



Collier County Dune Impacts in Response to Successive Hurricanes and Dune Restoration Plans for Improved Resiliency

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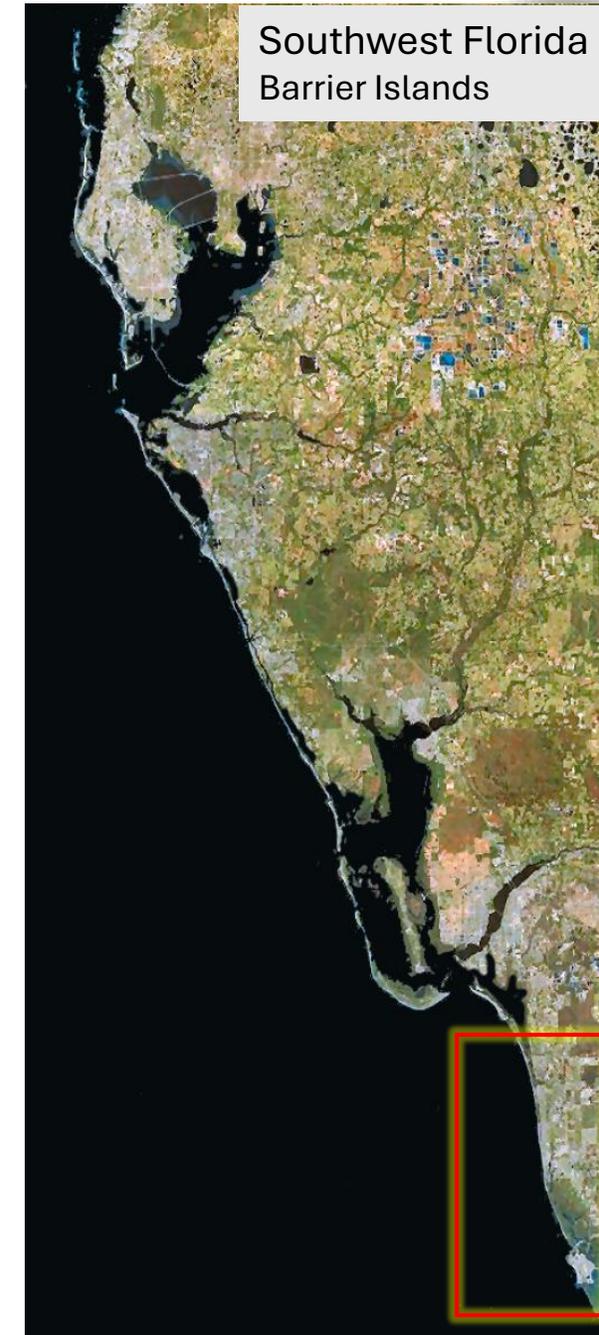
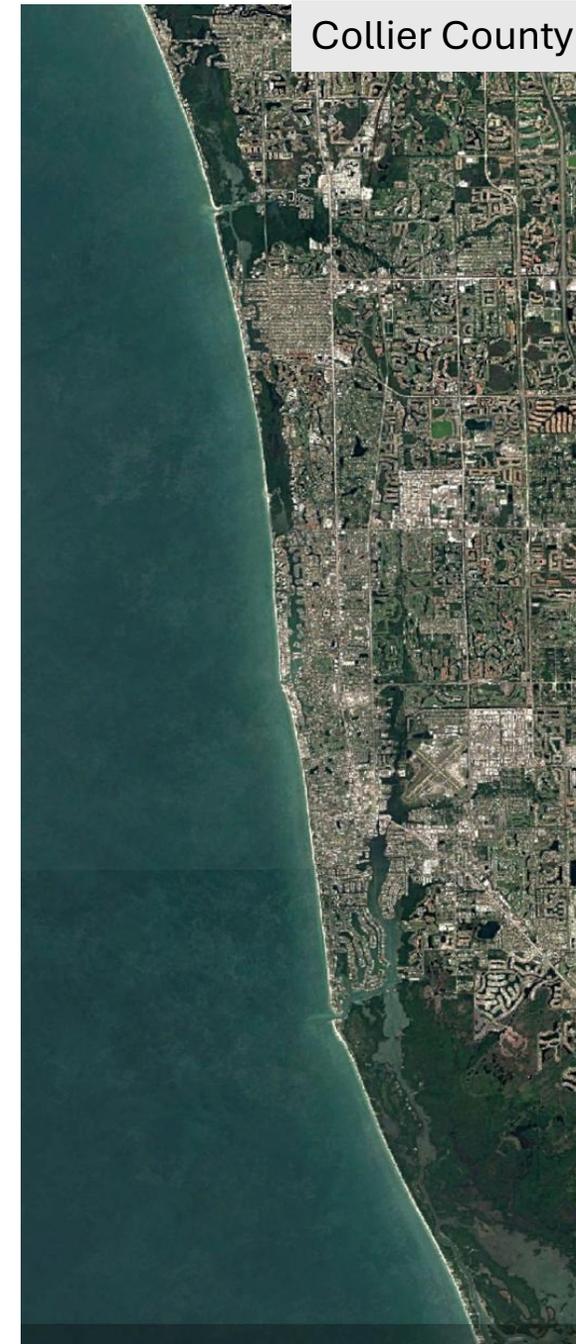
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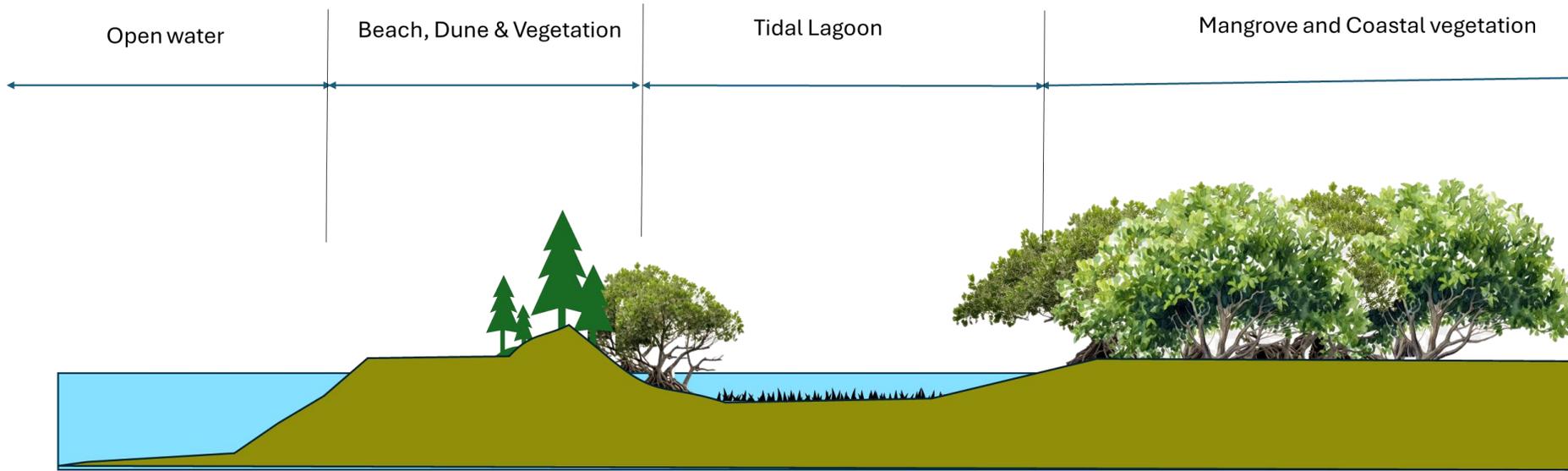
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□ Coastal Resiliency Considerations

- **Geophysical features**
 - *Coastal squeeze and encroachment*
- **Forcings and Frequency**
 - *Astronomical tides*
 - *Cold fronts*
 - *Tropical storms*
 - *Climate change*
- **Coastal defense systems**
 - *Space*
 - *Elevations*
 - *Resistance and resilience*
- **Natural and Nature Based Features**
 - *Dunes*
 - *Coastal Vegetation*
 - *Erosion Control*

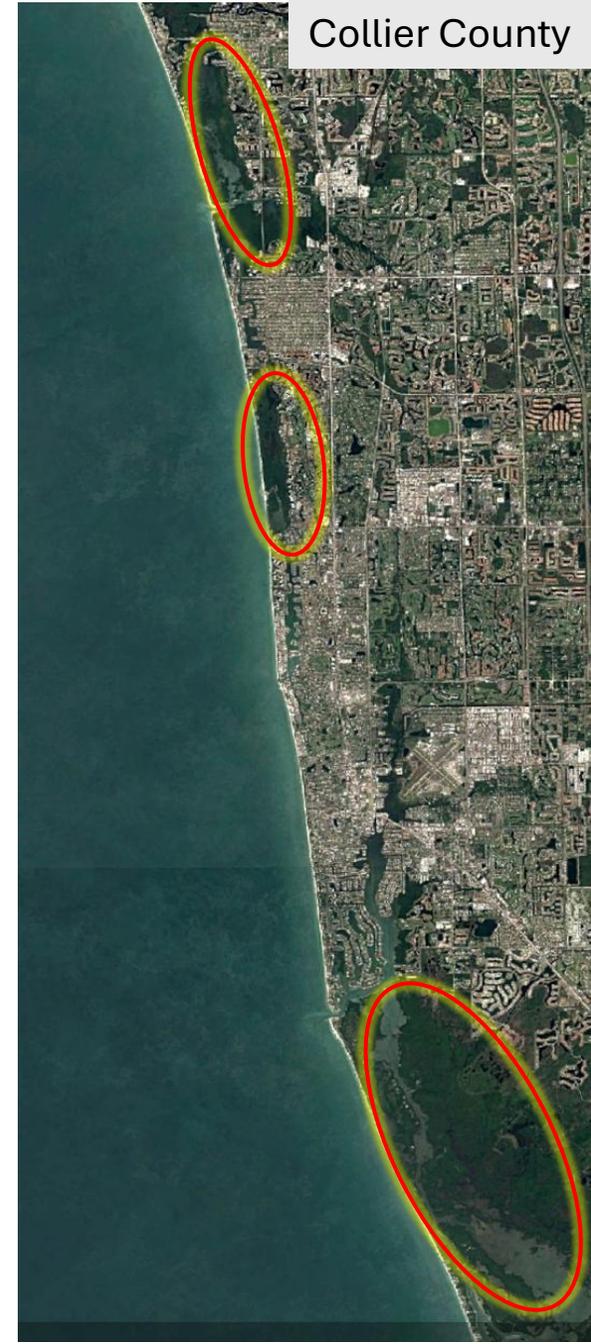


□ **Natural systems**

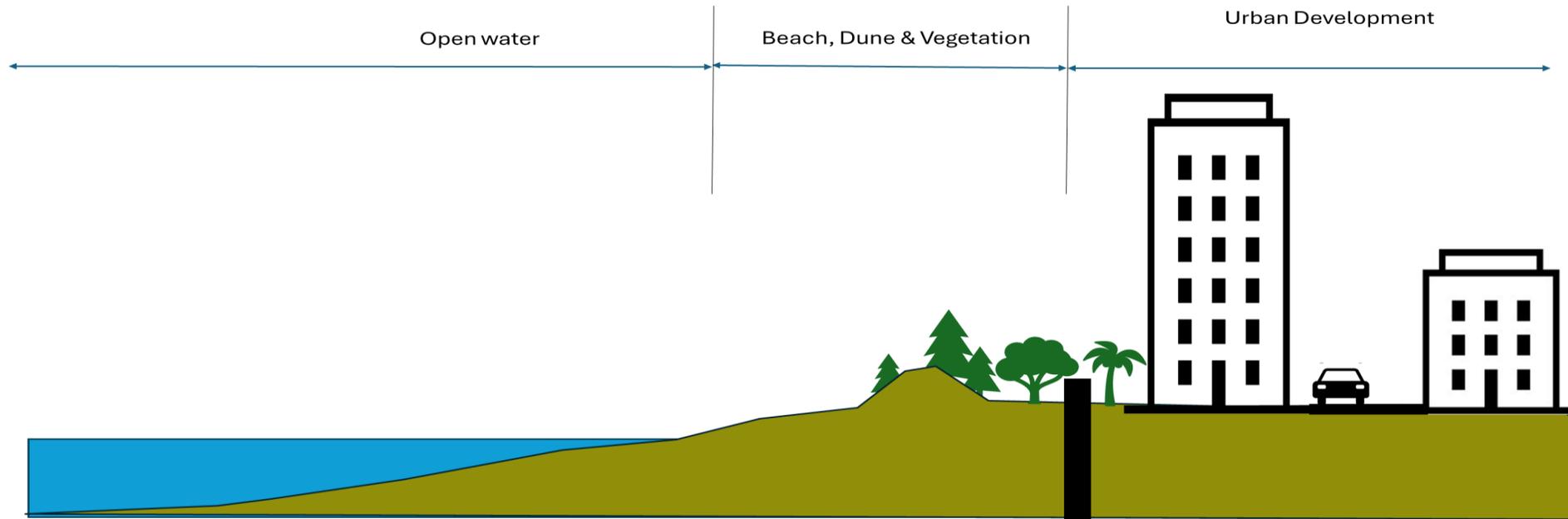


□ **Resiliency**

- **Natural dynamics and evolution**
- **Recovery time and space**
- **Natural adaptation to climate change**

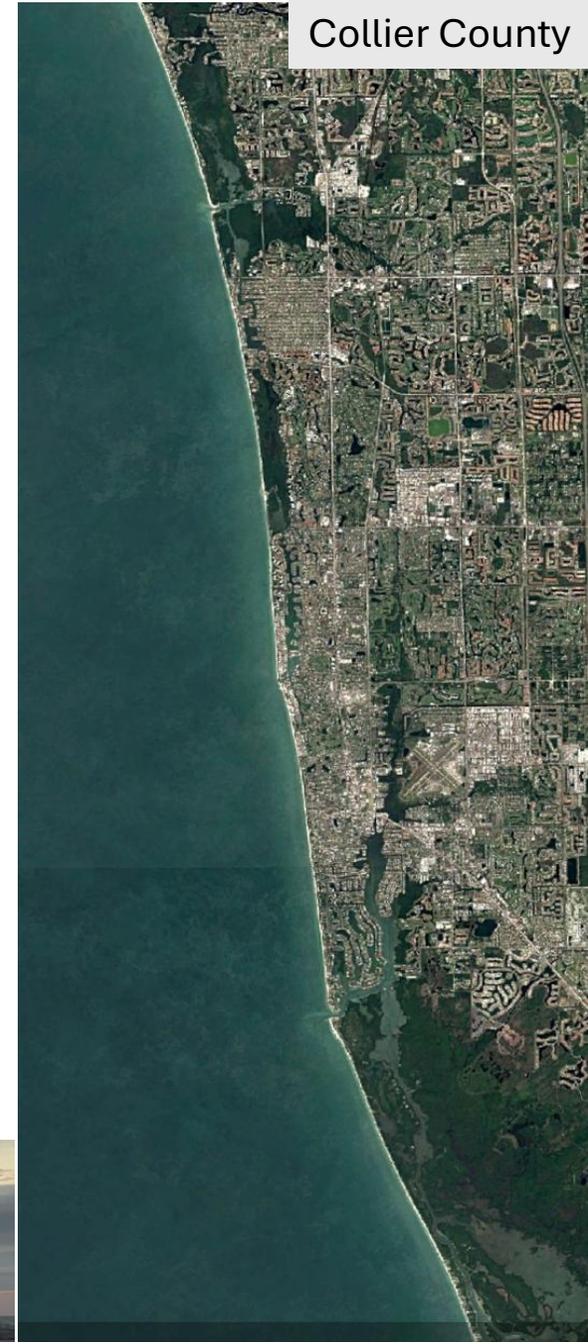


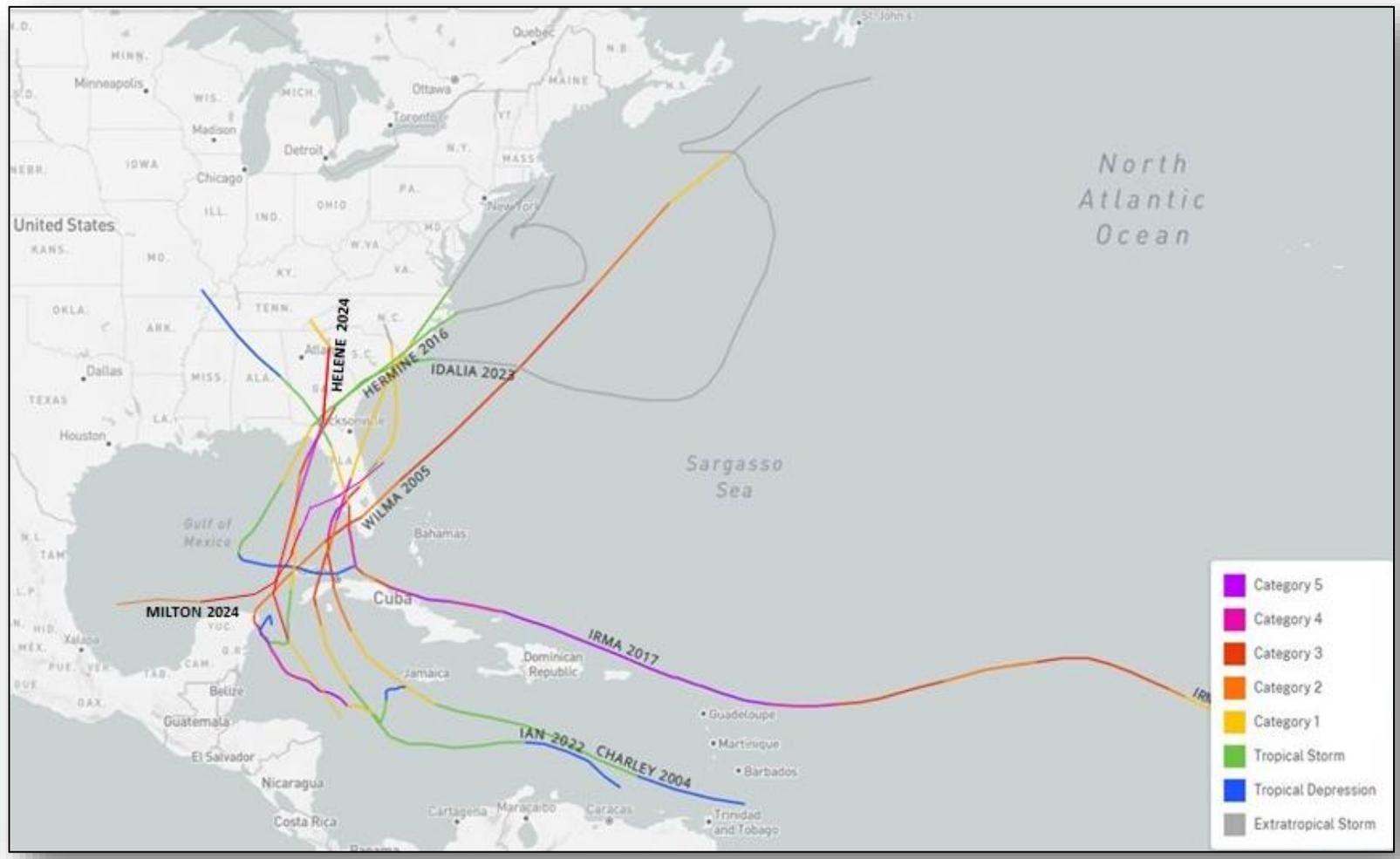
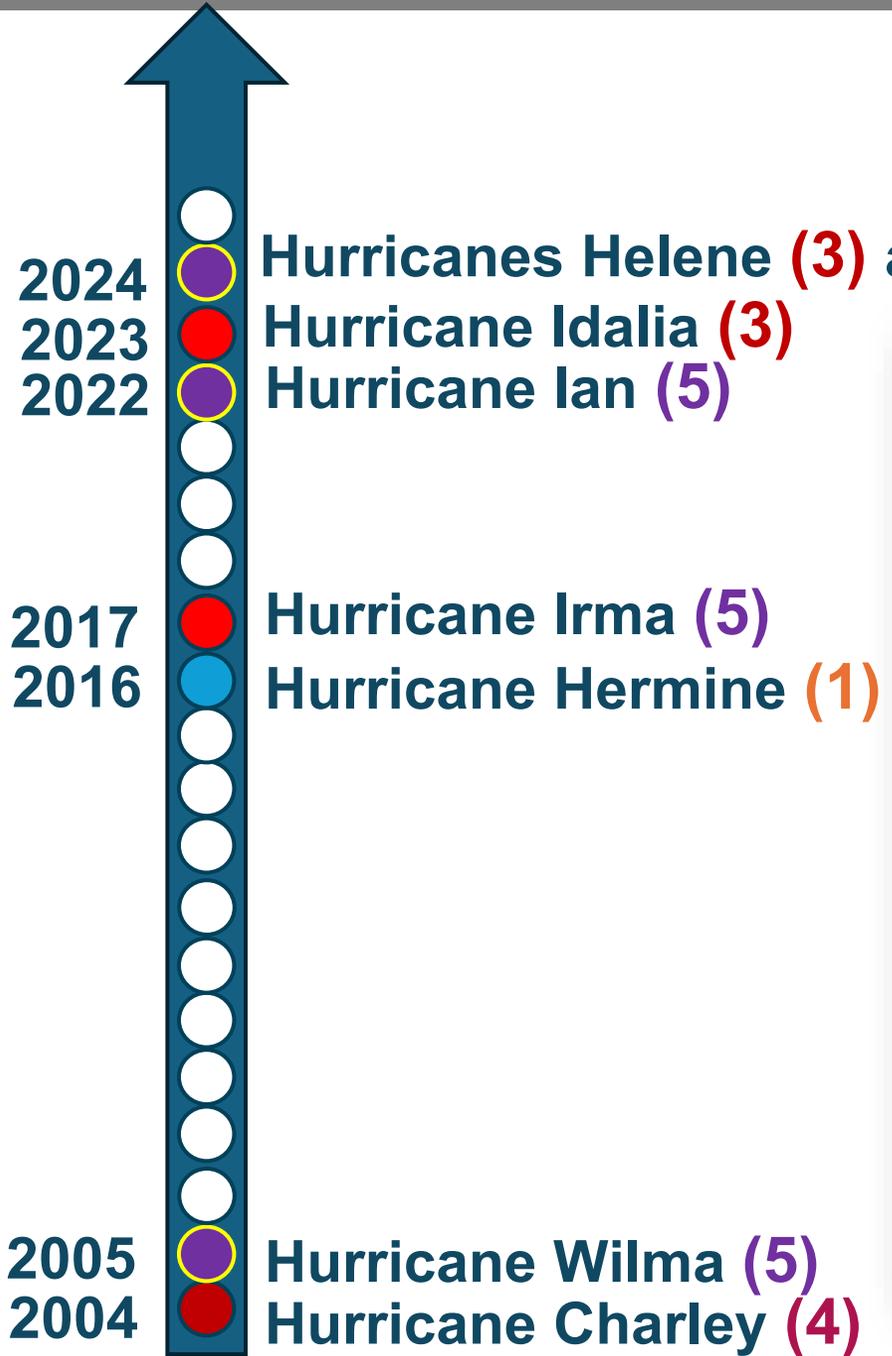
Urban systems

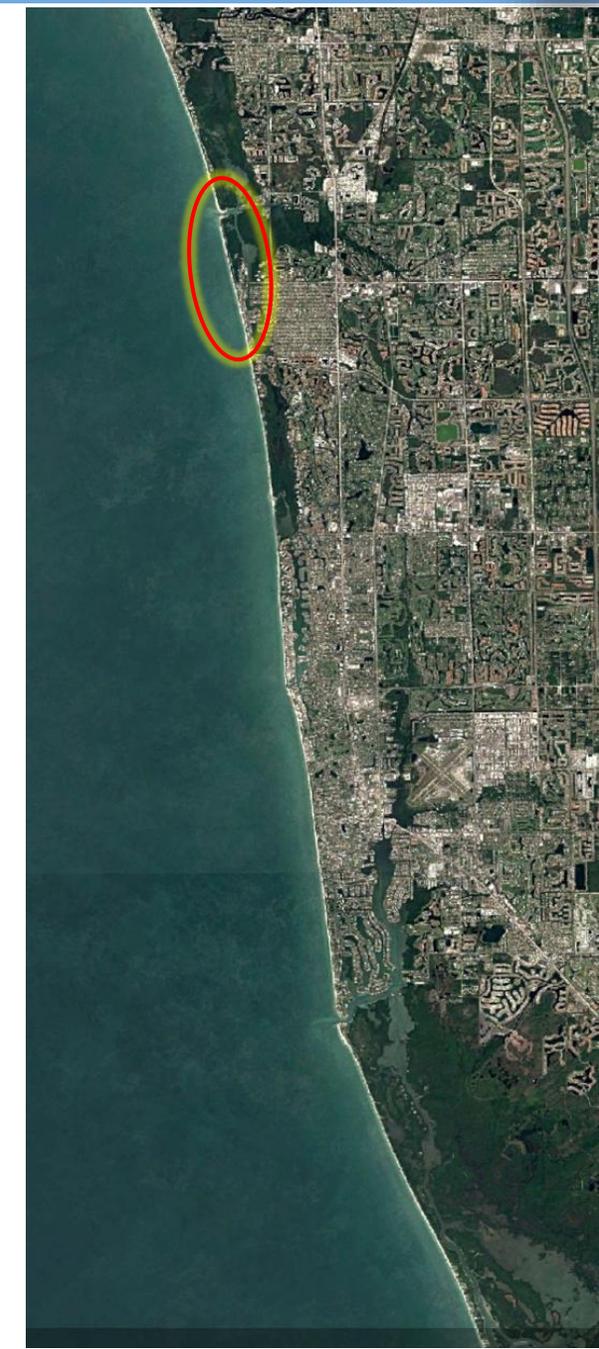
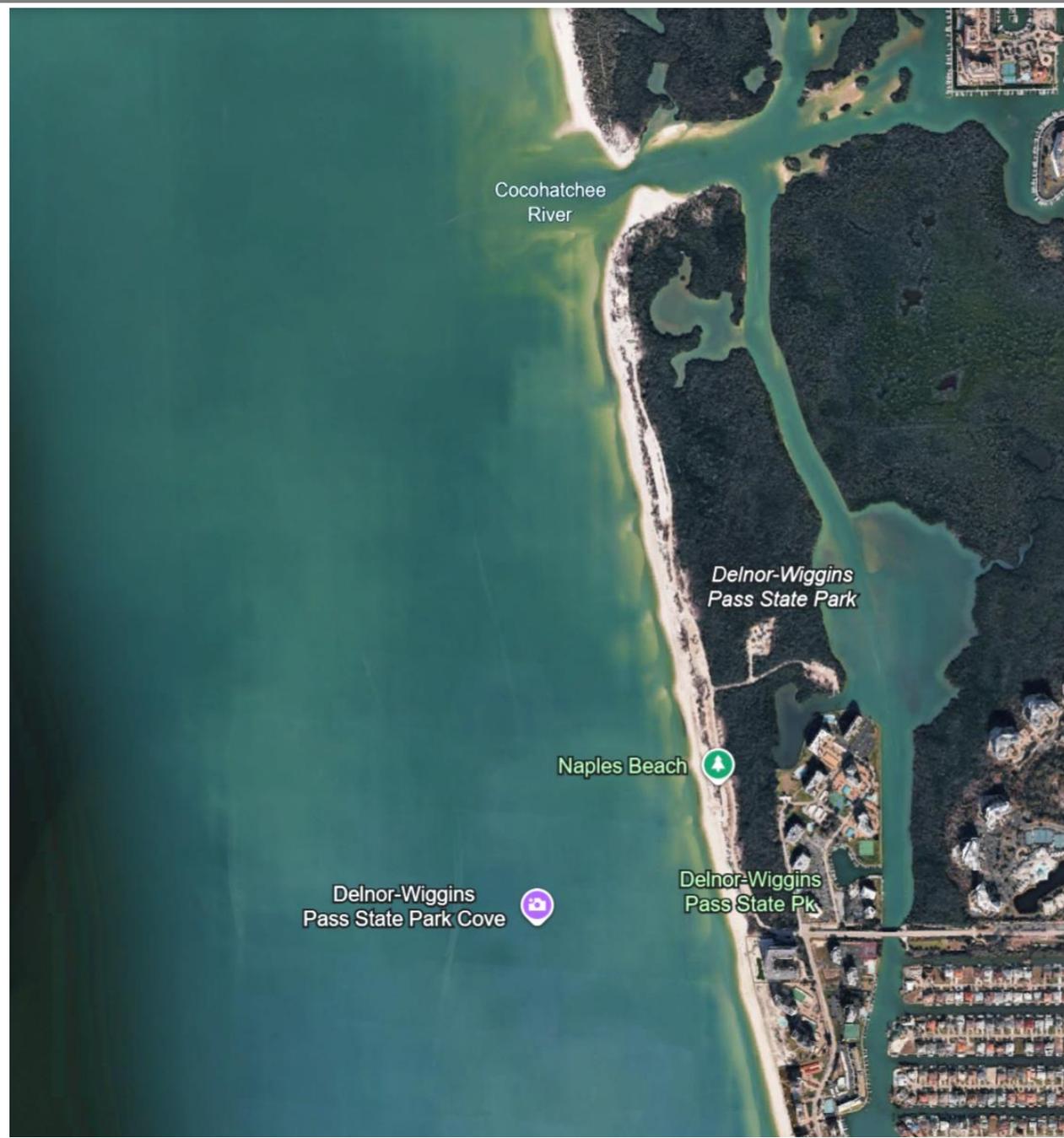


Resiliency

- Shore protection measures and maintenance
- Climate change and storm intensity challenges
- Adaptation strategies







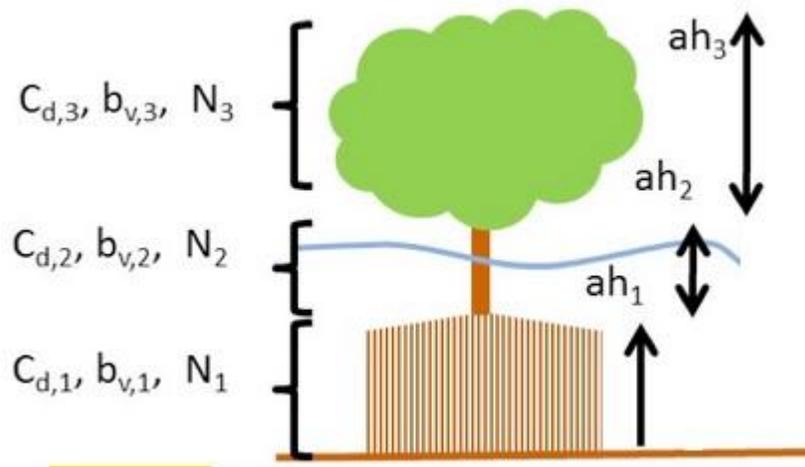
SEA -GRAPES



AUSTRALIAN PINES



XBEACH VEGGIES

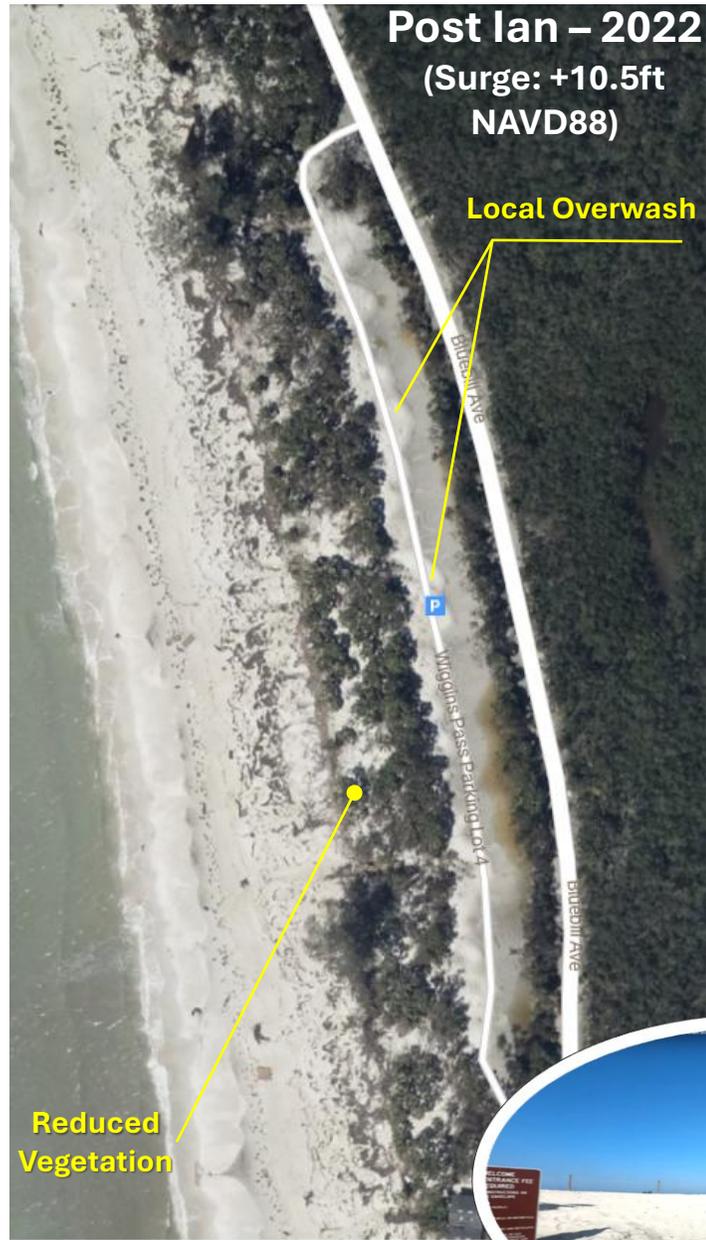


SEA OATS

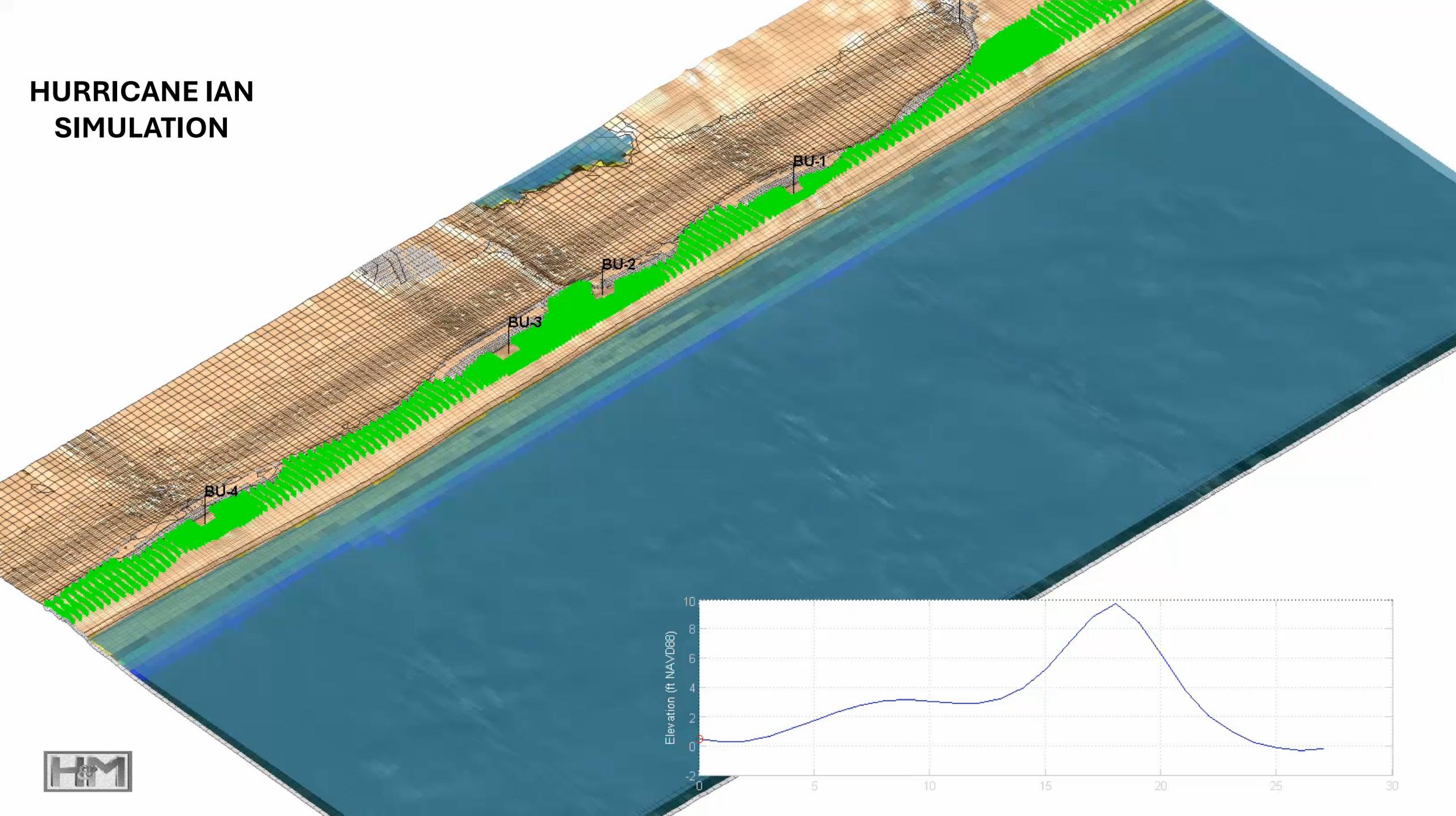


MANGROVES





HURRICANE IAN SIMULATION

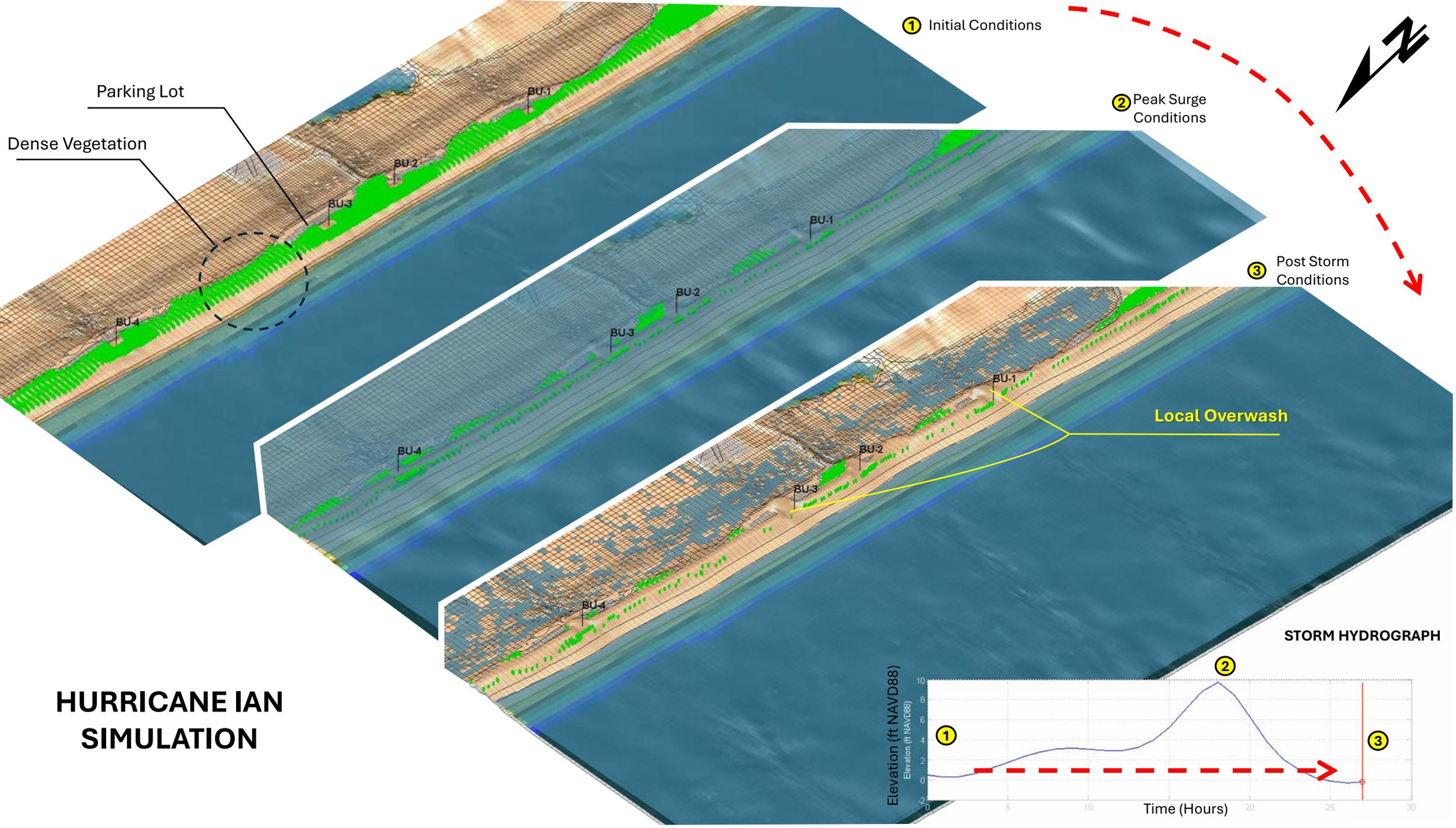


Parking Lot
Dense Vegetation

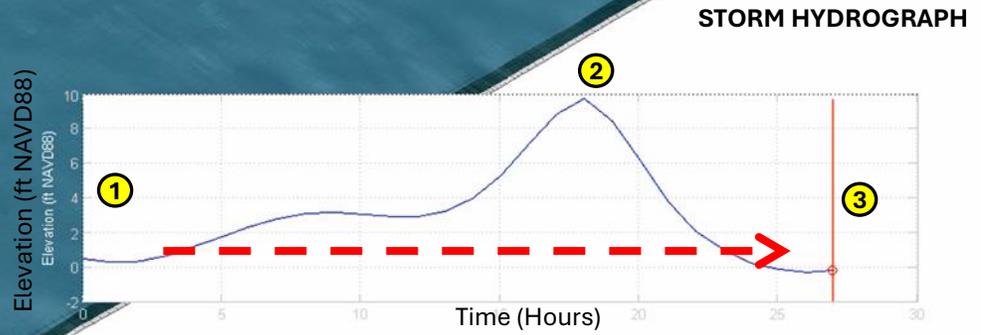
① Initial Conditions

② Peak Surge Conditions

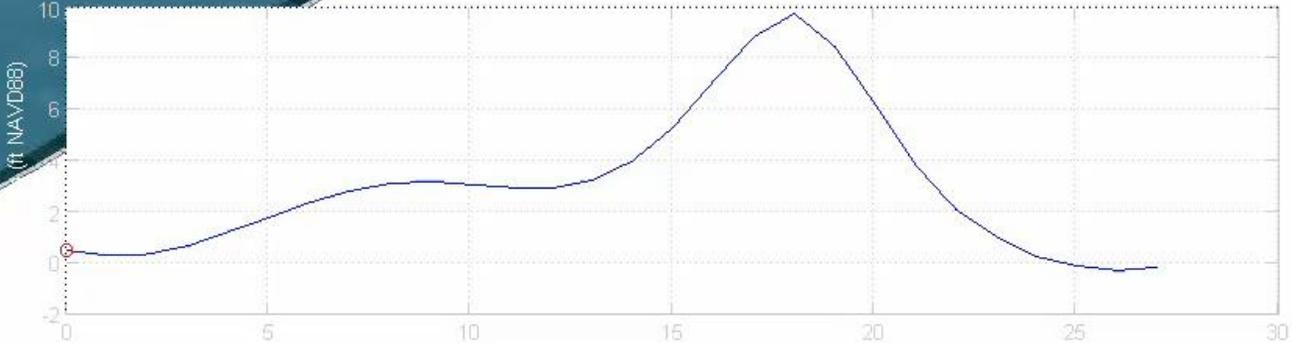
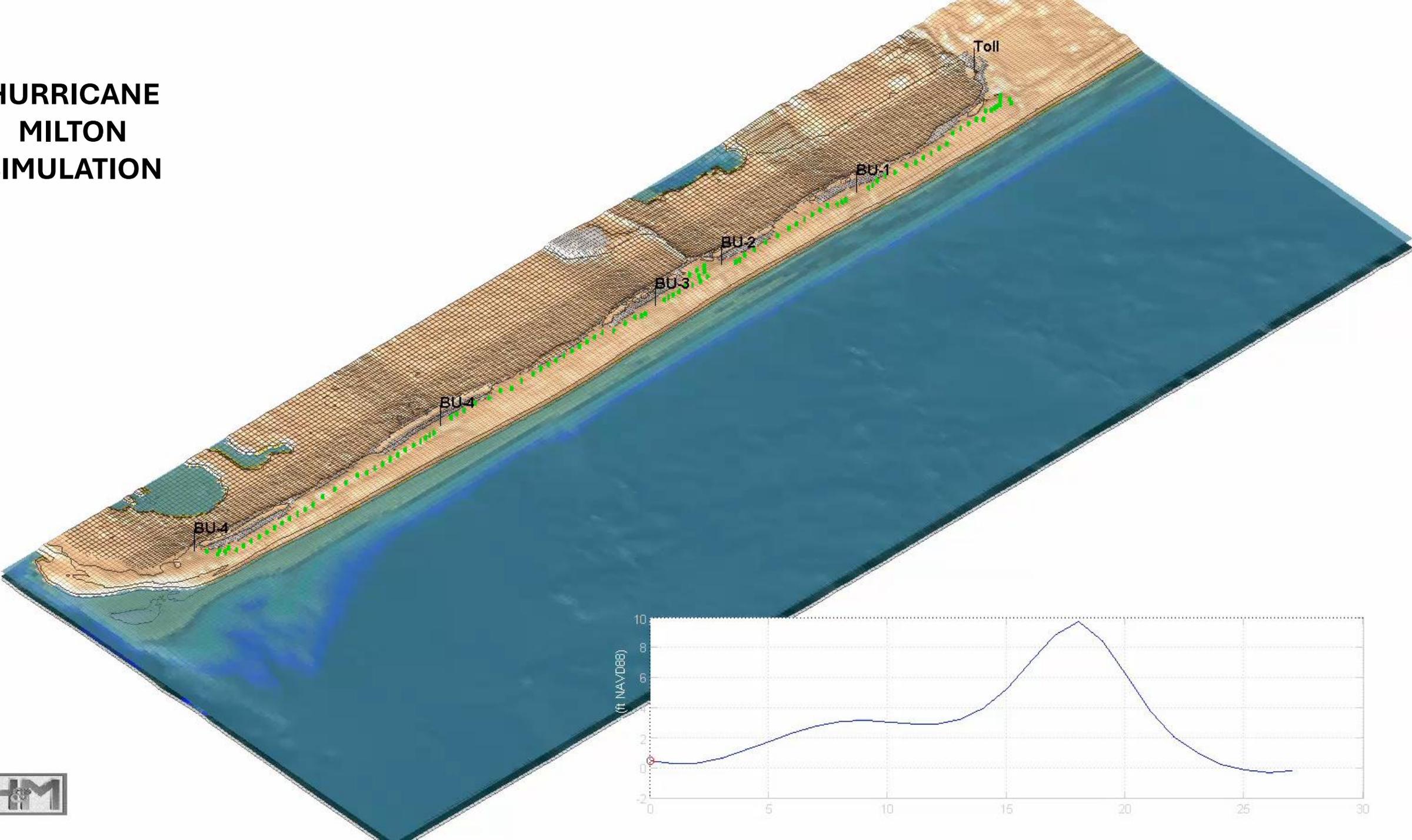
③ Post Storm Conditions



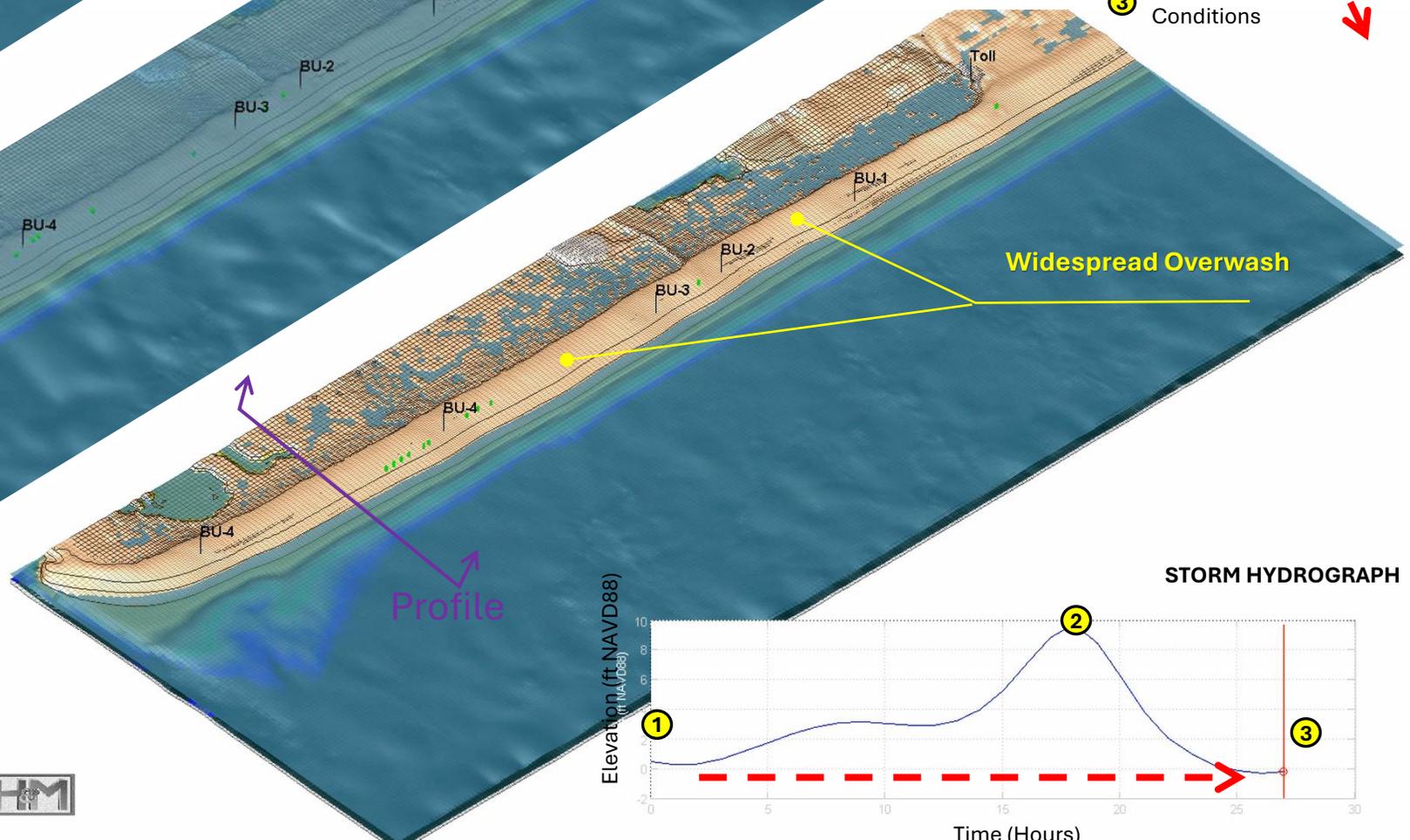
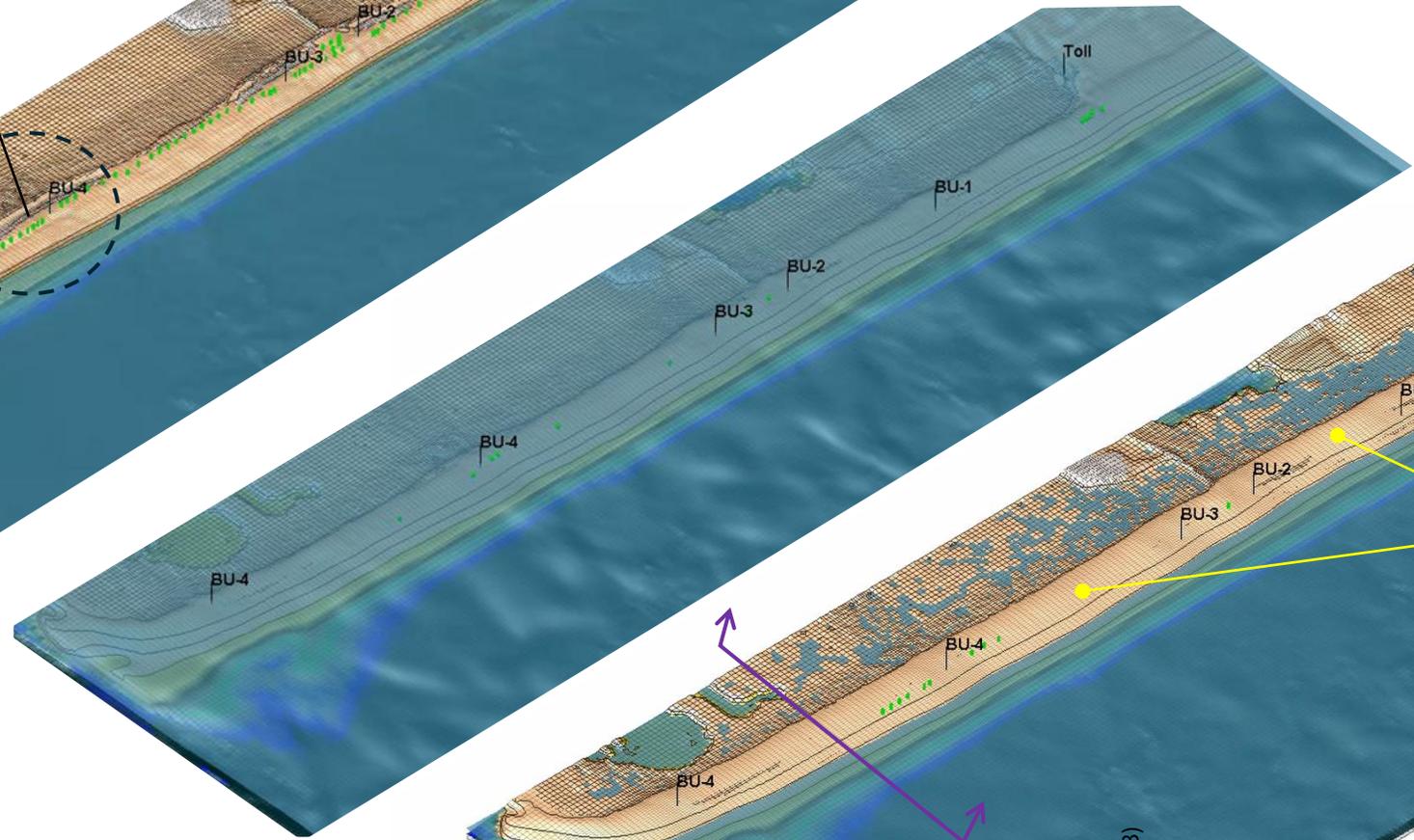
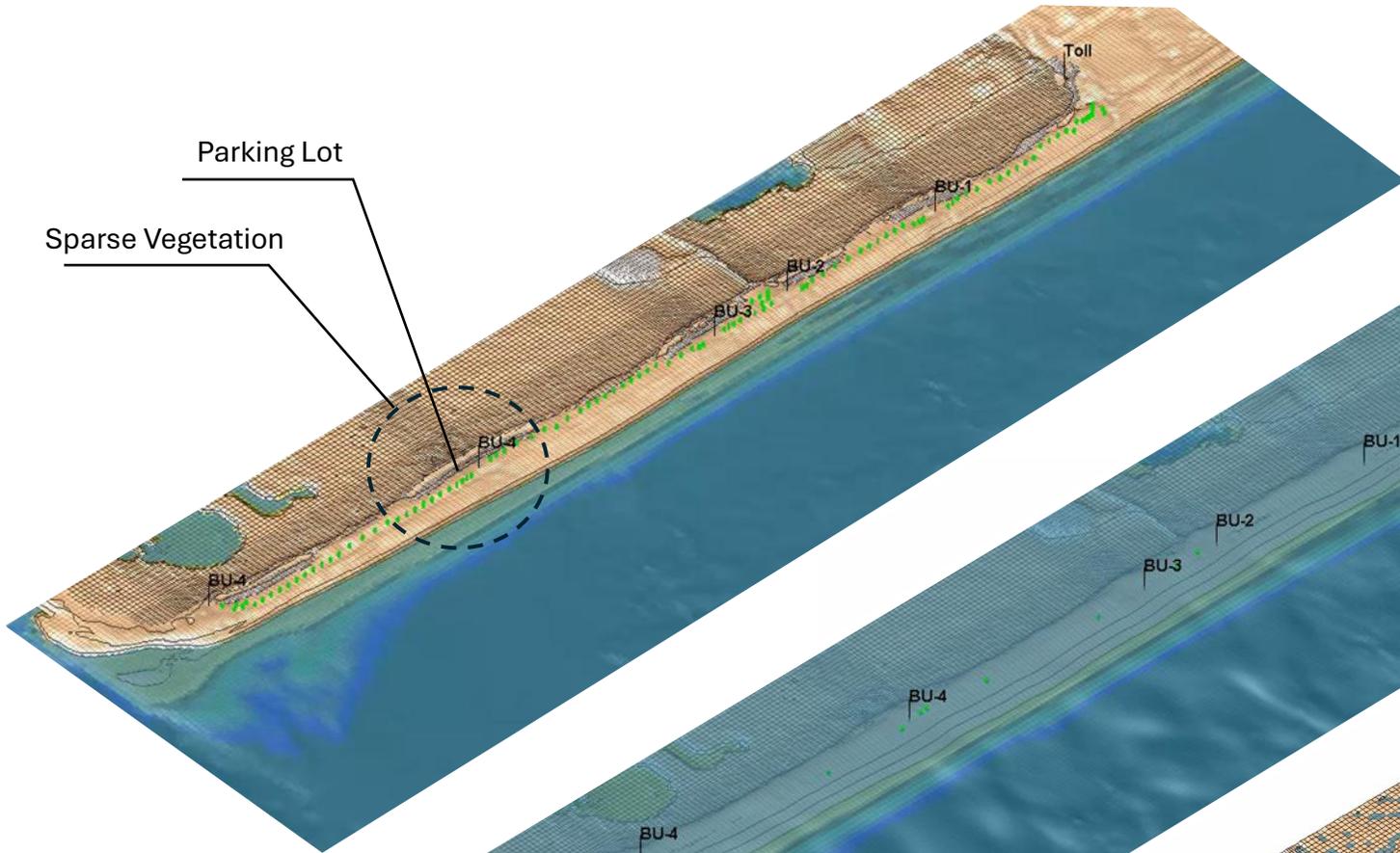
HURRICANE IAN SIMULATION



HURRICANE MILTON SIMULATION



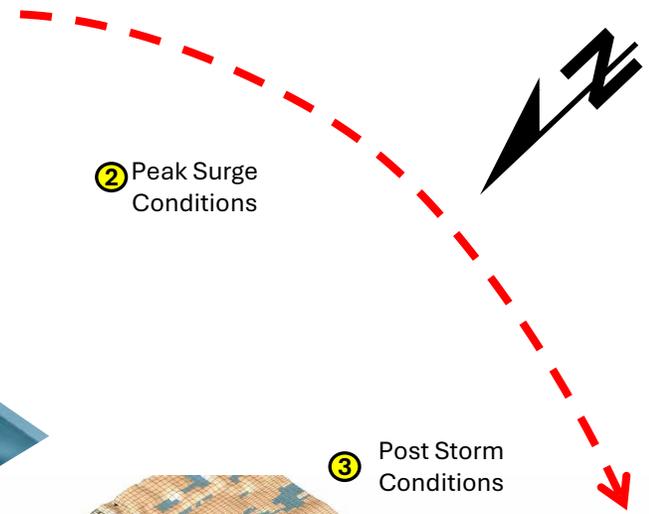
Parking Lot
Sparse Vegetation



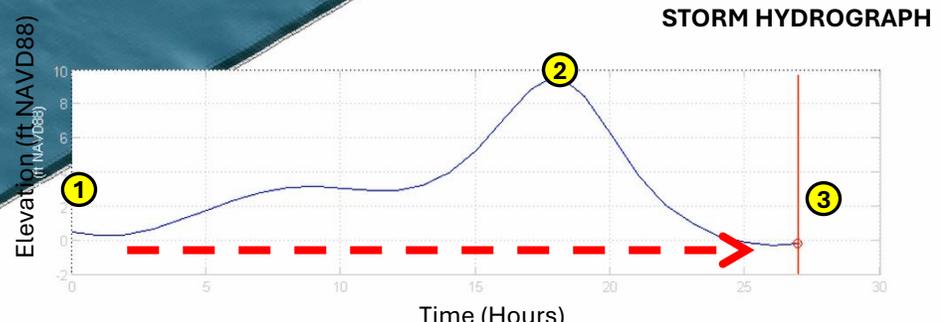
① Initial Conditions

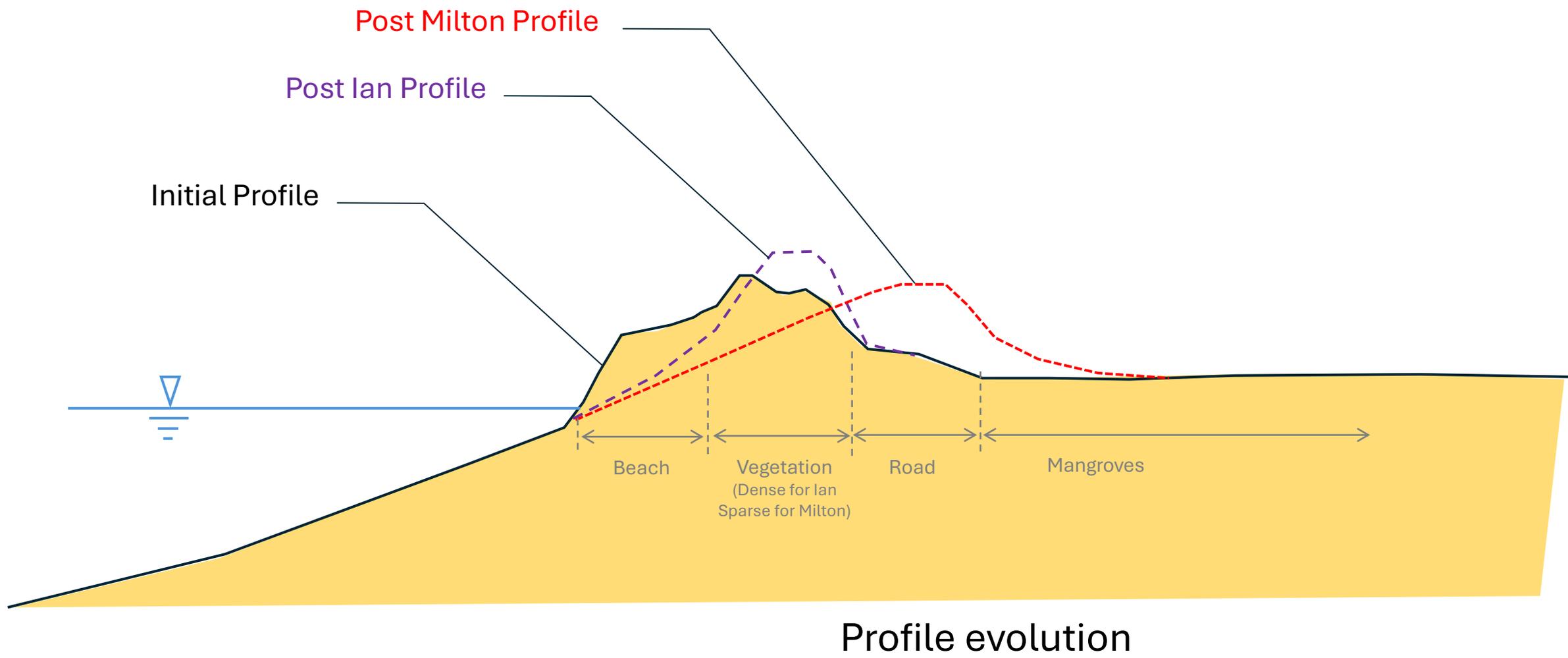
② Peak Surge Conditions

③ Post Storm Conditions

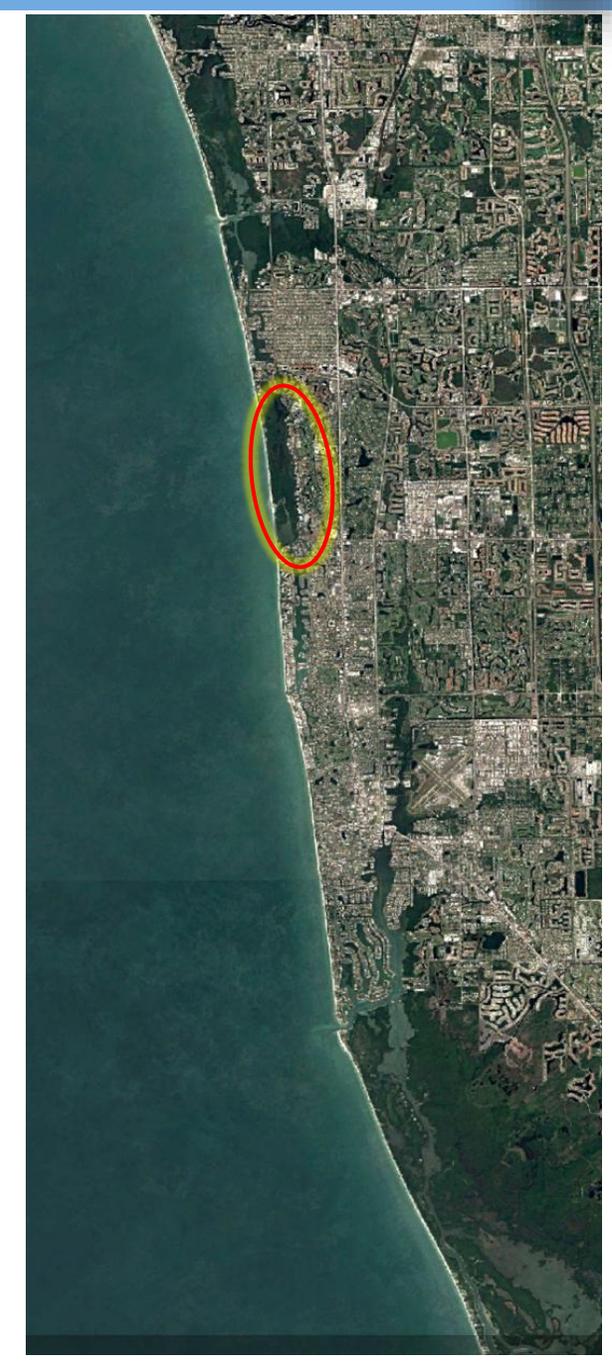


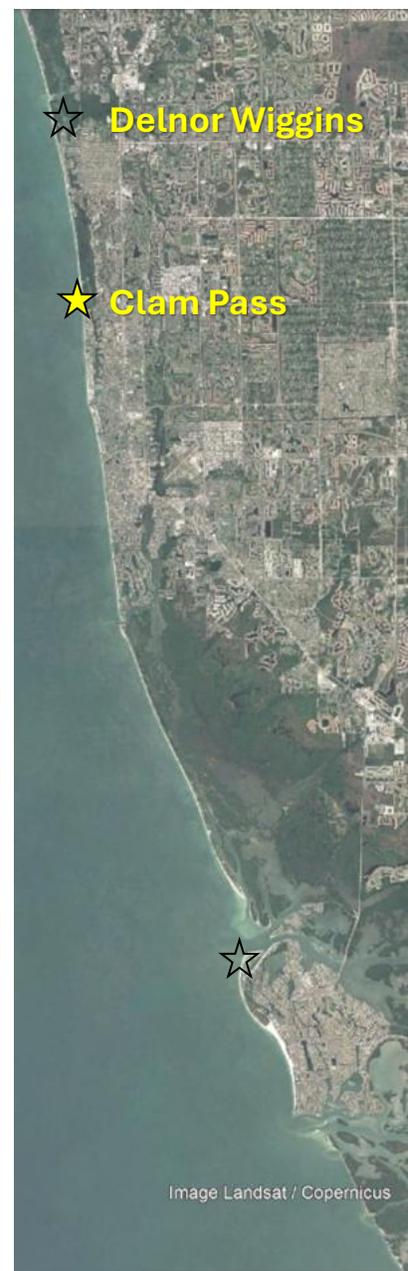
HURRICANE MILTON SIMULATION



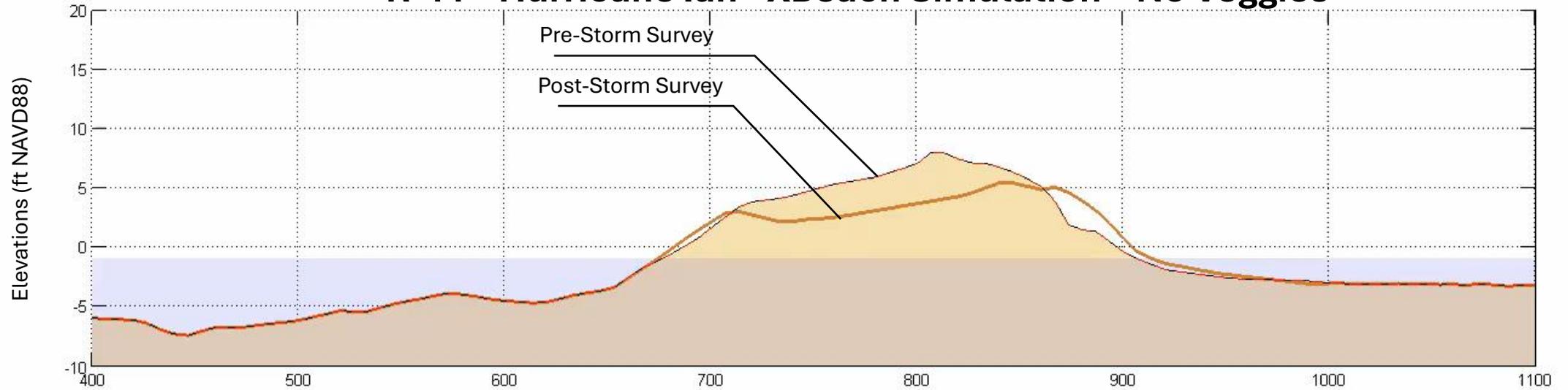


Pre-Ian Conditions

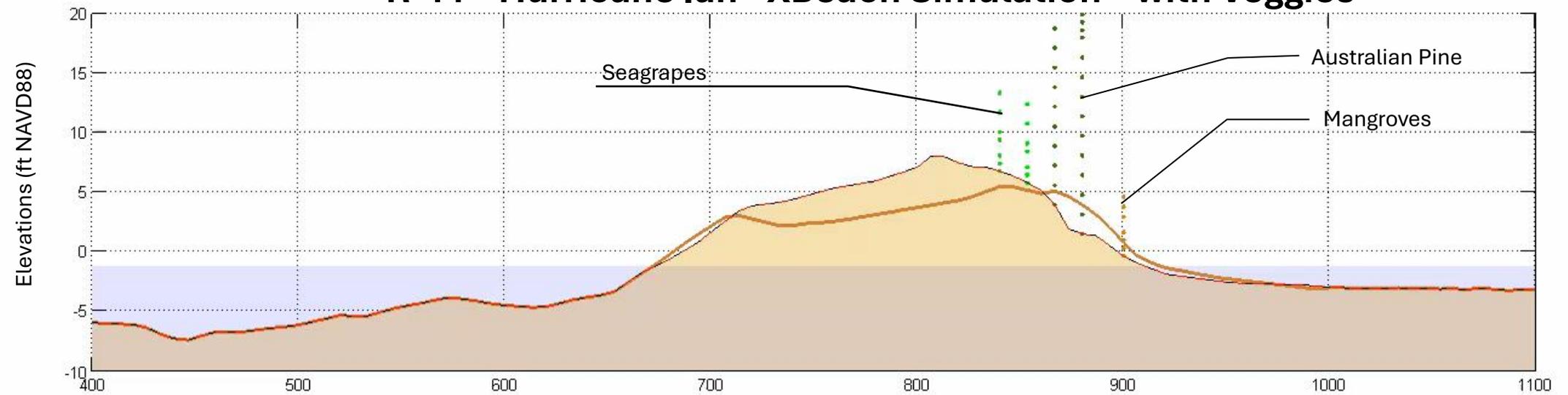




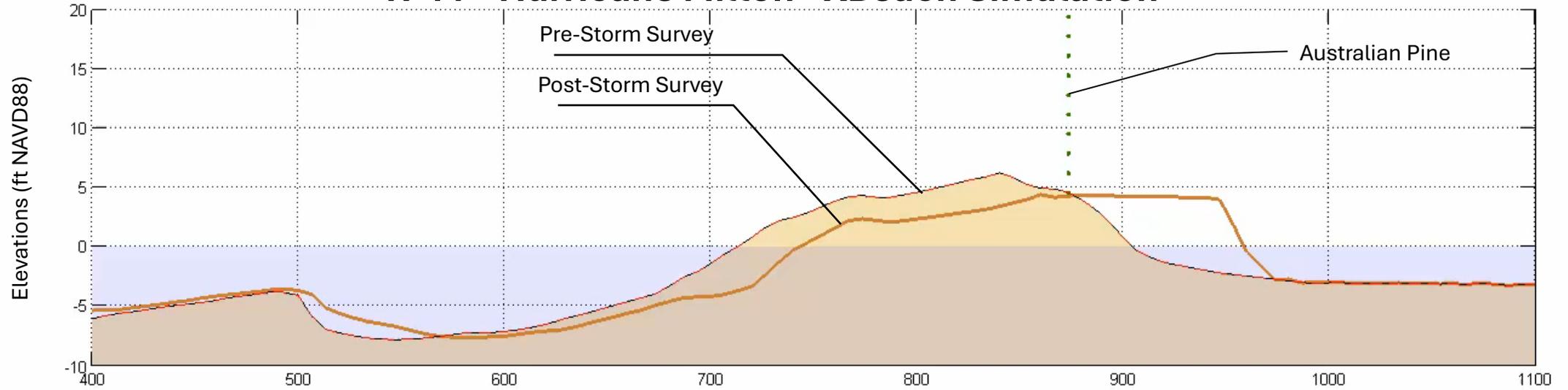
R-44 – Hurricane Ian - XBeach Simulation – No Veggies



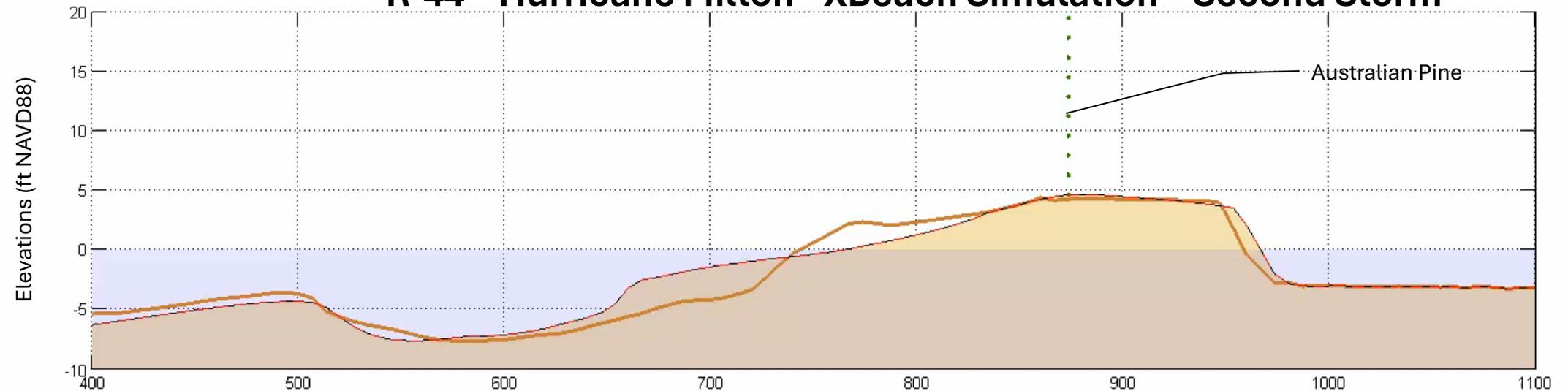
R-44 – Hurricane Ian - XBeach Simulation – with Veggies



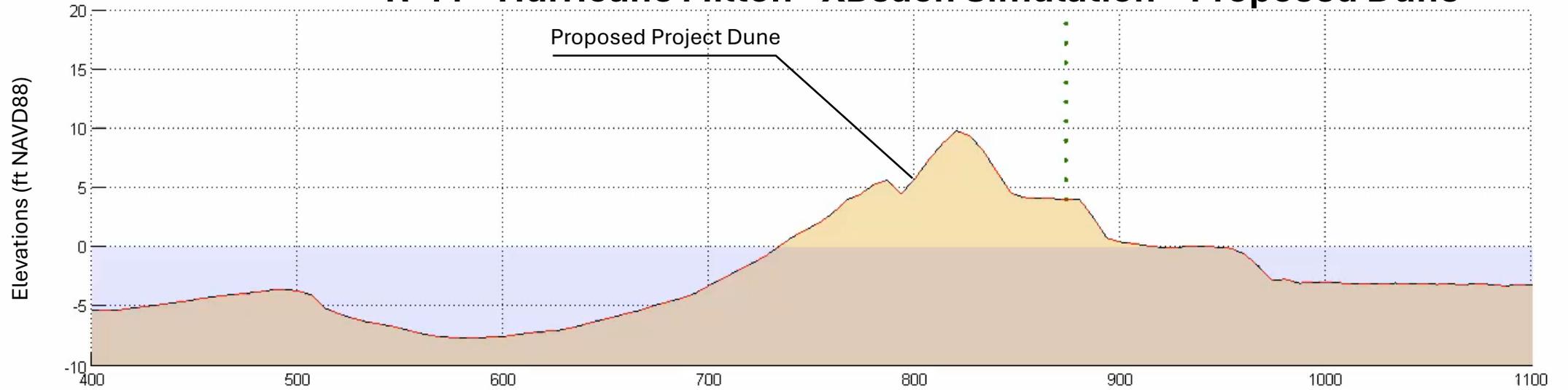
R-44 – Hurricane Milton - XBeach Simulation



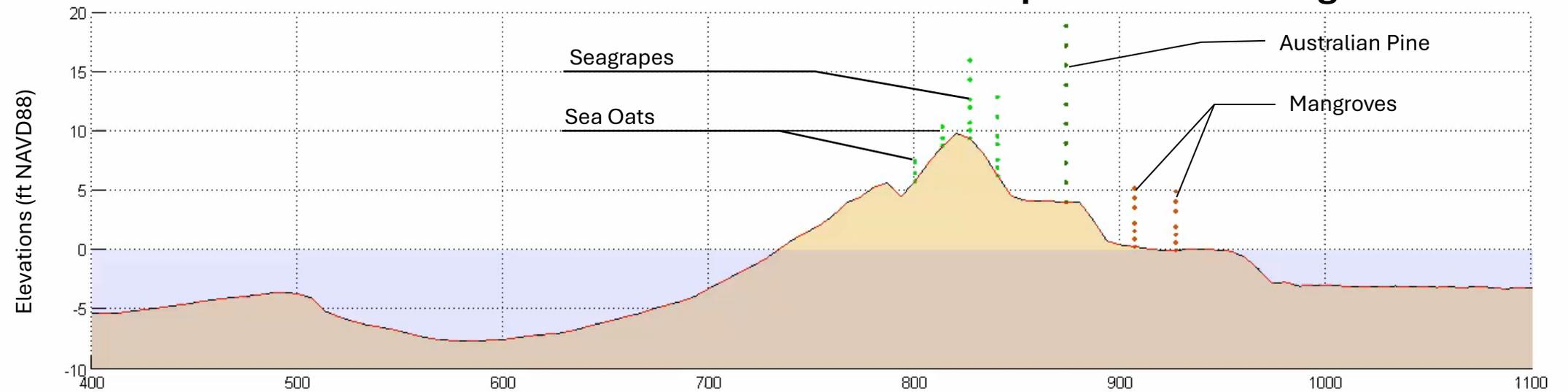
R-44 – Hurricane Milton - XBeach Simulation – Second Storm

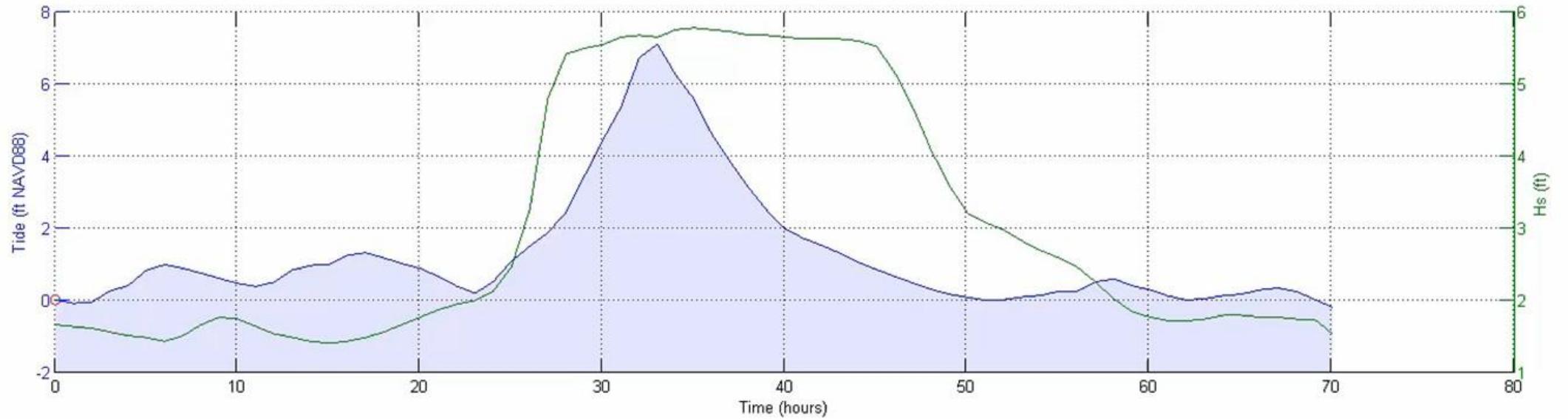
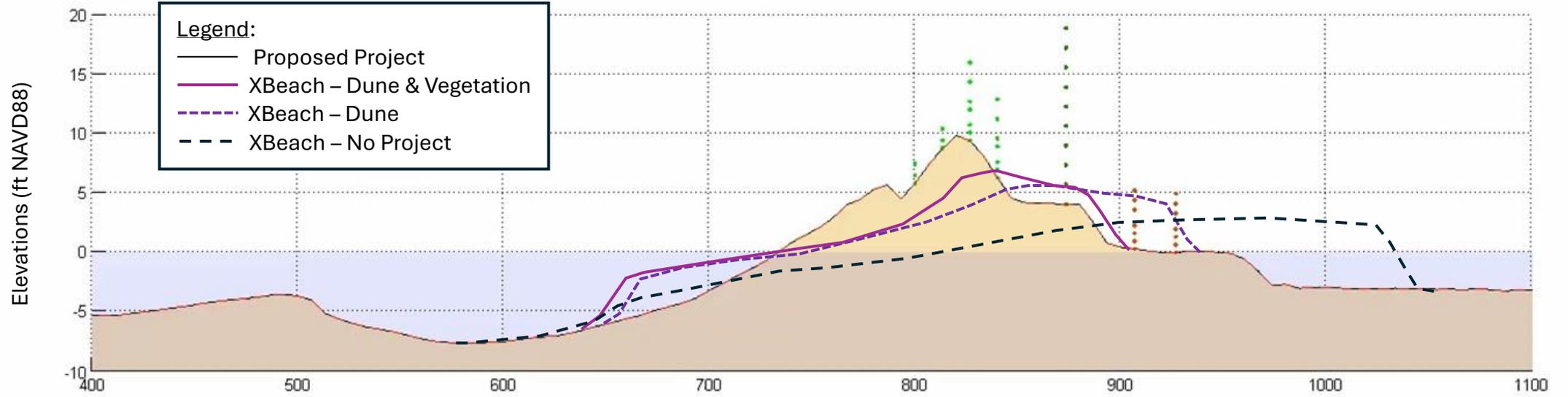


R-44 – Hurricane Milton - XBeach Simulation – Proposed Dune

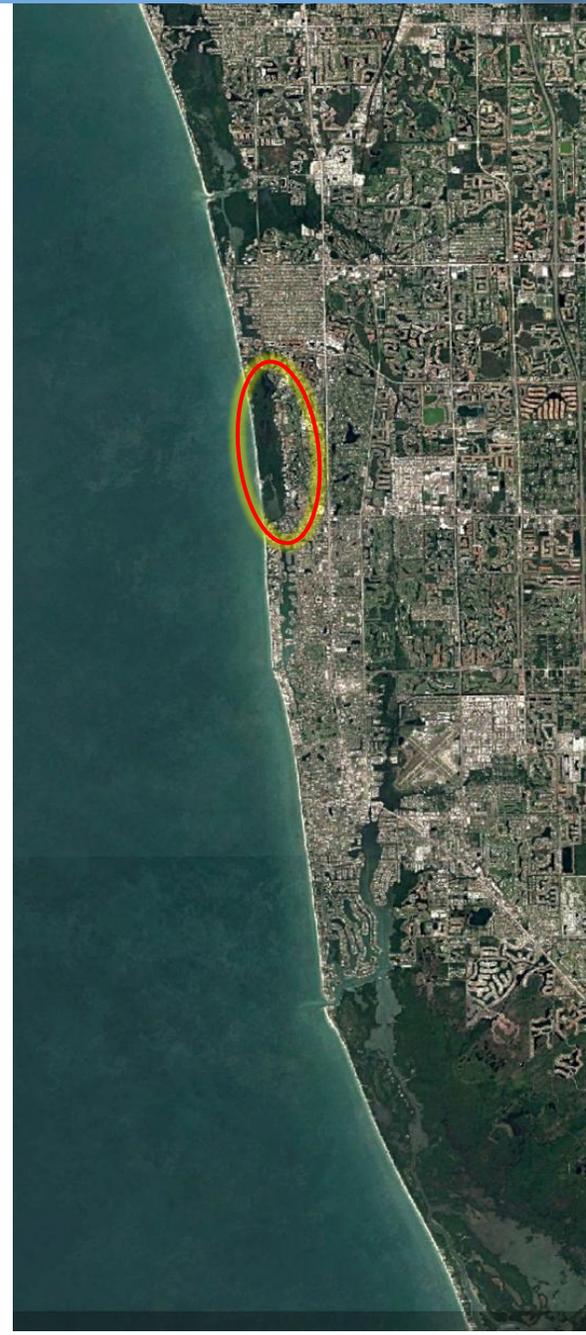
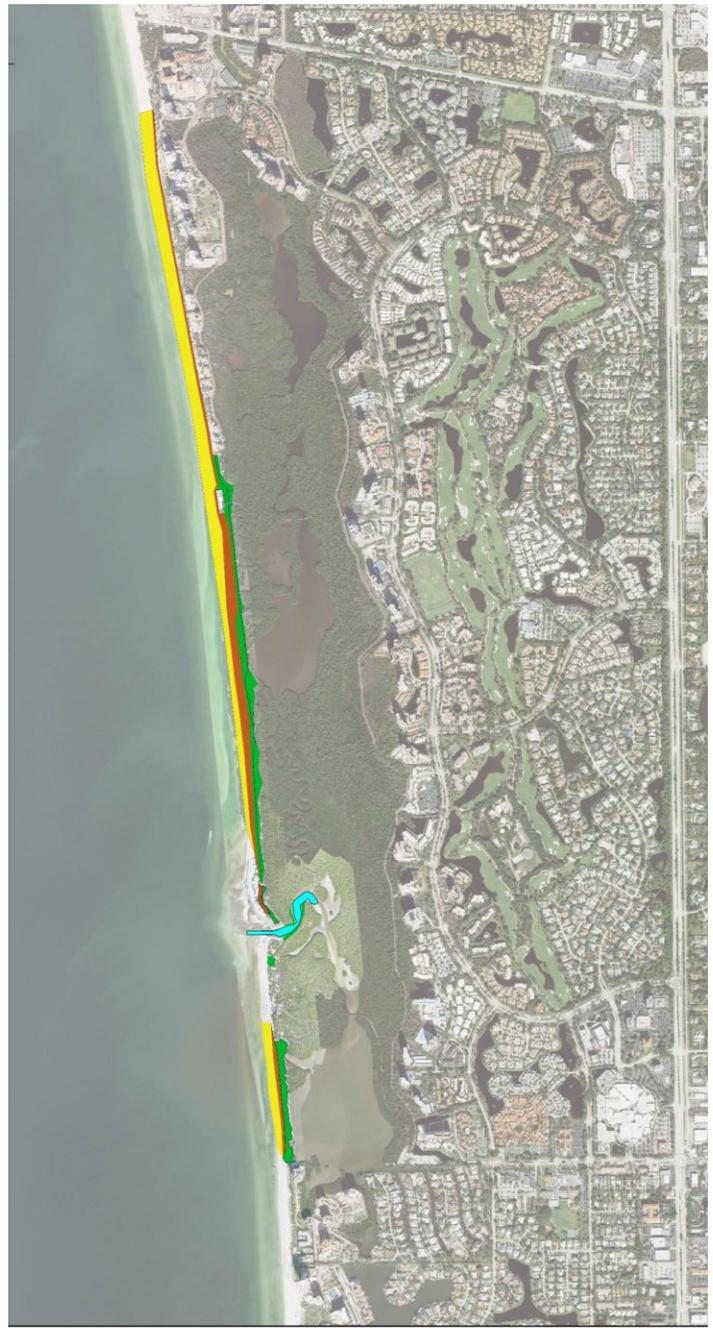
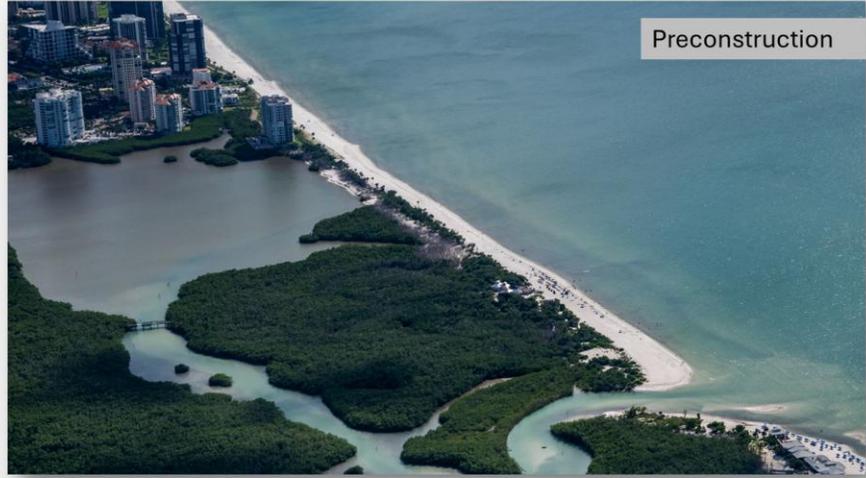


R-44 – Hurricane Milton - XBeach Simulation – Proposed Dune & Vegetation





Clam Pass Park/ Sea Gate Coastal Resiliency



□ Dune and vegetation as nature-based resiliency measure

- ***Storm Impacts and restoration strategies***
 - *Dunes are storm resiliency measures*
 - *Requires time and space to fully mature and function for major storms*
- ***Requirements***
 - *Stable beach conditions*
 - *Adequate width and elevation*
 - *Vegetation*
 - *Maintenance and protection*
- ***Resiliency considerations***
 - *Space and time allowance for adaptation*
 - *Incremental improvements as necessary*
- ***Design, Implementation and adaptation***
 - *Numerical modeling*
 - *Monitoring programs*
 - *Environmental considerations*

