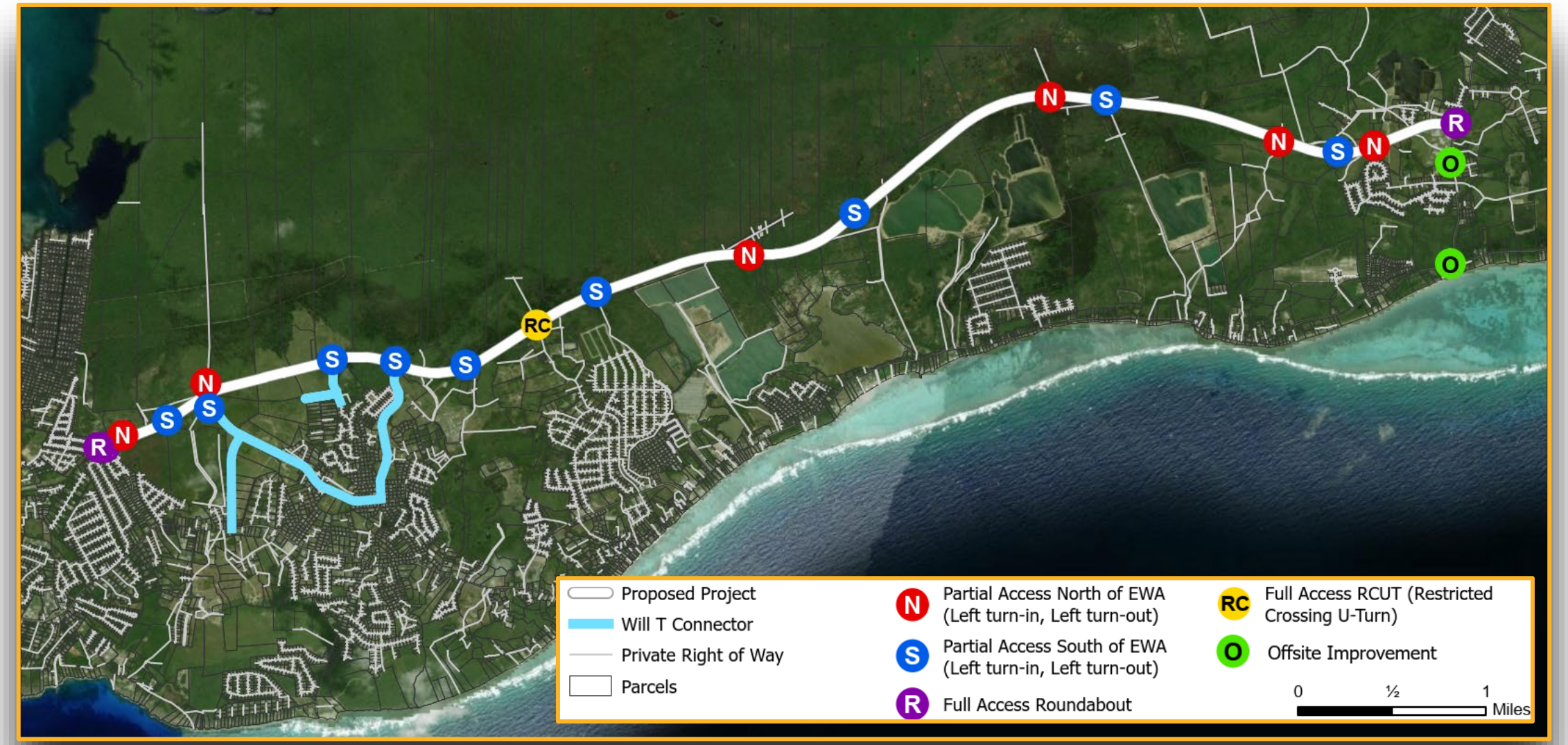
Proposed Project (2060 Build Year)

- **Sections 2 and 3 (Woodland Drive to Frank Sound Road)**
- *Includes two travel lanes (one in each direction), shoulders, median barrier, and highway lighting.*

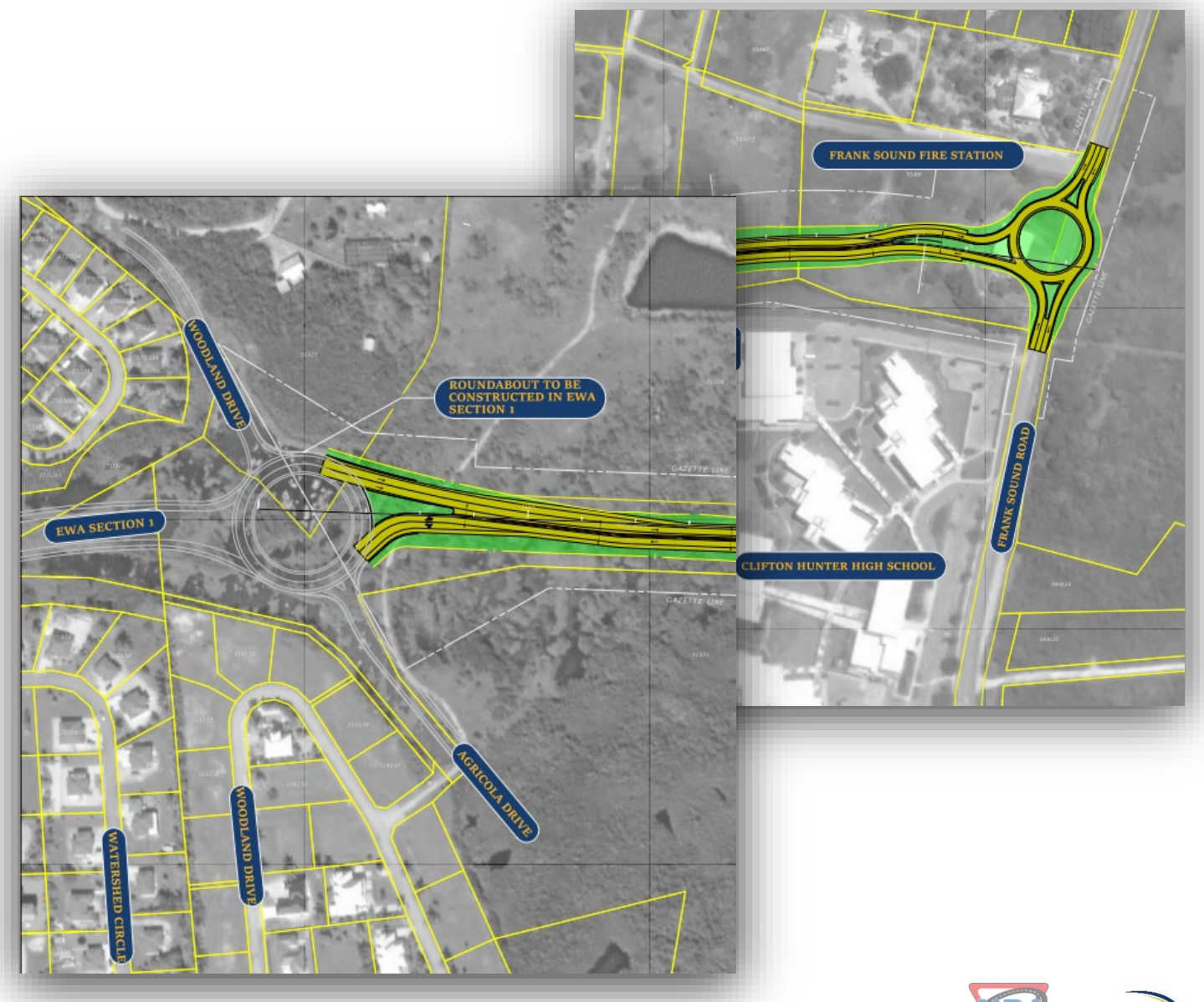


Intersection Types



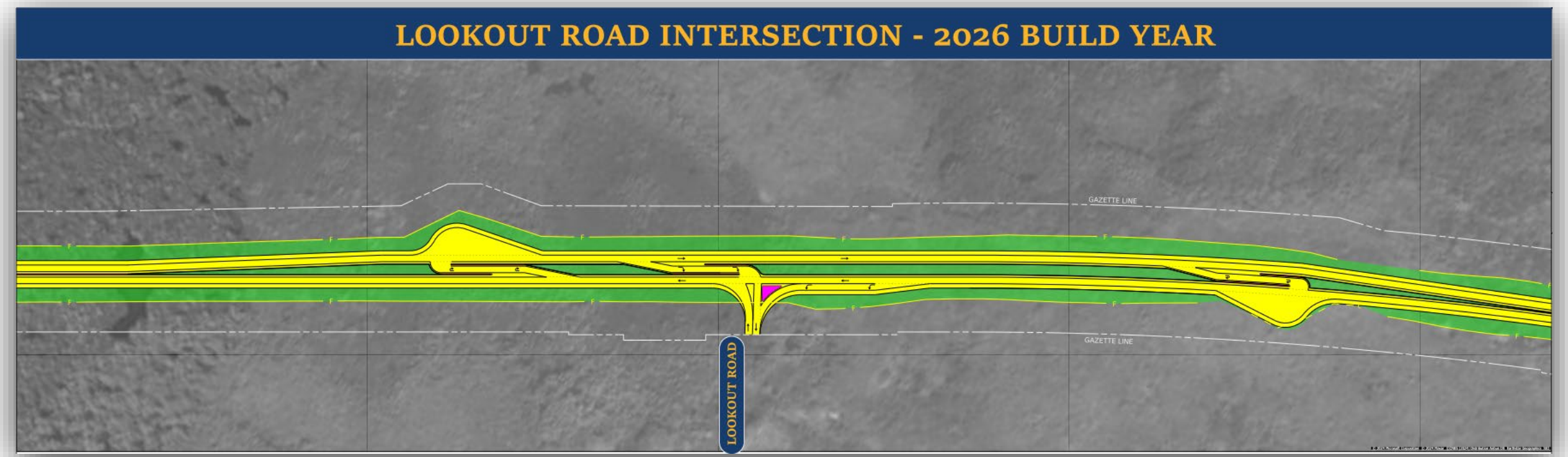
Intersection Types – Full Access

- 2 Roundabouts
  - EWA/Agricola Dr
    - Multi-lane 2026 Build
    - Grade Separation (when required)
  - EWA/Frank Sound Rd
    - Single lane 2026
    - Multi-lane (when required)



Intersection Types – Full Access

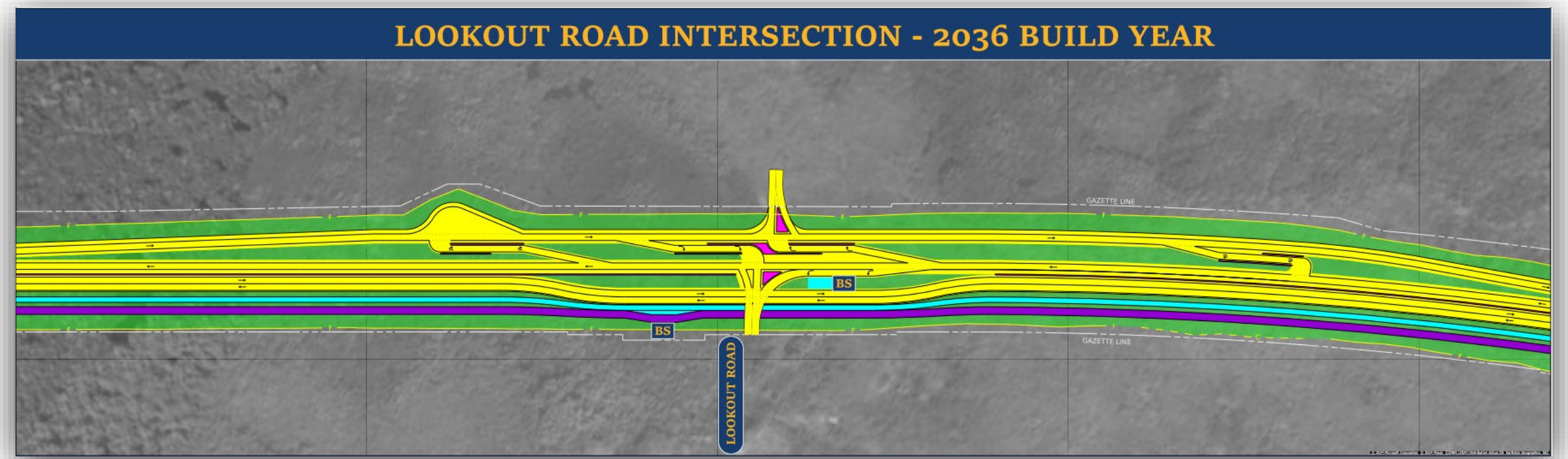
- **Restricted Crossing U-Turn (RCUT)**
  - 2 Travel Lanes
  - U-Turns beyond Lookout Road
  - Direct access to South (Lookout Road)



Intersection Types – Full Access

- **Restricted Crossing U-Turn (RCUT)**
  - 2 Travel Lanes
  - U-Turns beyond Lookout Road
  - Direct access to South (Lookout Road)
  - Direct Access to North (Lookout Road)

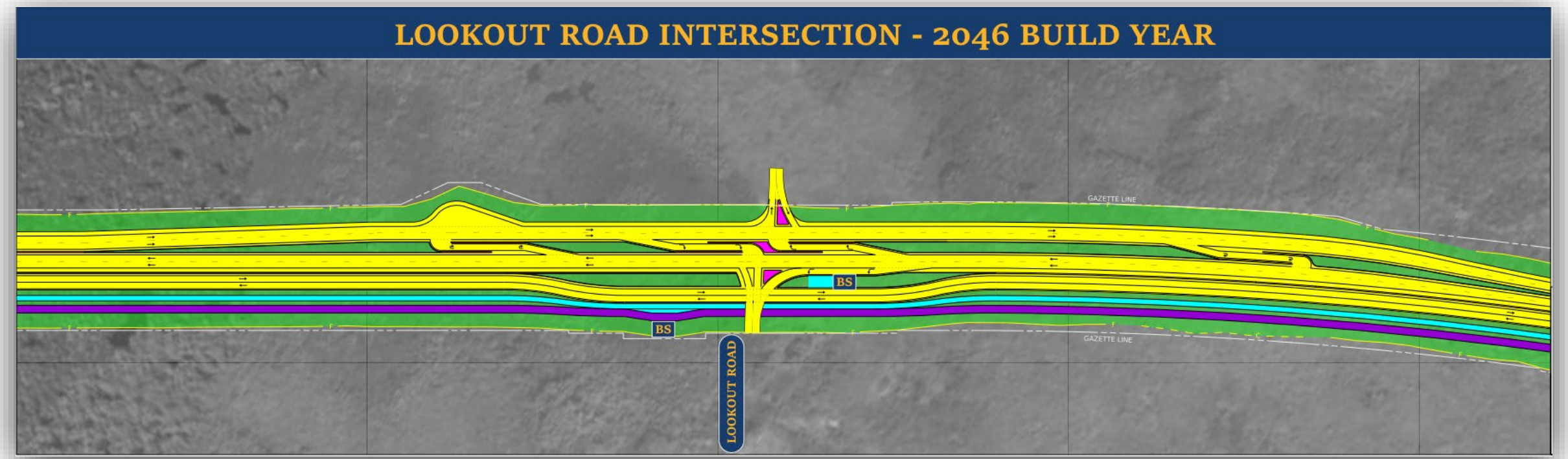
- Sidewalk/Micromobility Path
- Bus Rapid Transit (BRT) Lanes
- Bus Shelters



Intersection Types – Full Access

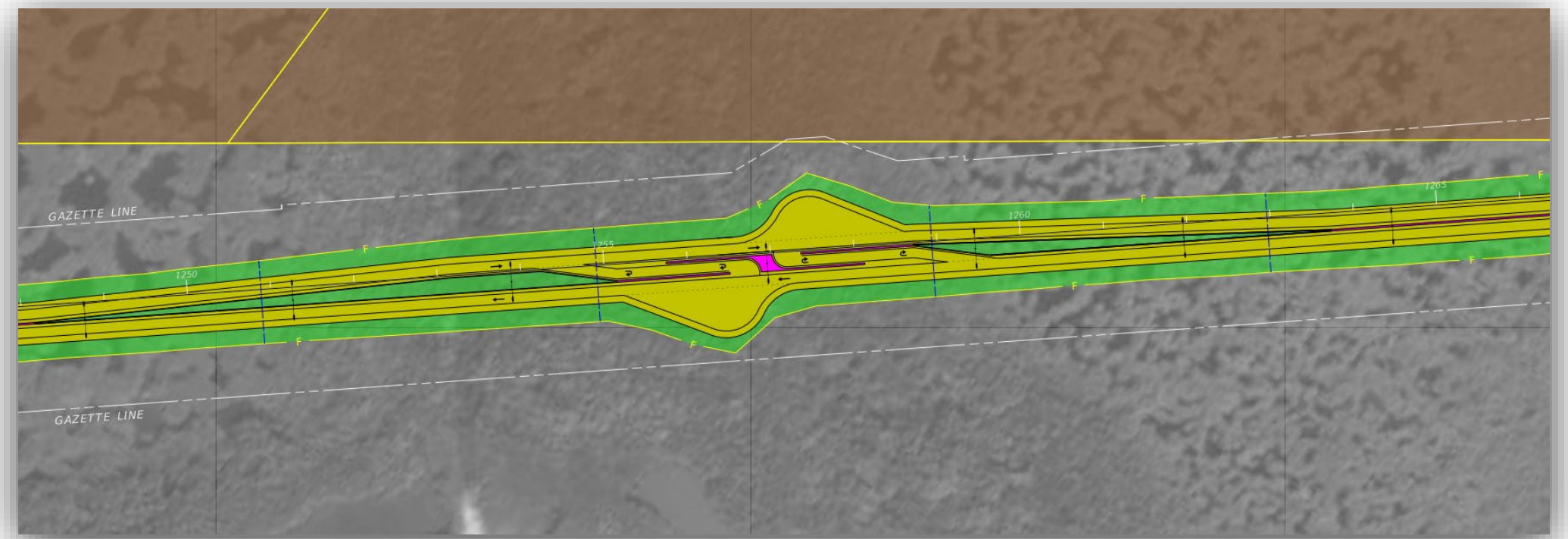
- **Restricted Crossing U-Turn (RCUT)**
  - 4 Travel Lanes
  - U-Turns beyond Lookout Road
  - Direct access to South (Lookout Road)
  - Direct Access to North (Lookout Road)

- Sidewalk/Micromobility Path
- Bus Rapid Transit (BRT) Lanes
- Bus Shelters

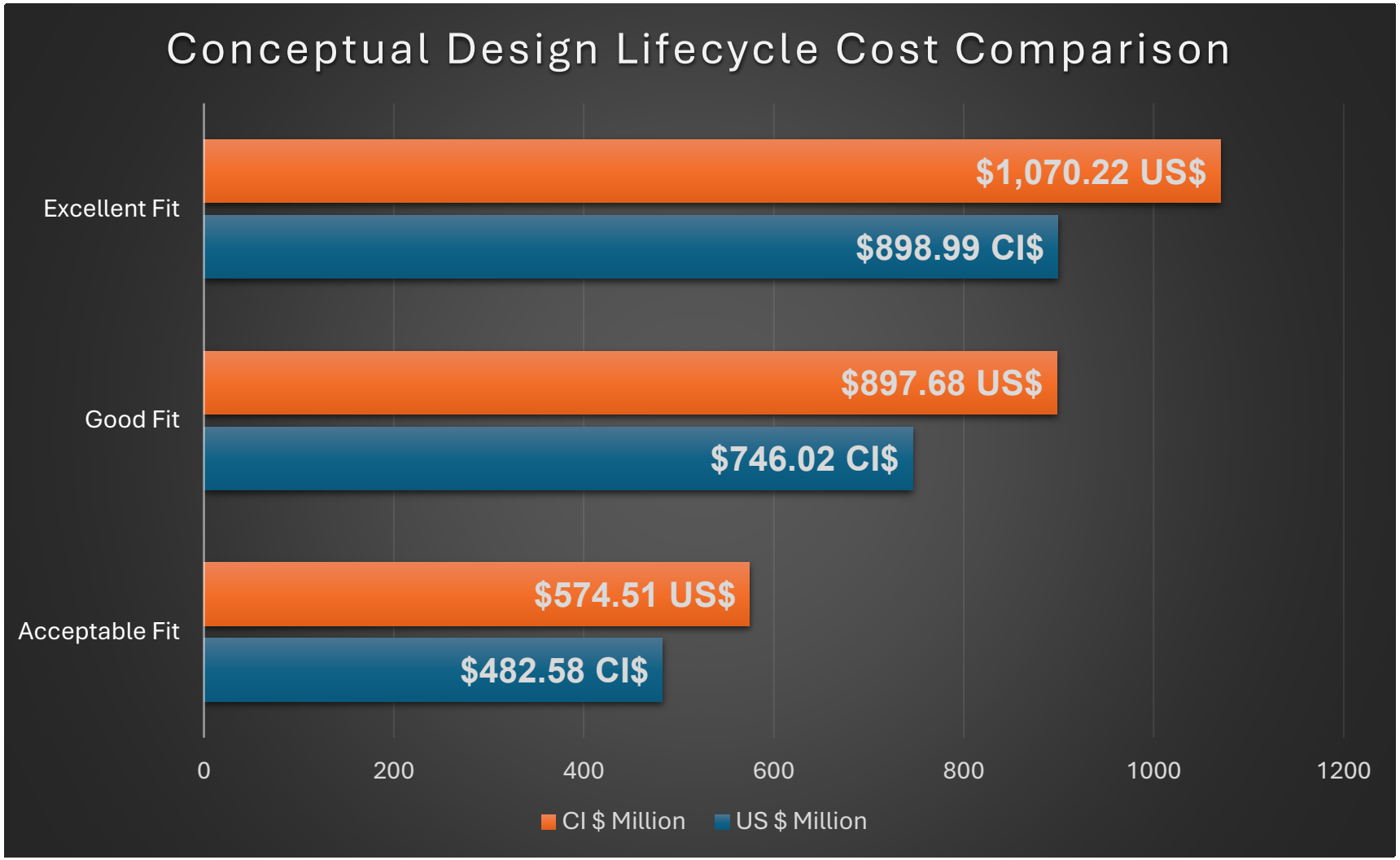


Intersection Types – Partial Access

- **Median U-Turns**
  - Spaced About 1.5 Miles
  - 2 U-turns locations provide access each direction for emergency services
- **Left-in/Left-Out (LILO)**
  - Restrict North access



Estimated Project Costs



Estimated Right-of-Way Costs
US$ 20.33 Million
CI$ 17.09 Million

Cost include new construction for each build year phase, lifecycle mainanance costs, Potential Terrestrial Ecology Mitigation and 20% Contingency.

Note that all cost estimates provided are calculated in 2024 dollars, without adjustments for inflation

Acceptable Fit “à la carte” Cost

Build-Year Phase	Construction Year	Section 2						Section 3					
		Primary Roadway Features		Optional Features				Primary Roadway Features		Optional Features			
		Travel Way Construction Cost by Year (CIS)	Travel Way Maintenance Cost by Year (CIS)	Micomobility Path Cost by Year (CIS)	Sidewalk Cost by Year (CIS)	Transit Lanes Cost by Year (CIS)	Will T Connector Cost by Year (CIS)	Travel Way Construction Cost by Year (CIS)	Travel Way Maintenance Cost by Year (CIS)	Micomobility Path Cost by Year (CIS)	Sidewalk Cost by Year (CIS)	Transit Lanes Cost by Year (CIS)	
2026	2026	$12.06	-	-	-	-	-	-	-	-	-	-	
	2027	$18.05	-	-	-	-	-	-	-	-	-	-	
	2028	-	-	-	-	-	-	$13.72	-	-	-	-	
	2029	-	-	-	-	-	-	$9.37	-	-	-	-	
	2030	-	-	-	-	-	$10.83	$29.37	-	-	-	-	
Build-Year Subtotal:		**$30.11**	-	-	-	-	**$10.83**	**$52.46**	-	-	-	-	
2036	2036	-	-	$2.16	$1.22	$5.18	-	-	-	-	-	-	
	2037	-	$13.31	$1.70	$5.24	$12.89	-	-	-	-	-	-	
	2038	-	-	-	-	-	-	-	-	$1.97	$1.07	$10.44	
	2039	-	-	-	-	-	$4.02	-	$17.71	$0.65	$1.43	$17.84	
Build-Year Subtotal:		-	**$13.31**	**$3.86**	**$6.46**	**$18.07**	**$4.02**	-	**$17.71**	**$2.62**	**$2.50**	**$28.28**	
2046	2046	$8.28	$3.20	-	-	-	-	-	-	-	-	-	
	2047	$6.42	$4.59	$1.57	-	$5.18	-	-	-	-	-	-	
	2048	-	-	-	-	-	-	-	$18.85	5.82	4.35	-	
	2049	-	-	-	-	-	$4.49	-	$8.27	$2.85	$6.94	$8.50	
Build-Year Subtotal:		**$14.70**	**$7.79**	**$1.57**	-	**$5.18**	**$4.49**	-	**$27.12**	**$8.67**	**$11.29**	**$8.50**	
2060	2060	$11.10	$15.56	$1.12	$11.18	$9.94	-	-	-	-	-	-	
	2061	-	-	-	-	-	-	$13.39	-	-	-	-	
	2062	-	-	-	-	-	$4.02	$24.86	$20.91	$2.68	$2.72	$12.25	
Build-Year Subtotal:		**$11.10**	**$15.56**	**$1.12**	**$11.18**	**$9.94**	**$4.02**	**$38.25**	**$20.91**	**$2.68**	**$2.72**	**$12.25**	
2074	2074	-	$14.81	$1.50	-	$4.44	$11.80	-	-	-	-	-	
	2075	-	-	-	-	-	-	-	$16.24	$3.57	$14.43	$6.52	
Build-Year Subtotal:		-	**$14.81**	**$1.50**	-	**$4.44**	**$11.80**	-	**$16.24**	**$3.57**	**$14.43**	**$6.52**	
Section Total:		**$55.91**	**$51.47**	**$8.05**	**$17.64**	**$37.63**	**$35.16**	**$90.71**	**$81.98**	**$17.54**	**$30.94**	**$55.55**	
		Section 2 Total Construction and Maintenance Cost = $205.86						**Section 3 Total Construction and Maintenance Cost = $276.72**					

Total Construction and Maintenance Cost for the Proposed Project = $482.58

Value Engineering

Option Description	Potential Cost Savings in 2026 (Percentage)	Potential Cost Savings in 2026 (CI$ Million)	Potential Cost Savings by 2074 (Percentage)	Potential Cost Savings by 2074 (CI$ Million)
Elevate Only 2 Travel Lanes for Resiliency*	High – 40% to 60%	$93.55 to $140.32	High – 40% to 60%	$359.59 to $539.39
Elevate Only 4 Travel Lanes for Resiliency*	None	$0.00	Medium to High – 10% to 40%	$89.90 to $359.59
Elevate Only 2 Travel Lanes – Employ ITS Options*	None	$0.00	High – 40% to 60%	$359.59 to $539.39
Use of Alternative Structure Type (Box Culvert)*	Medium – 5% to 10%	$11.69 to $23.39	Medium – 10% to 15%	$89.90 to $134.85
Use of Viaduct Sections**	None (Substantial Increase)	$0.00	None(Substantial Increase)	$0.00
Reduce Structure Height*	Medium – 5% to 10%	$11.69 to $23.39	Low to Medium – 1% to 5%	$8.99 to $44.95
Reduce Fill Slope Grade to 4:1	Low to Medium – 1% to 5%	$2.34 to $11.69	Low – Less than 1%	$8.99
Reduce Fill Slope Grade to 3:1	Low to Medium – 1% to 5%	$2.34 to $11.69	Low – Less than 1%	$8.99
Reduce Fill Slope Grade to 2.5:1	Low to Medium – 1% to 5%	$2.34 to $11.69	Low – Less than 1%	$8.99
Reduce Fill Slope Grade to 2:1	Medium – 5% to 10%	$11.69 to $23.39	Low – Less than 1%	$8.99
Use of Geosynthetic Solutions to Address Peat Area* ^ ~	Low to Medium – 1% to 5%	$2.34 to $11.69	Low to Medium – 1% to 5%	$8.99 to $44.95
Reduction of Travel Lane Width from 12 ft to 11 ft ^ ~	Low to Medium – 1% to 5%	$2.34 to $11.69	Low to Medium – 1% to 5%	$8.99 to $44.95
Change Concrete Median Barrier to Guard Rail System ^ ~	Low to Medium – 1% to 5%	$2.34 to $11.69	Low to Medium – 1% to 5%	$8.99 to $44.95
Change 8 ft Paved Shoulder to 2 ft Paved and 6 ft Graded Aggregate ^ ~	Low – Less than 1%	$2.34	Low to Medium – 1% to 5%	$8.99 to $44.95
Reduce Width of Sidewalk and Micromobility Path^ ~	Medium – 5% to 10%	$11.69 to $23.39	Low to Medium – 1% to 5%	$8.99 to $44.95
Locate Utilities Below Micromobility Path^	Low – Less than 1%	$2.34	Low – Less than 1%	$8.99

Public Involvement

Key Feedback & Lessons Learned

- Strong Support for a New Route
- Environmental Concerns
- Excellent Fit Estimated Cost Concerns
- Flooding & Roadway Design Concerns
- Need for Better Communication on Lifecycle Costs
- Uncertainty About Project Funding

Next Steps for Detailed Design

- ✓ **Detailed Surveying and Geotechnical Investigations**
  - ❑ Further assess peat depths and top of rock
- ✓ **Environmental Monitoring and Compliance**
  - ❑ Develop environmental monitoring program for construction to protect wetlands, wildlife habitats, and water quality
- ✓ **Hydraulic and Hydrologic Modelling**
  - ❑ Further developed and refine modeling during the detailed design using more detailed survey.
- ✓ **Sustainability and Future-Proofing**
  - ❑ Sustainable design practices need to be explored, including options for green infrastructure, solar-powered systems, and energy-efficient solutions
  - ❑ Future-proofing the Proposed Project for long-term adaptability to future traffic demand and climate resiliency
- ✓ **Risk Management and Contingency Planning**:
  - ❑ Develop a detailed risk management plan
  - ❑ Develop a contingency plan for cost over runs and schedule adjustments
- ✓ **Roadway Modelling and Final Design Elements**

NRA NATIONAL ROADS AUTHORITY WRA

Overall Questions / Discussion

Brent Barrett, PE

Associate

Whitman, Requardt & Associates, LLP

bbarrett@wrallp.com

Lindsey Ulizio, PE

Associate

Whitman, Requardt & Associates, LLP

lulizio@wrallp.com

Special thanks to our client:

National Roads Authority, Cayman Islands

Edward Howard, Managing Director

Denis Thibeault, Assistant Director – Transportation & Planning Unit