Measurements of Marsh Resilience Under Future Sea-Level Rise Conditions in the Meadowlands of New Jersey

CD- 96247300

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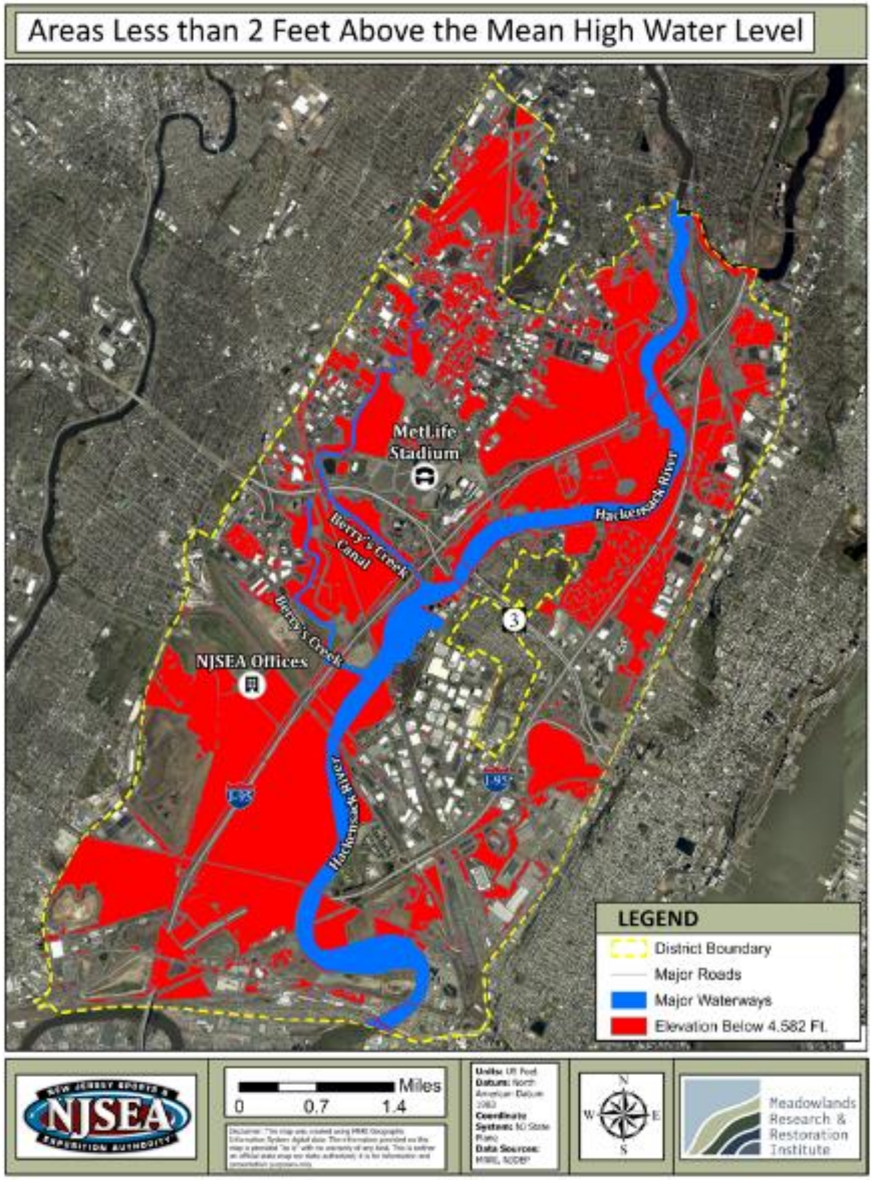
NEW JERSEY SPORTS & EXPOSITION AUTHORITY NJSEA

Meadowlands Research & Restoration Institute

Intro – The Meadowlands



8400 acres wetland interspersed with low-lying residential, commercial and industrial areas

Sea level rise threatens with coastal squeeze and higher frequency flooding

Mudflat extension and loss of marsh plain

Ultimate Outcome of the Project

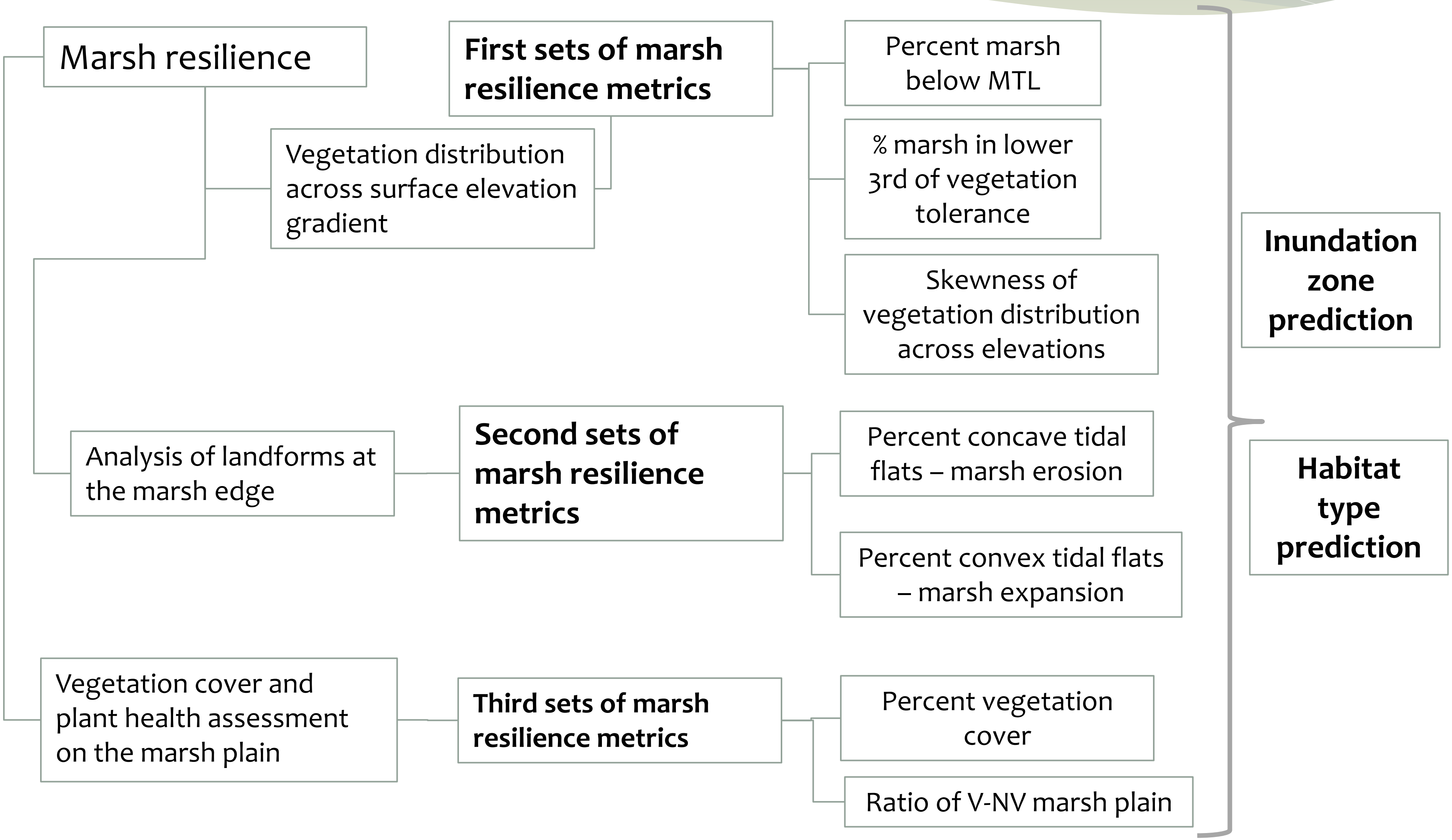
Category	Metric	Data needs
MARS metrics (Raposa *et al* 2016)		
Marsh elevation distributions	Percent of marsh below MHW	Frequency distribution of marsh elevations; estimate of mean high water
	Percent of marsh in lowest third of plant distribution	Frequency distribution of marsh elevations
	Skewness	Frequency distribution of marsh elevations
Marsh elevation change	Elevation change rate (mm yr^{-1})	Time series data from surface elevations tables (SETs)
Sediment/accretion	Short-term accretion rate (mm yr^{-1})	Time-series data from marker horizons
	Long-term accretion rate (mm yr^{-1})	Soil cores for radiometric dating
	Turbidity(NTU)	Mean turbidity from water quality sondes
Tidal range	Tidal range (m)	Mean daily tidal range from water quality sondes
Sea-level rise	Long-term rate of SLR (mm yr^{-1})	Long-term data from NWLON station
	Short-term inter-annual variability in water levels (mm)	Inter-annual variability data from NWLON station
Ganju *et al* (2017) metrics		
	Flood-ebb turbidity differential	Mean suspended sediment concentrations on flood and ebb tides
	UVVR	Relative area of vegetated marsh and unvegetated areas from aerial photographs
Observed change in vegetation		
	Decadal change in UVVR	UVVR (see above) assessed at 2 + points spanning ~10 years
	Percent of marsh plain with vegetation	Area of vegetated marsh divided by total marsh landscape area (vegetated+unvegetated) × 100
	Decadal change in percent vegetated	Change in above, assessed at 2 + points spanning ~10 year

Elevation

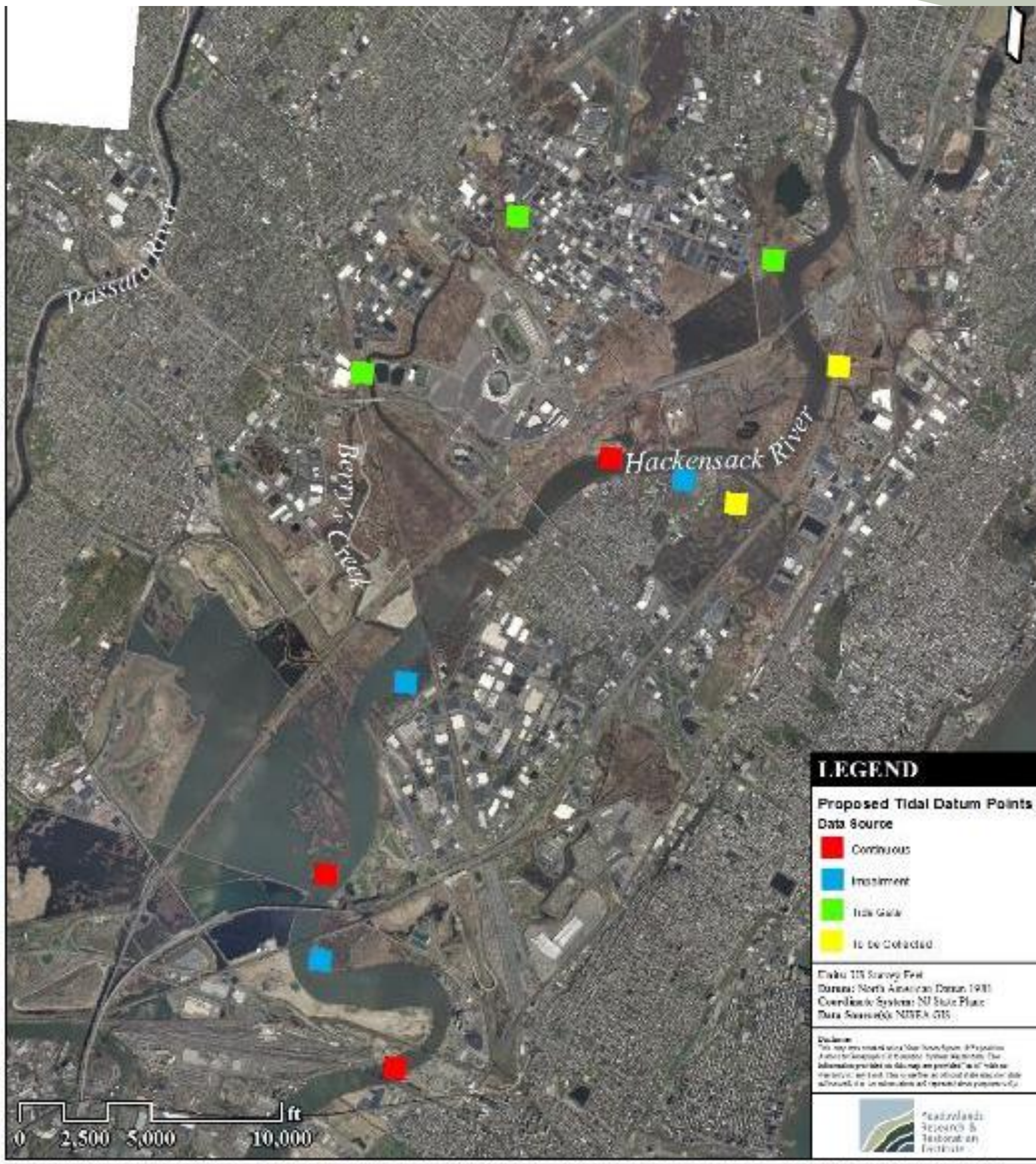
Erosion

Vegetation

Marsh Resilience - Workflow



Task 1– Tidal Datum Analysis



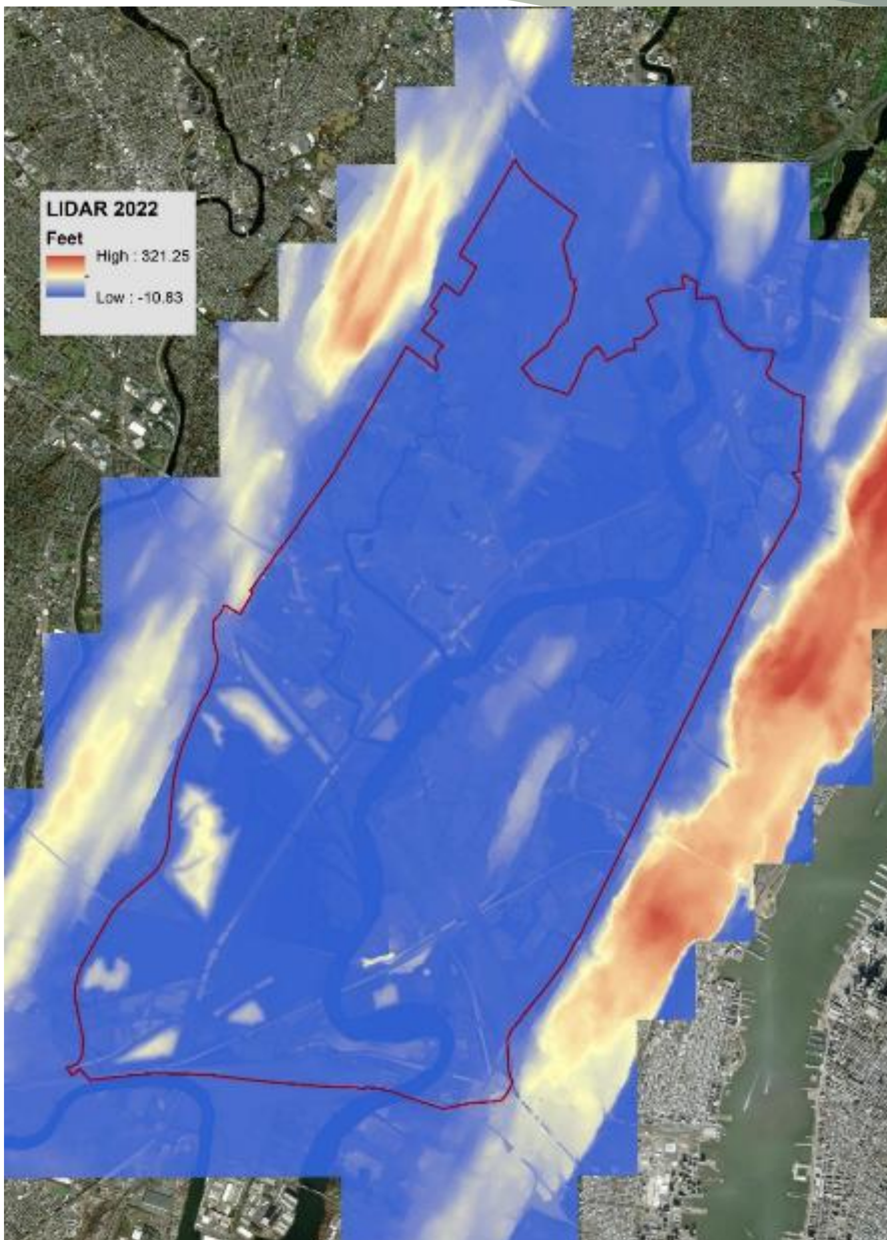
Marsh plains situated lower than 0.5ft below the mean tide level are not suitable for sustaining vegetation.

Marsh plains below this threshold turn into perennial mud flats or open water areas.

New tidal datum specific to the marshes need to be calculated.

Woods Hole Oceanographic Institution performed the tidal datum analysis.

Task 2– Elevation data collection



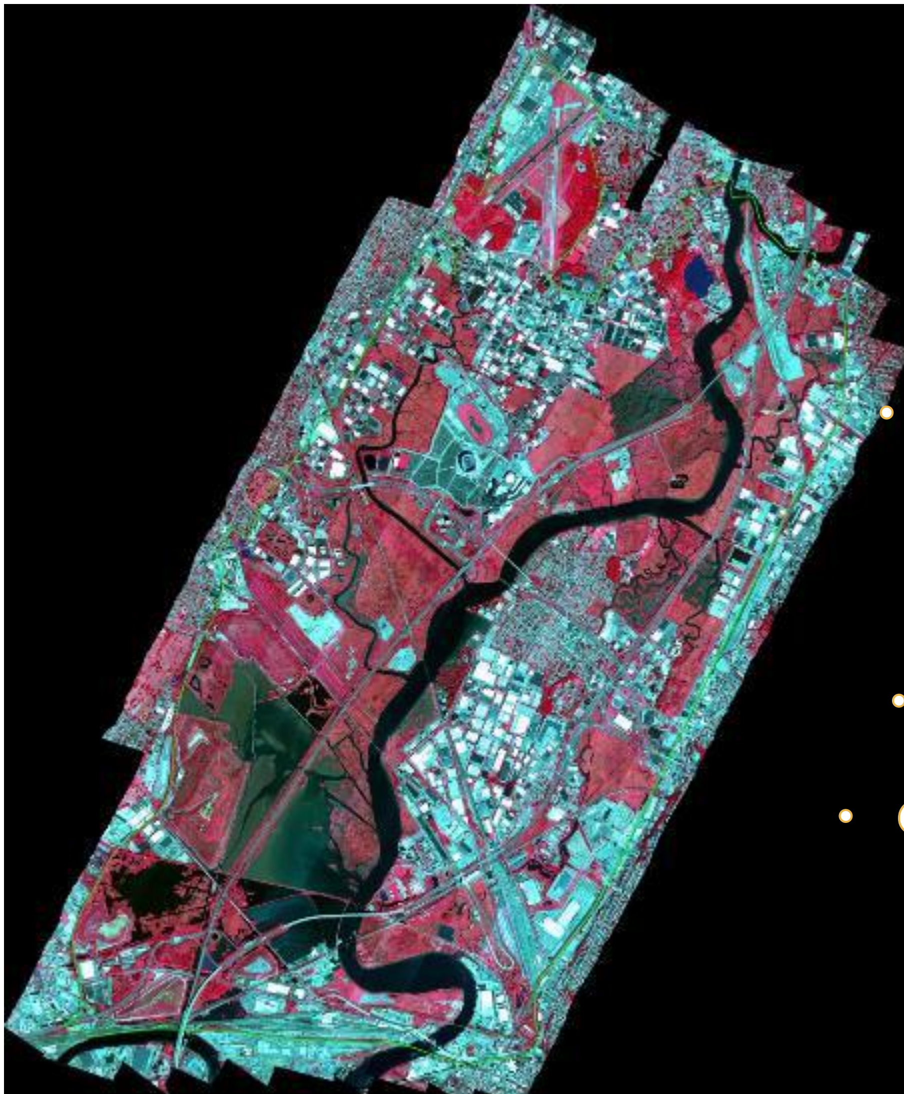
Q1 LiDAR flown in March, 2022

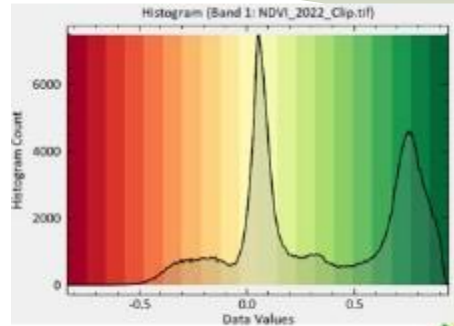
Leaf off conditions

A two hour window of low tide

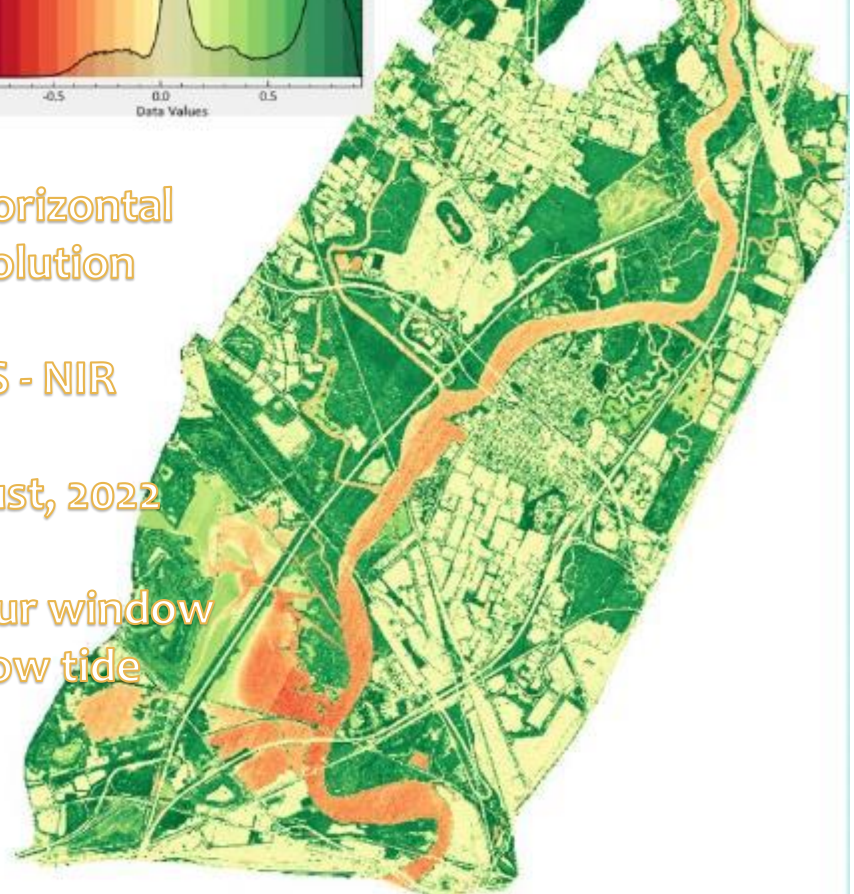
DEM - 1 foot vertical and horizontal accuracy

Task 3 – Hyperspectral Image Acquisition & Processing



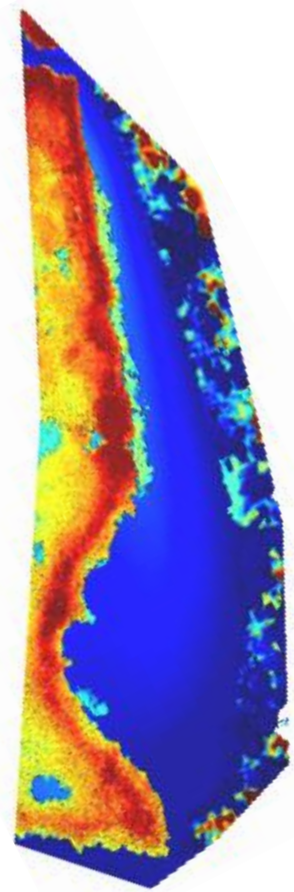


- 1 m horizontal resolution
- VIS - NIR
- August, 2022
- One hour window of low tide



Task 4 – Assessing Marsh Plain Errosion

Strategic marsh areas were flown with a DJI Phantom 4 Pro drone equipped with an RTK unit to assess the microtopography of the mud flat - shoreline boundary.



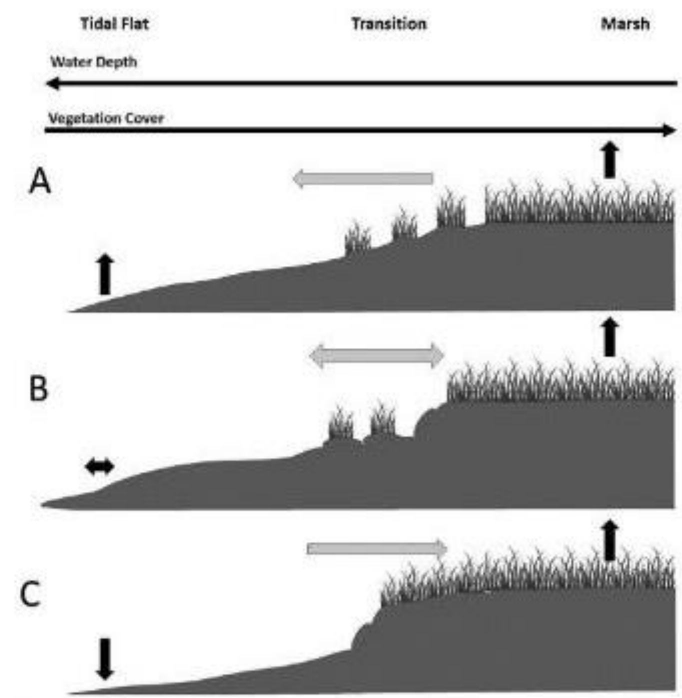
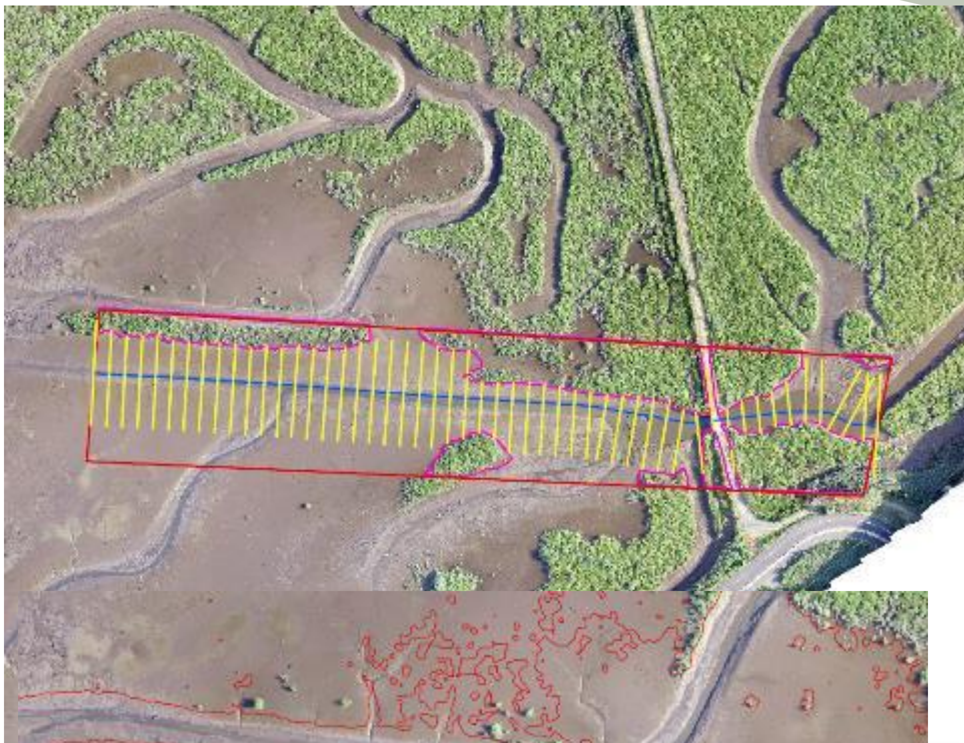
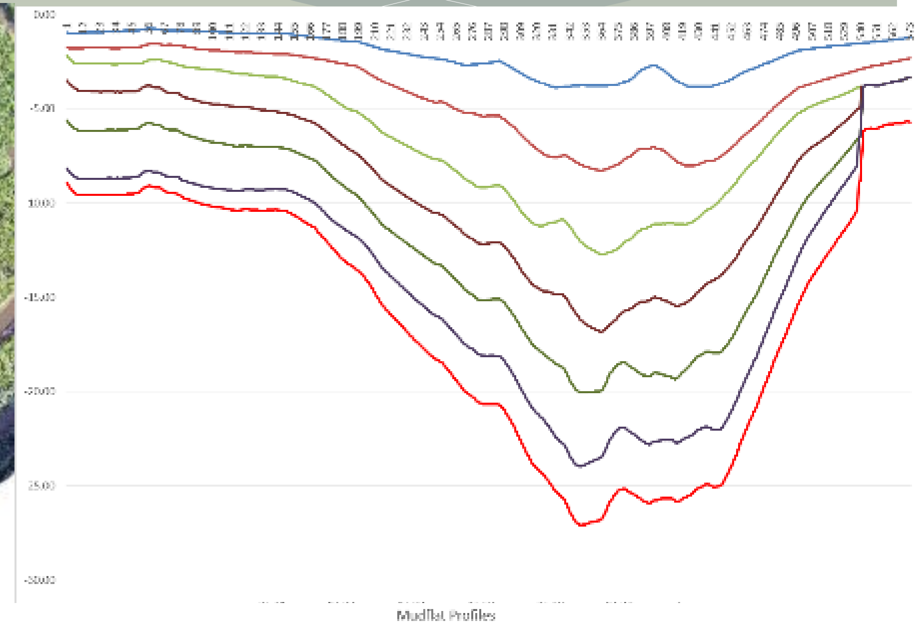
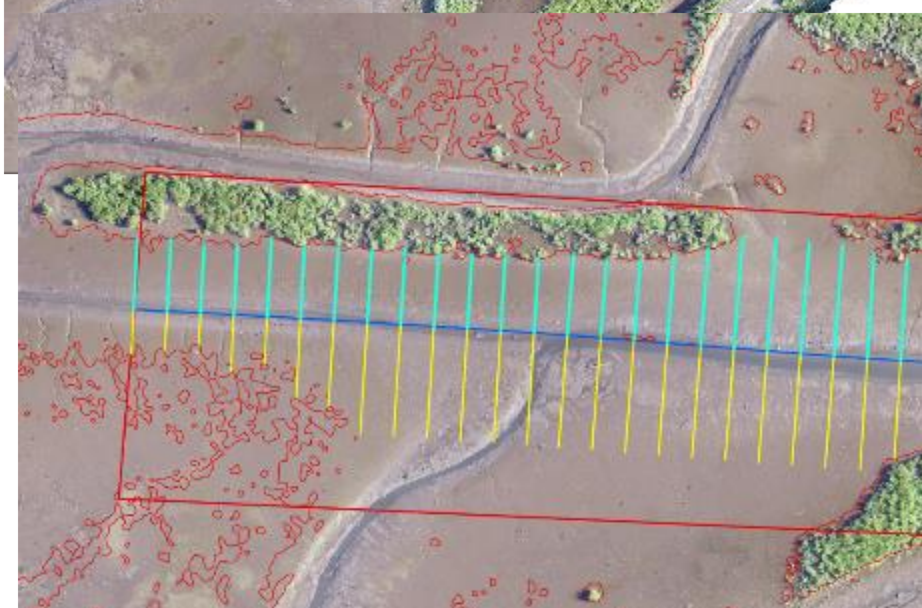


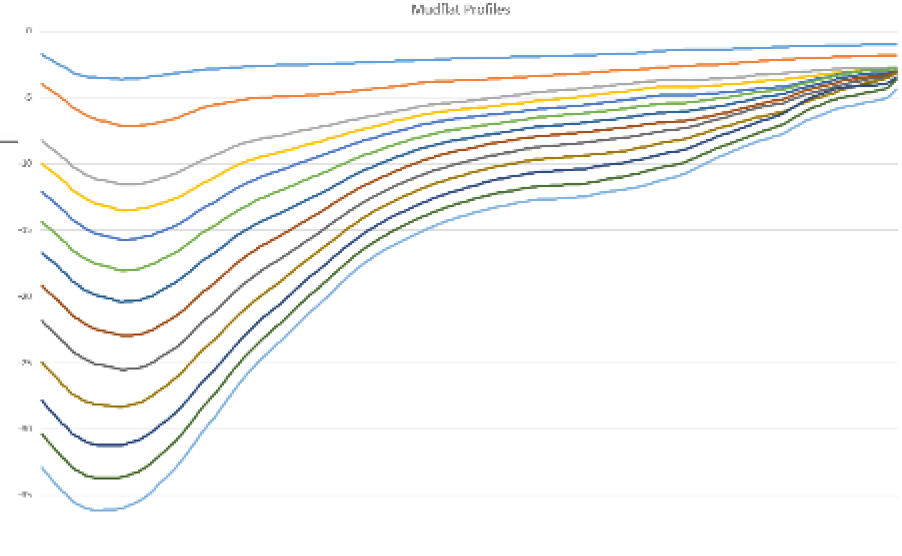
Fig. 3. Typology of tidal flat –wetland systems that reflects varied geomorphic contexts. A. Prograding marsh and accreting tidal flats. B. Marsh cliff with rejuvenation and dynamic tidal flat, C. Retreating marsh and eroding tidal flat. Elevation ranges and slopes are idealized and will vary according to tidal range and width available. Dark arrows indicate accretionary status of wetlands and light arrows indicate lateral growth or retreat.

Results – Crossection Analysis

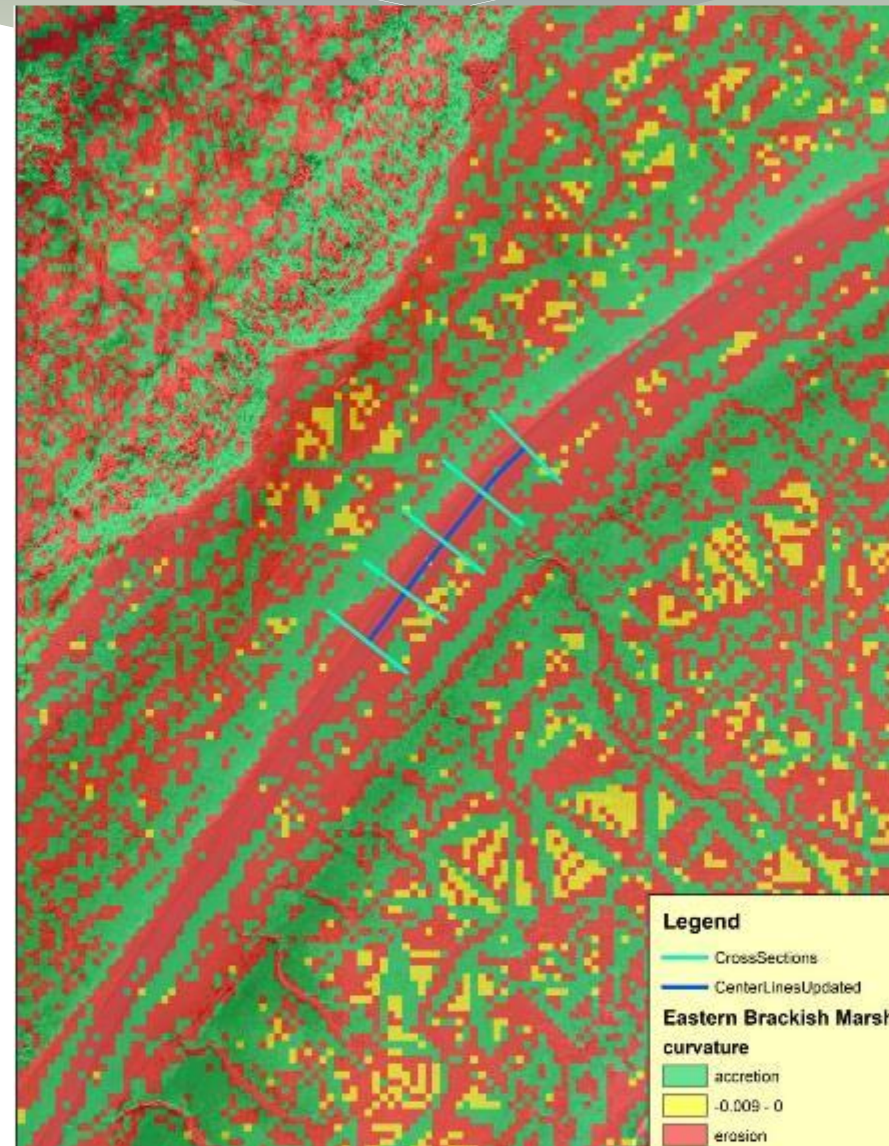




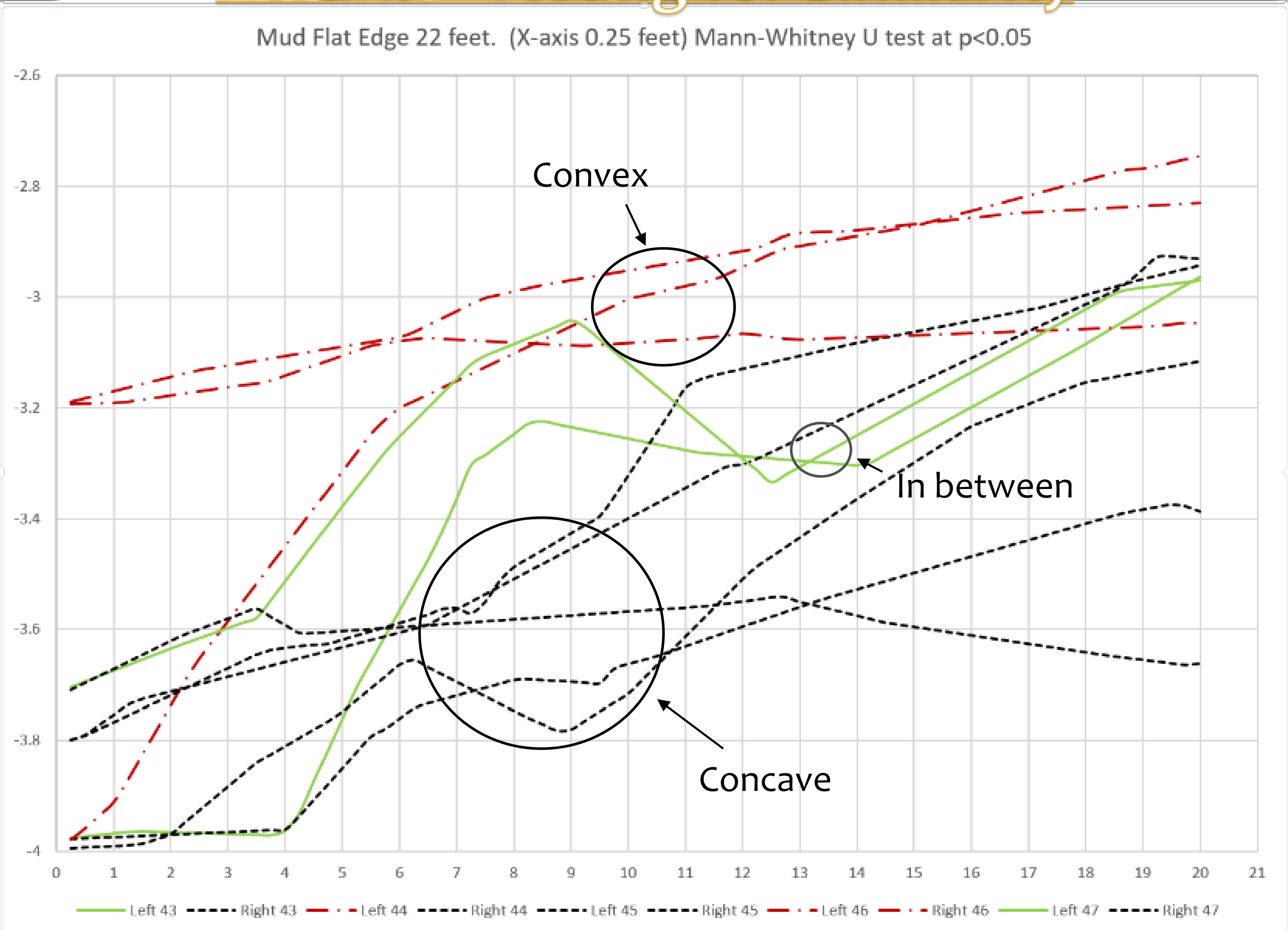




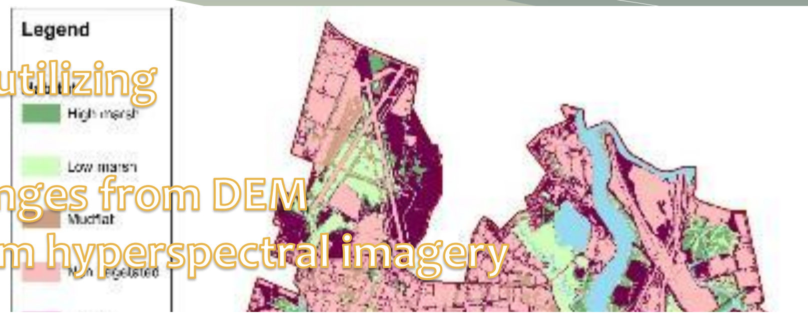
Results - Calculating Curvature



Results – Testing for Similarity

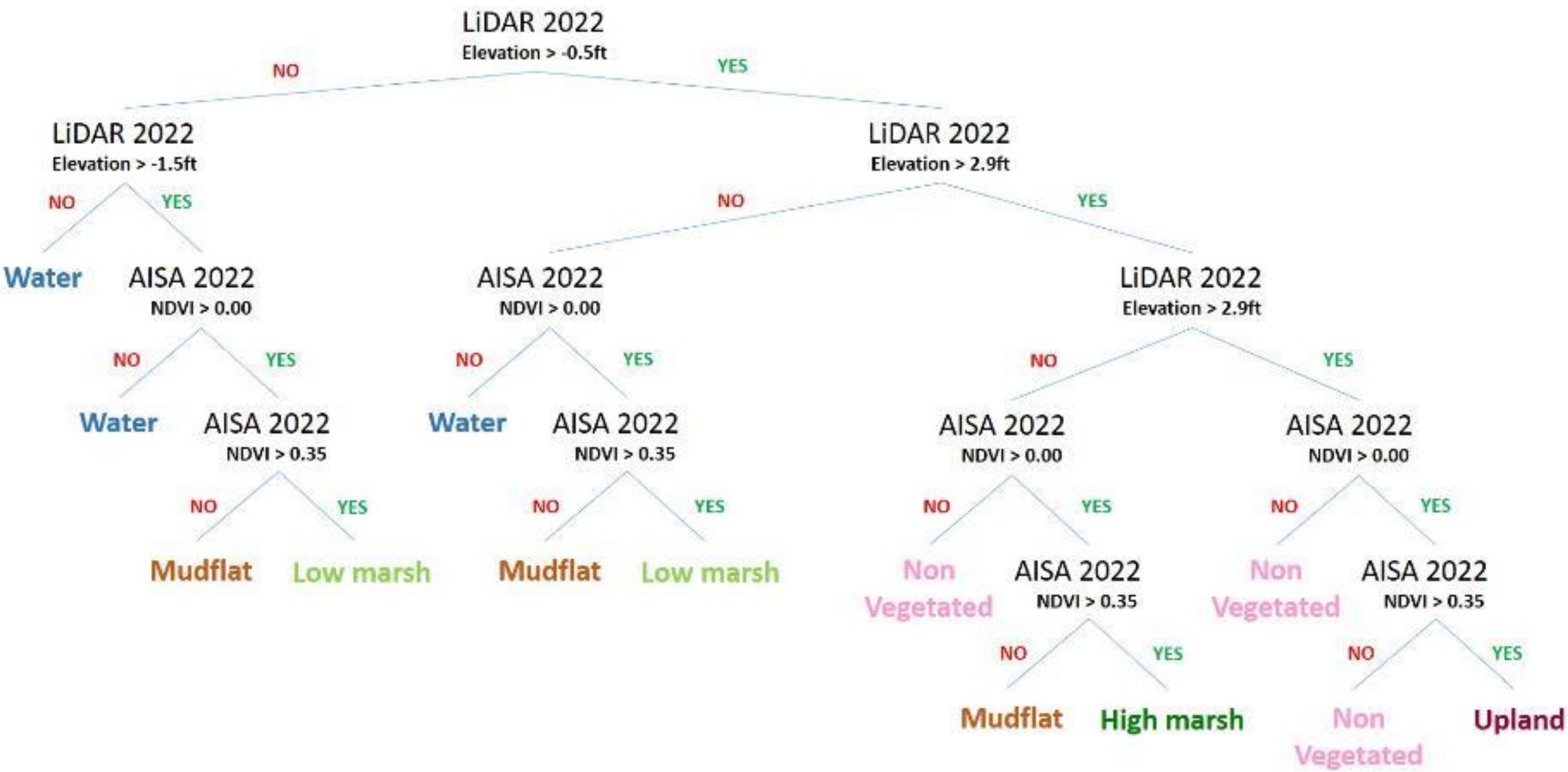


Results – Habitat Type Prediction

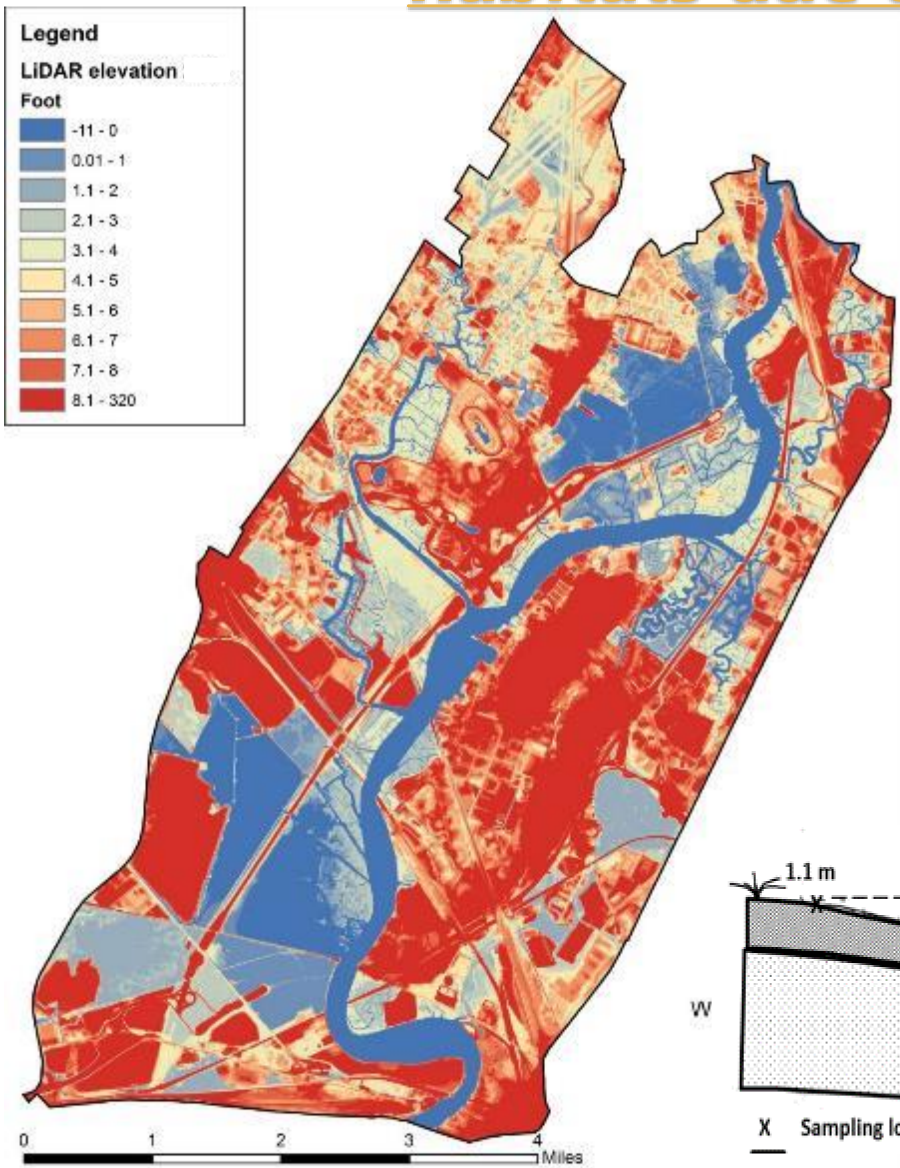


Decision Tree Model – utilizing

- habitat elevation ranges from DEM
- plant cover data from hyperspectral imagery



Results - Assessing future changes in wetland habitats due to sea level rise

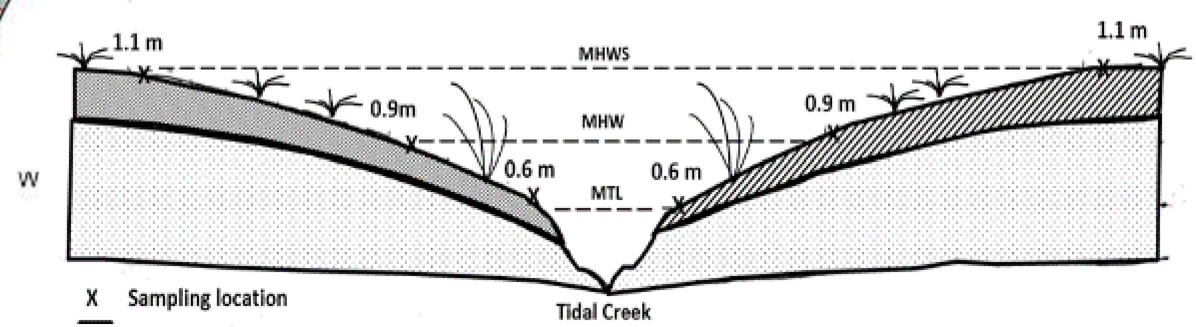


Marsh accretion in the main stem of the river

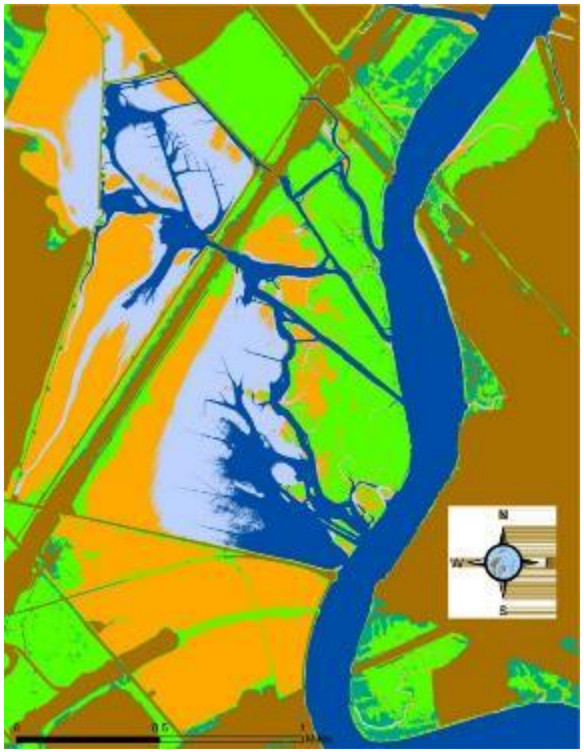
– 5mm/year

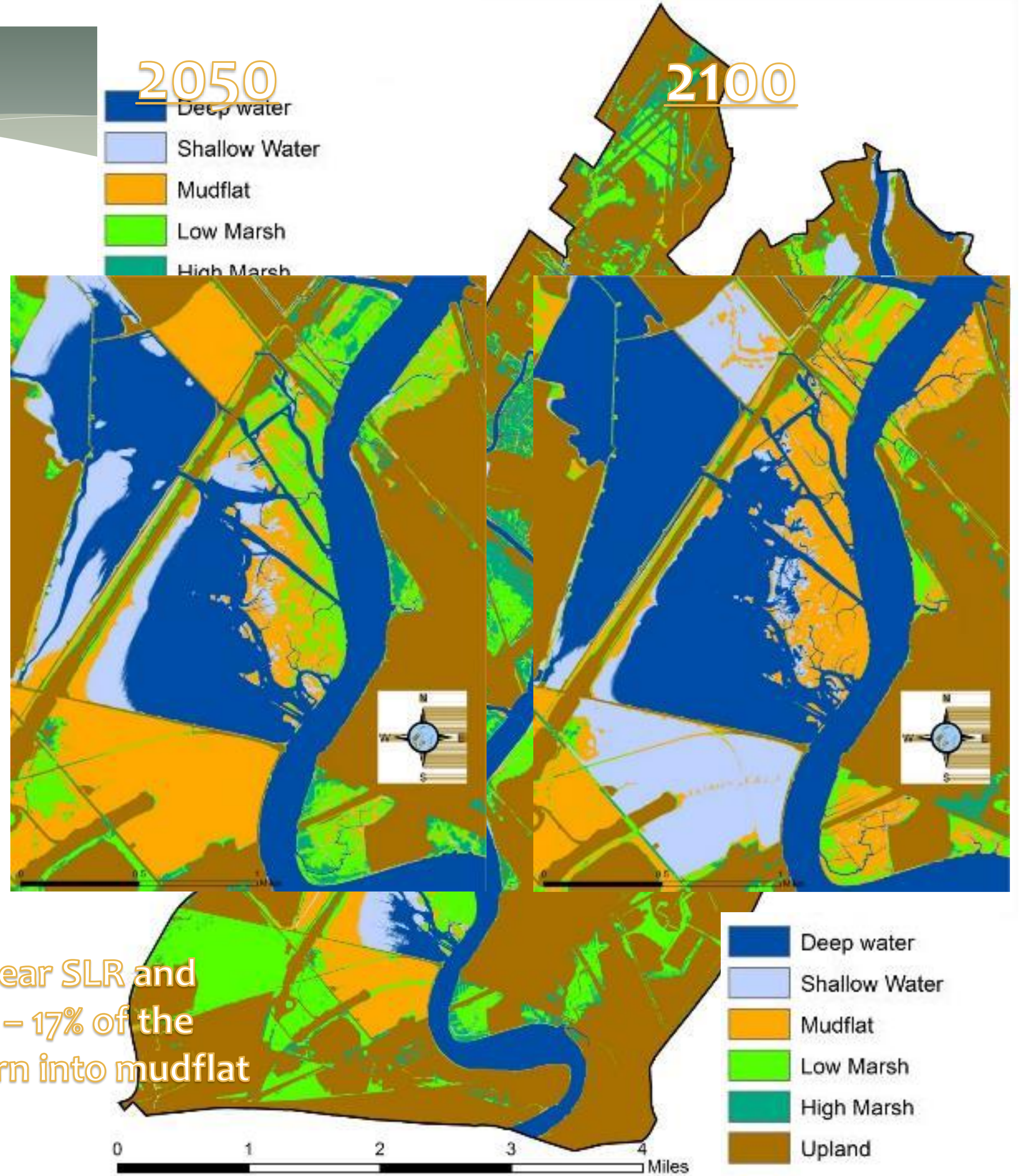
Predicted regional sea level rise

– 8 - 9 mm/year



2023 2050 2100





By 2100 with an average 9mm/year SLR and 5mm/year marsh accretion rate – 17% of the Meadowlands' wetlands will turn into mudflat

Thank you!

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