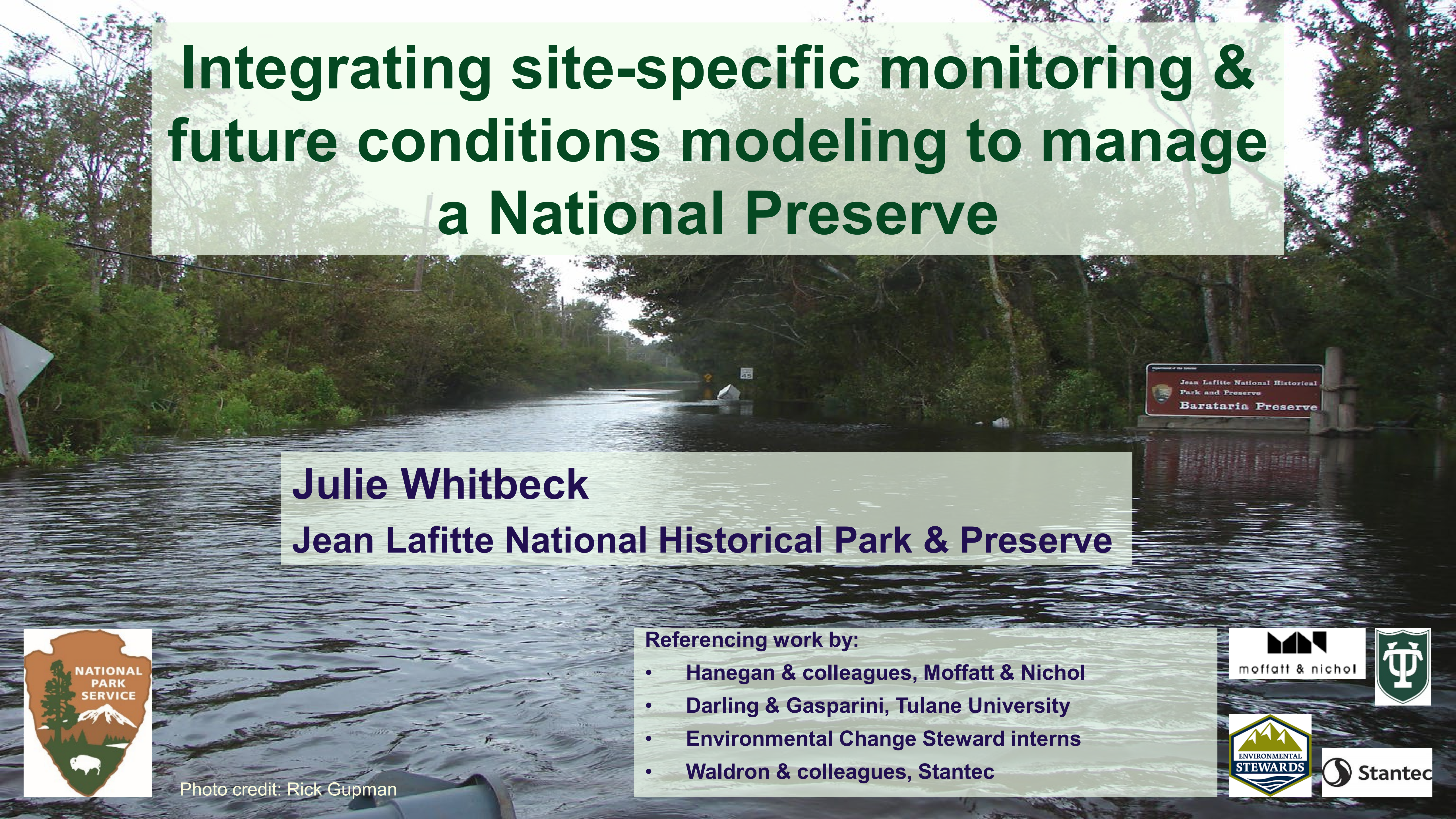


Integrating site-specific monitoring & future conditions modeling to manage a National Preserve

Julie Whitbeck

Jean Lafitte National Historical Park & Preserve

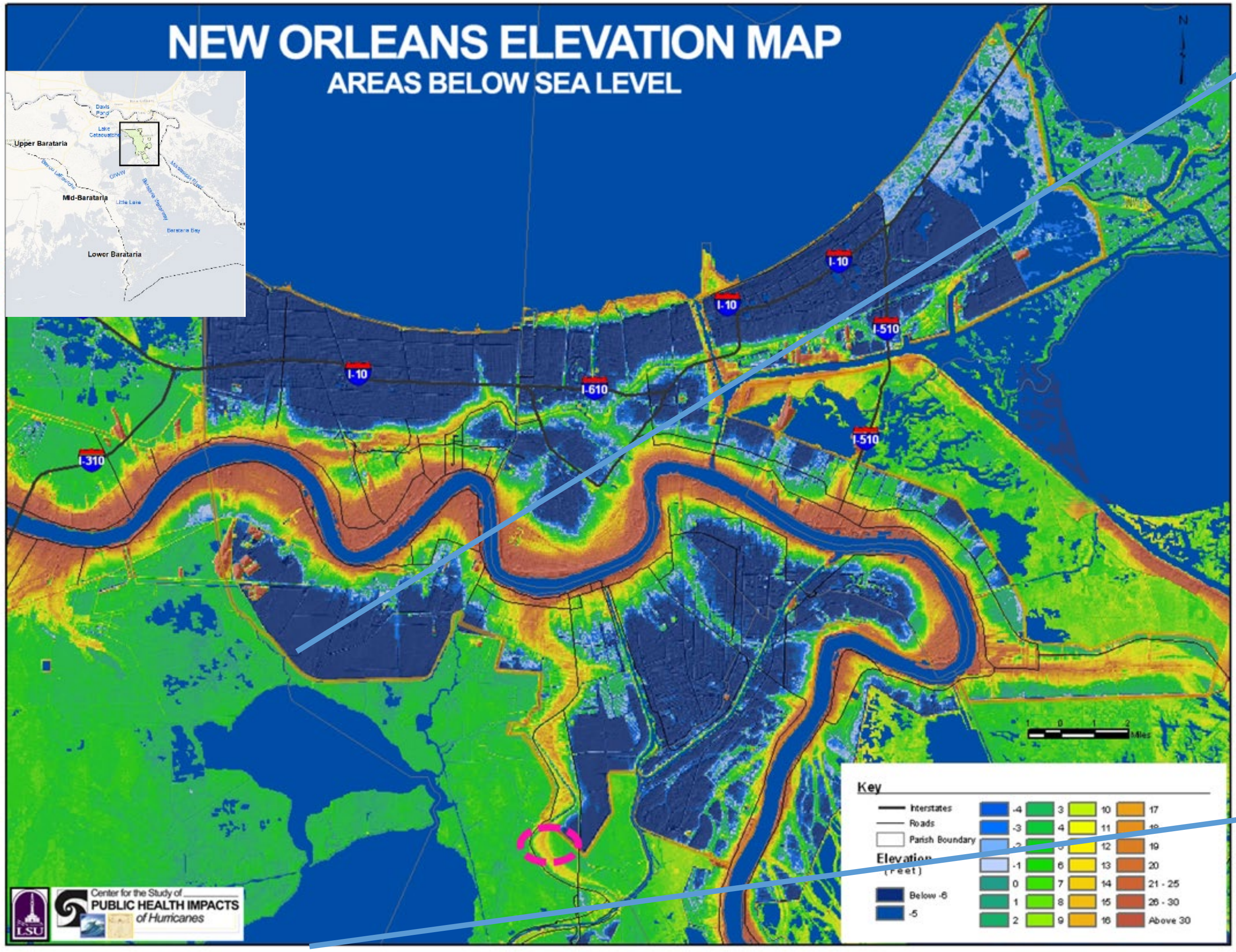
Referencing work by:

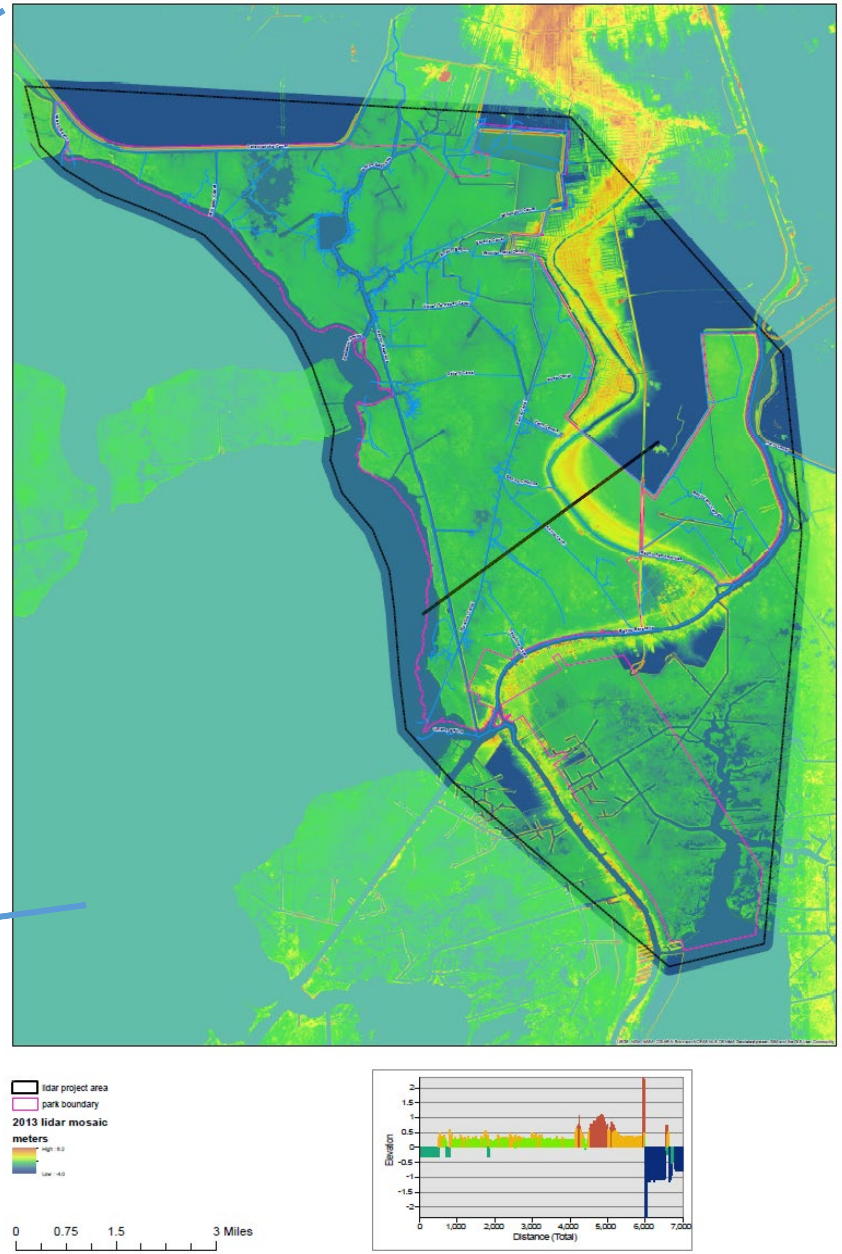
- Hanegan & colleagues, Moffatt & Nichol
- Darling & Gasparini, Tulane University
- Environmental Change Steward interns
- Waldron & colleagues, Stantec

Photo credit: Rick Gupman

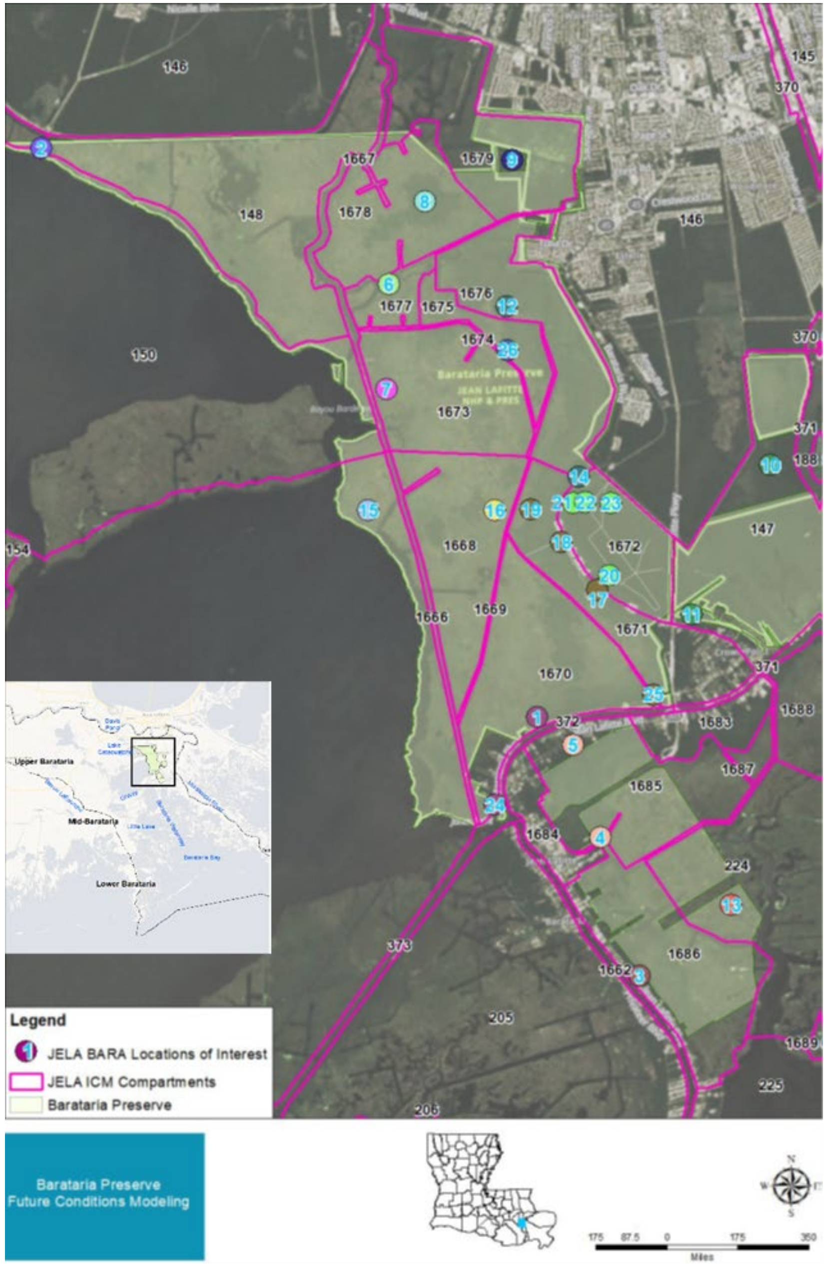

Upstream Dams
Levees
Mississippi River
Lake Pontchartrain
I-10
I-510
I-610
I-310
New Orleans
Levees
Gulf Intracoastal Waterway
Barataria Bay Waterway
Gulf of Mexico

Barataria Preserve setting: geology, topography, hydrology





What does the model report illustrate?



For each scenario, report figures illustrate

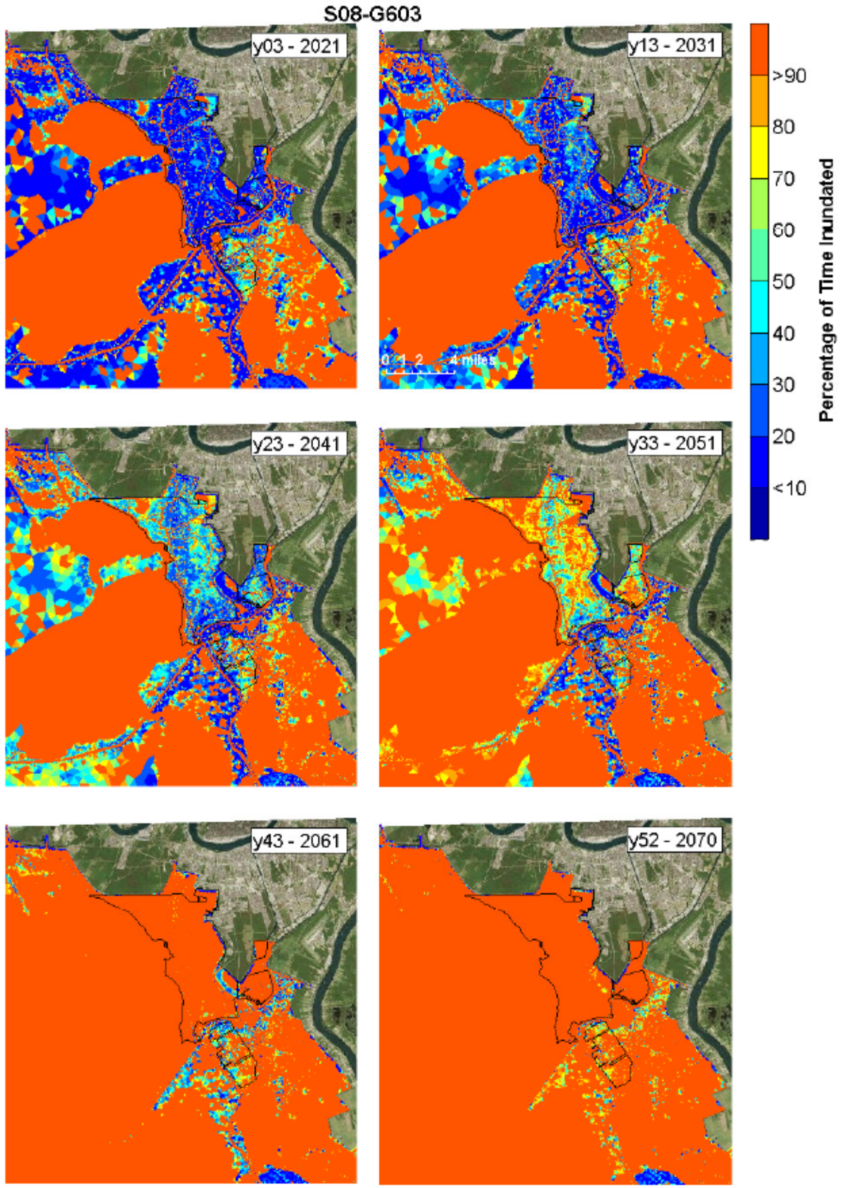
Compartment scale (ICM) – *daily & monthly averages for 50 years*

- water surface elevation
- salinity
- landscape maps (ICM projections at 10-year intervals)
  - surface type
  - habitat / vegetation type
  - elevation change

Hydro-dynamic model projections at specific locations – *annual cycle illustrations at 10-year intervals*

- water surface elevation
- salinity
- current speed
- landscape maps
  - percentage of time inundated
  - surface elevation (mean & max)
  - salinity (mean & max)
  - current velocity (mean & max)

How are park managers using the future conditions model projections <u>now</u>?



Intermediate high, MBSD only

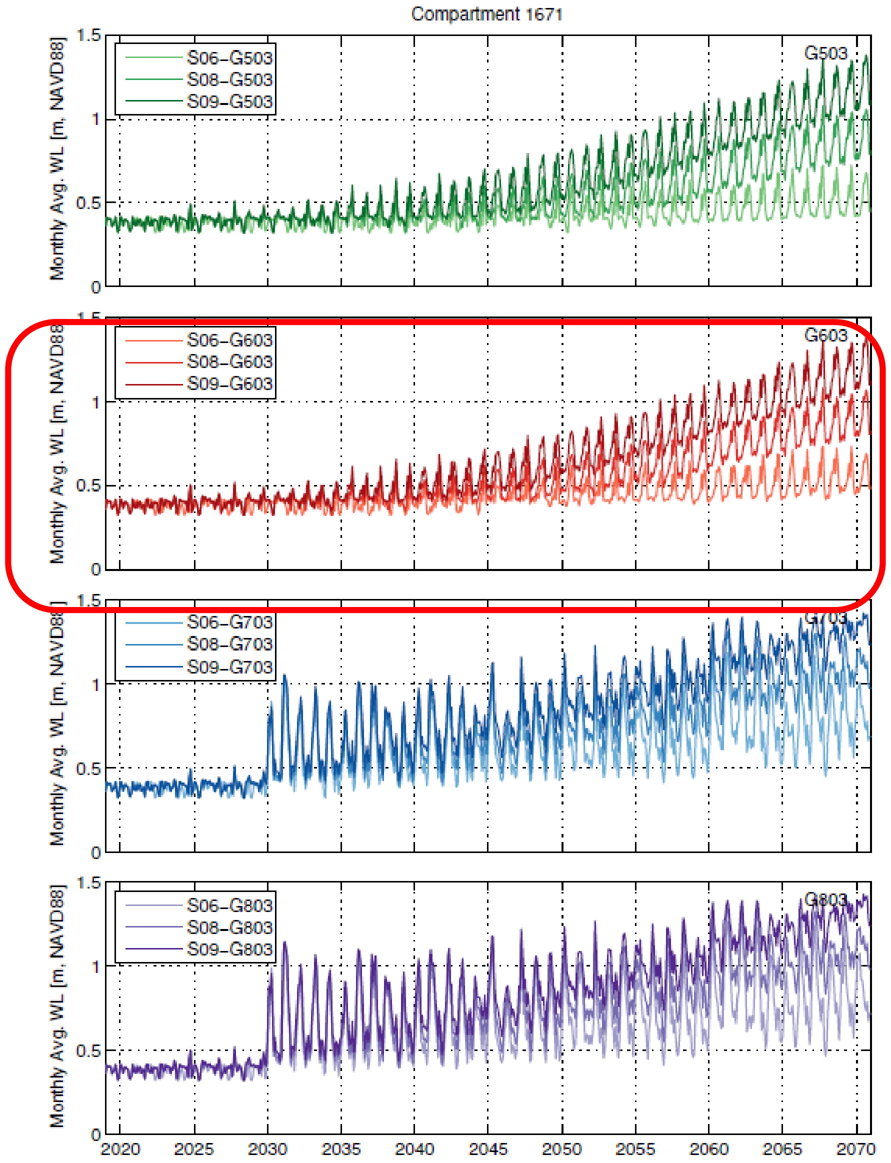
The park's management team advocates for funding with regional & national NPS decision makers.

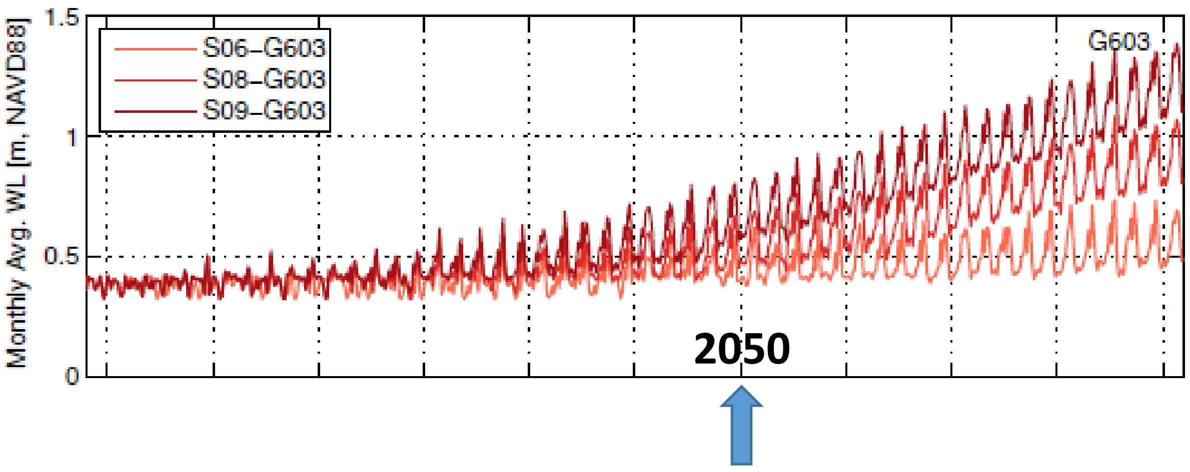
- **future conditions model projections inform infrastructure investment**

For example

- overall investment in the park's Barataria Preserve unit
  - cyclical maintenance funding sources
  - competitive funding opportunities
- DS-22 funded consolidation of administrative infrastructure
  - hydro-dynamic model point-based projections
- DS-22 funded rebuilding of damaged trails
  - ICM compartment-based projections

future conditions modeling informs resource mgmt operations location





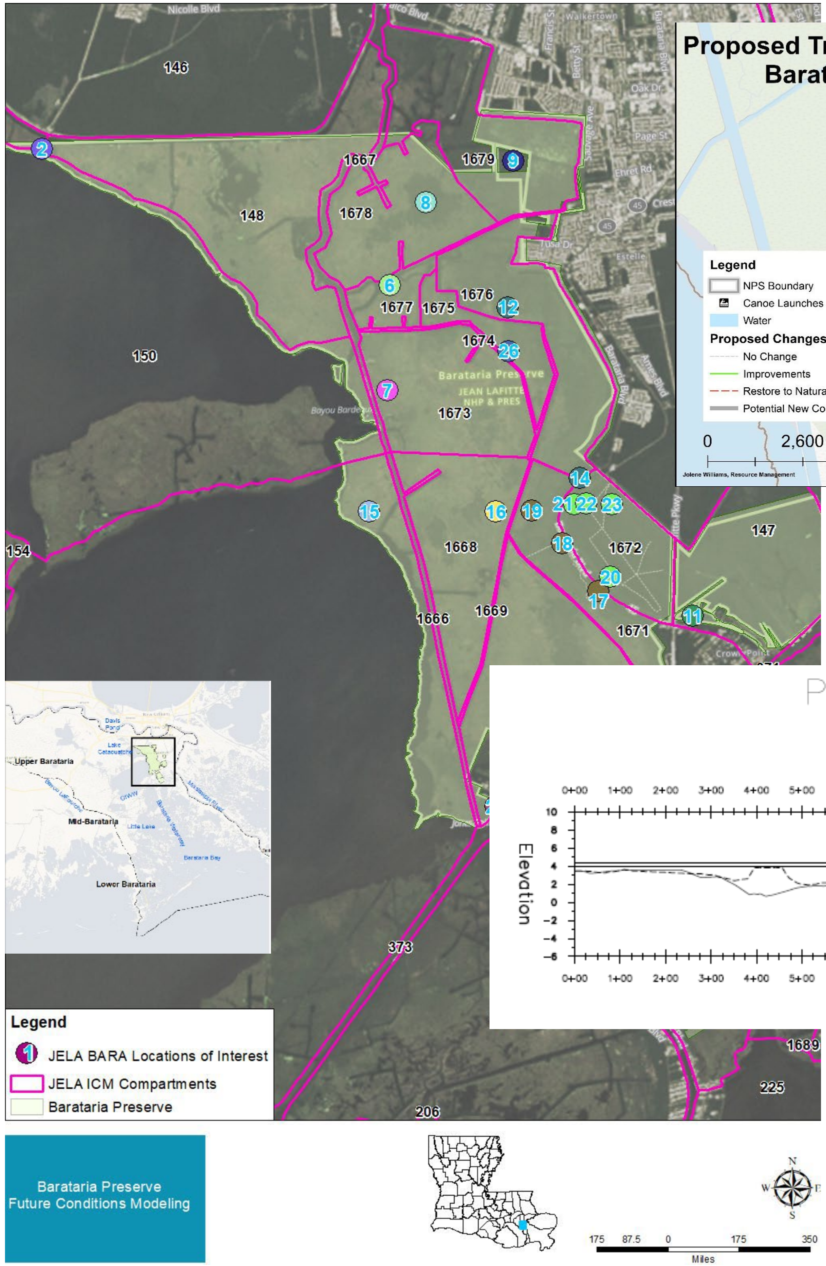
Barataria Future Conditions Modeling project projection

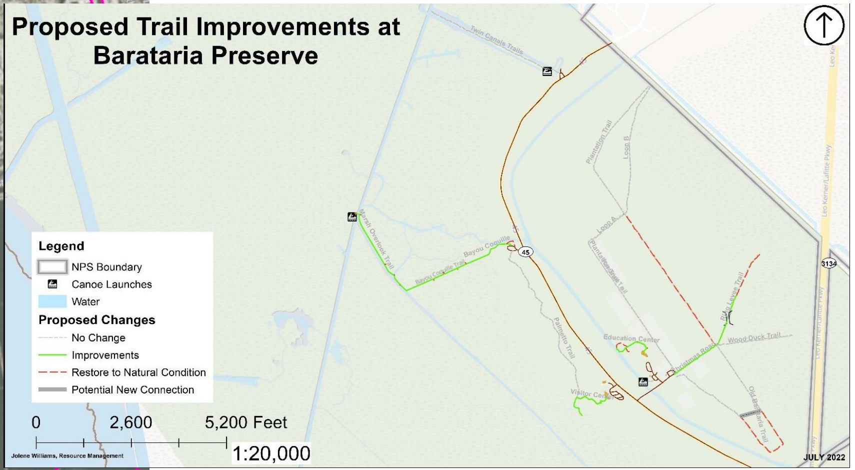
Regional Management Scenario is:
+ Mid-Barataria sediment diversion implemented

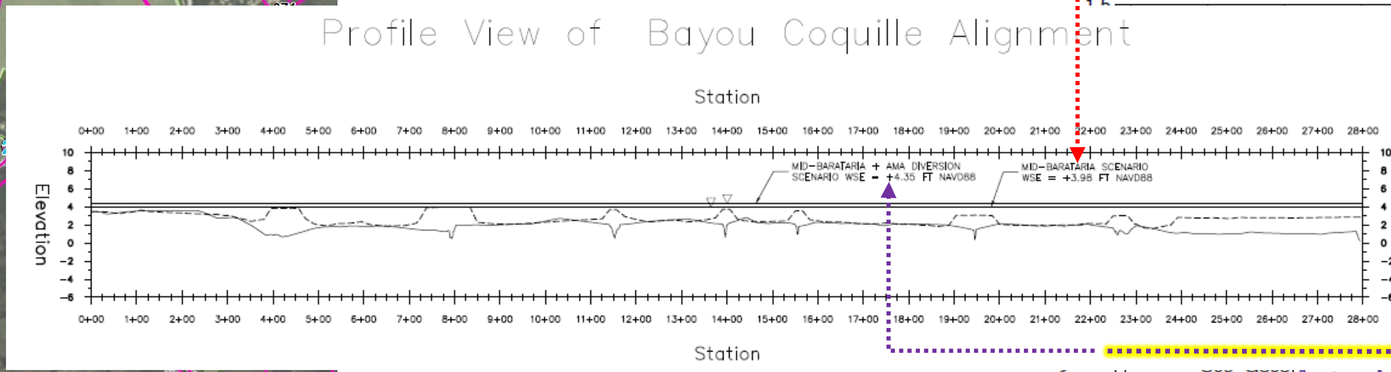
Water surface elevation in 2050 at VC:
+ NOAA low (S06) – 0.45 m (1.48 ft) NAVD88
+ NOAA intermediate-high (S08) – 0.55 m (1.80 ft) NAVD88
+ NOAA high (S09) – 0.45 m (1.48 ft) NAVD88

Current surface elevations at VC:
+ parking area – 0.95 m (3.13 ft) NAVD88
+ building floor – 2.44 m (8.00 ft) NAVD88

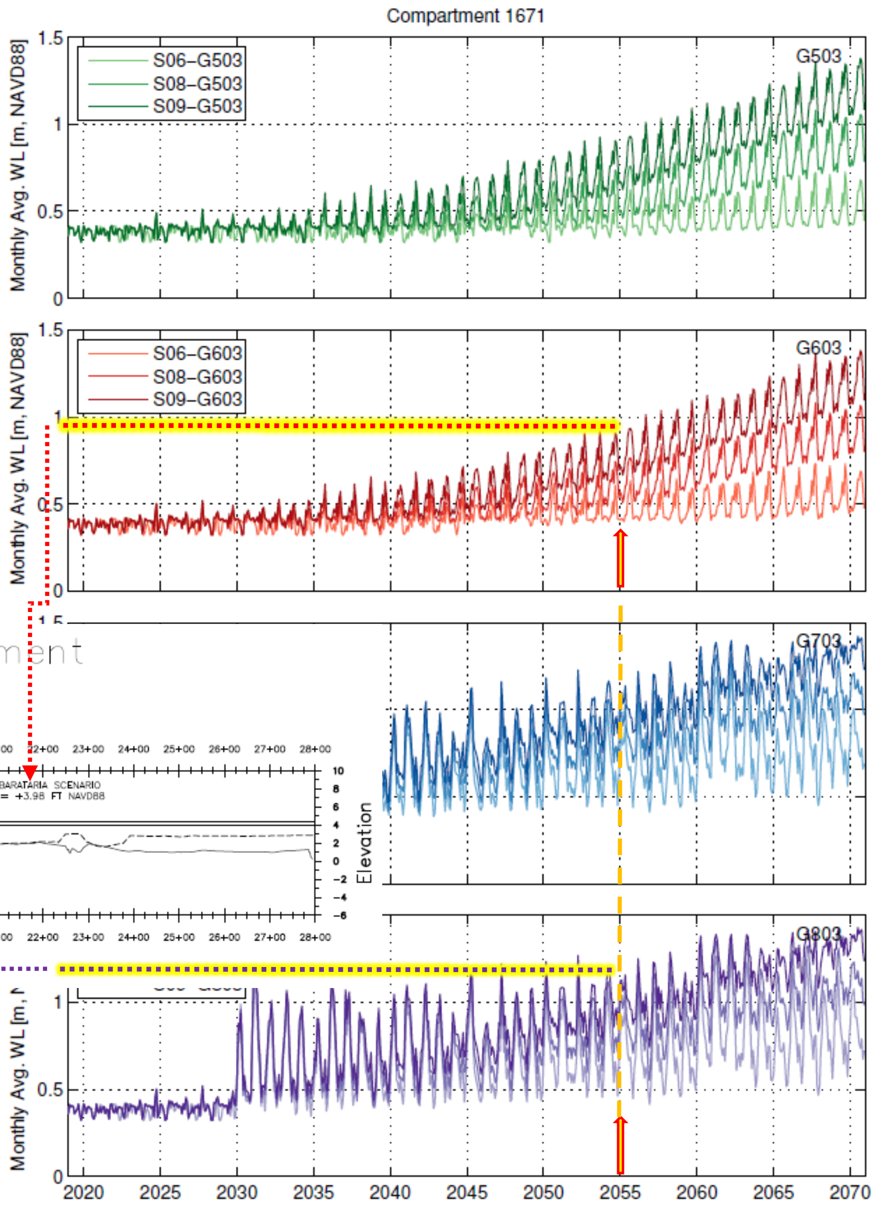
future conditions model projections inform trail design







pre-design illustration, Stantec, 2023 (Waldron)



How else could park managers use this future conditions model?

for example . . .

Infrastructure planning

- Until when will park buildings and public trails be accessible by road, or on foot?
- How much above the ground surface should we build a trail so it is flooded less than 10 percent of the time in 2050?

Resource-focused adaptive management

- Based on flooding & salinity conditions, where & when will freshwater flotant marsh be likely to disintegrate?
- When will salinity or flooding exceed Bald cypress tolerance?
- When will emergent wetland area drop below wading bird habitat needs?
- How many hunting permits will the park be able to issue in 2030? In 2040?
- What parts of the cultural landscape will visitors be able to experience in 2045?
- When will current velocity threaten midden sites?

concept

Now the **park wishes to link actual observations of changing conditions with model forecasts** to evaluate which model scenario best represents realized change and to document landscape transformation as it occurs. We **envision a tool that will enable park managers to <u>visualize and compare monitoring observations with critical environmental and ecological thresholds and with model-projected values</u> at specific locations across the Preserve landscape**, including the areas of most intensive infrastructure and public use. Here we ***sketch elements of our tool***, we ***illustrate its use with salinity and flooding observations from the Preserve's monitoring datasets***, and we ***show how park managers would use it to address questions about public access and resource stewardship***.

Barataria Preserve change-detecting "tools"

tool type	elements	scale / design	focal ecosystem/s	gradient/s	date established
weather station	*RAWS-compliant*	hourly as of 9/2016			1980 & 2016
elevation map / data		landscape (0.1 m vertical resolution)	terrestrial	- topographic - aquatic/terrestrial boundary detection	various
water quality monitoring		fixed points (1-2 mo frequency)	- waterways - freshwater forested wetlands	- focal inflow locations - watershed position	- circa 2000 - 2014
elevation & hydrology dynamics array	- benchmark rods / SETs - marker horizons - water level wells & loggers	ecosystem to landscape elev: every 5 yrs accretion: yearly hydrology: hourly	elev: terrestrial accretion: terrestrial water level: all	- topographic - hydrologic / flooding - salinity	2014 - 2018
vegetation map	spatially-explicit digital product suite	landscape	all *aquatic veg not mapped*		2016
monitoring plots	varies: community & ecosystem properties & processes foci	0.01 ha (marsh) 0.05 - 5.0 ha (forest/swamp)	- freshwater floating peat marsh - bottomland hardwood forested wetland - bald cypress swamp	- salinity exposure - topographic - hydrologic / flooding	various: 1998 - 2011
'signal' taxon monitoring	- amphibians & herps - breeding birds	community	bottomland hardwood		2010
biological inventories	taxon-specific	public trail &/or waterway-based	terrestrial focus		various
phenology monitoring	"citizen science"	fixed points on trails	freshwater forested wetlands		2017
research archive	web access				circa 1980

Barataria Preserve Monitoring Datasets

<u>Elevation & Hydrology Monitoring Array (EHMA)</u>:

- high-resolution elevation *(baseline 2018; re-measure every 5 yrs)*
- surface accretion *(annual measurements)*
- subsidence *(rSETs, annual measurements)*
- water level *(estab. 2013-2018; hourly data)*
- referenced to common geo-spatial elevation datum: NAVD88

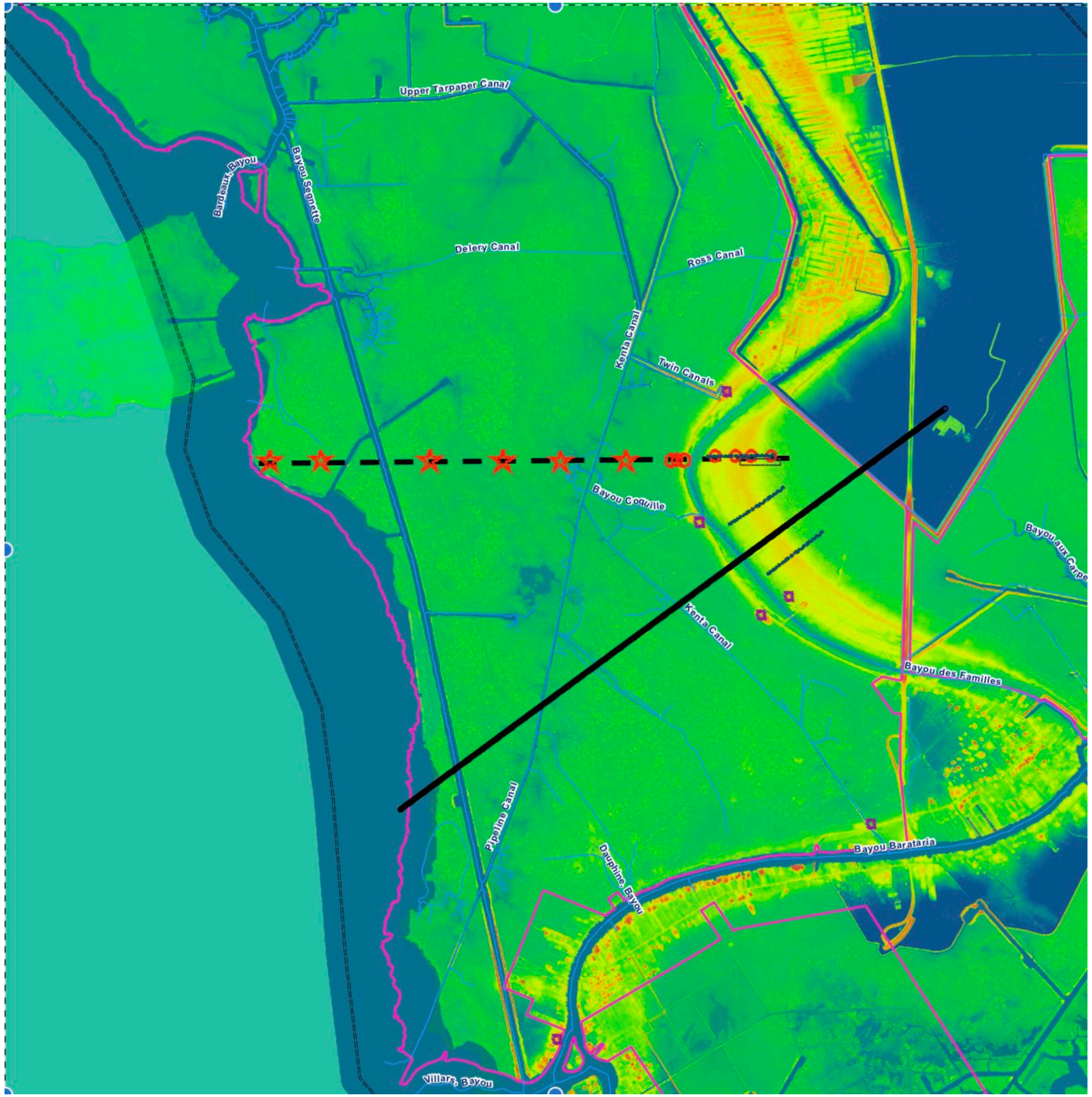
<u>Water Quality</u>:

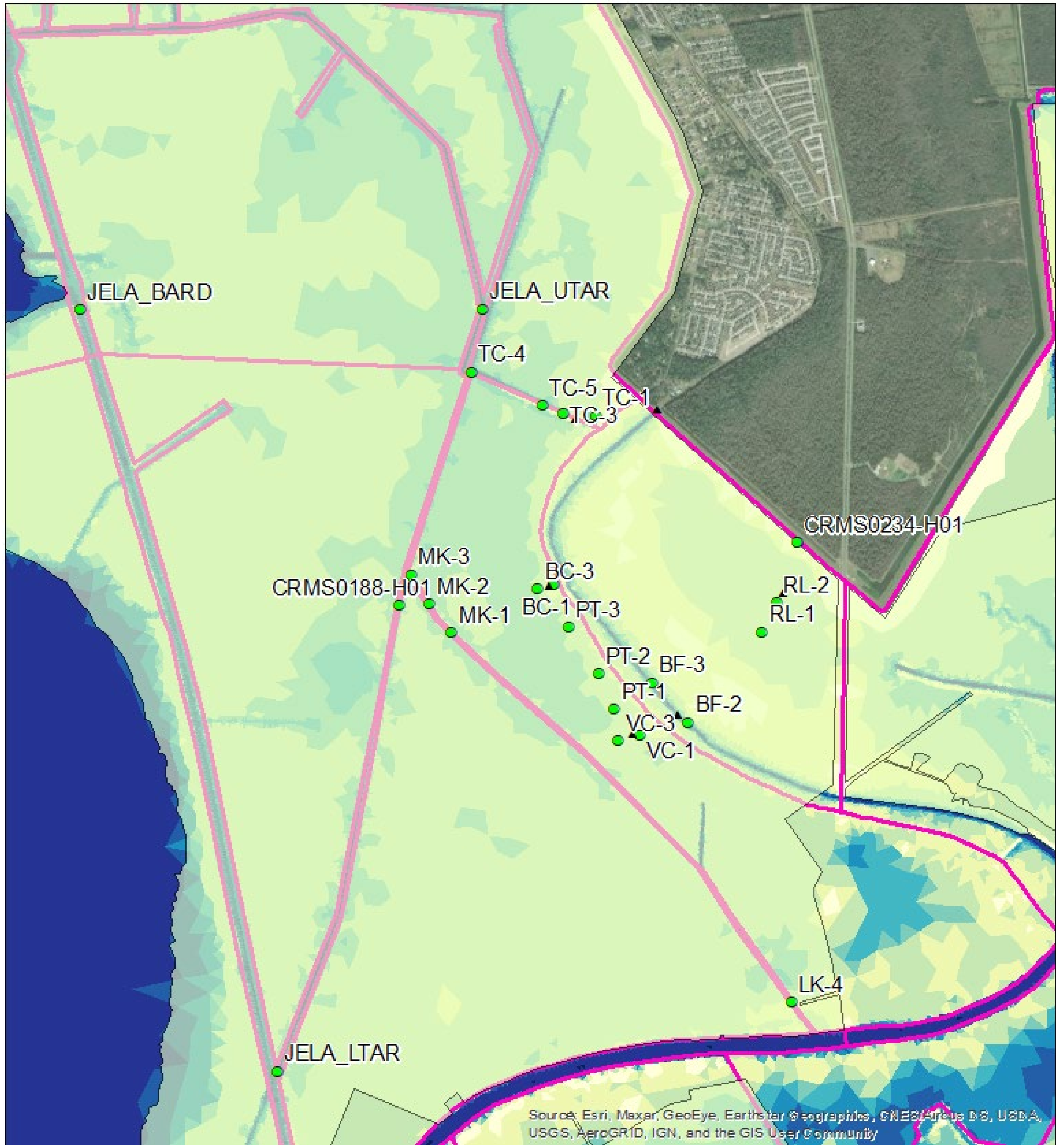
- parameters: temperature, conductivity/salinity, pH, DO
- NPS Inventory & Monitoring *(5 sites, every other month)*
- JELA (park) Resource Mgmt *(14 sites, monthly)*

<u>other Preserve change-detecting "tools"</u>:

- automated weather station *(on-line Sept 2016; hourly observations)*
- 'long transect' vegetation plots *(established 2005)*
- 5 ha plot in bottomland hardwood forested wetland *(established 1998)*
- partner investigator & CRMS long-term observations *(bald cypress & marsh ecosystems, waterway channels)*

Barataria Preserve EHMA & water quality monitoring sites





link monitoring observations with future conditions model projections

draw on

- environmental & ecological understanding
- BARA future conditions model projections

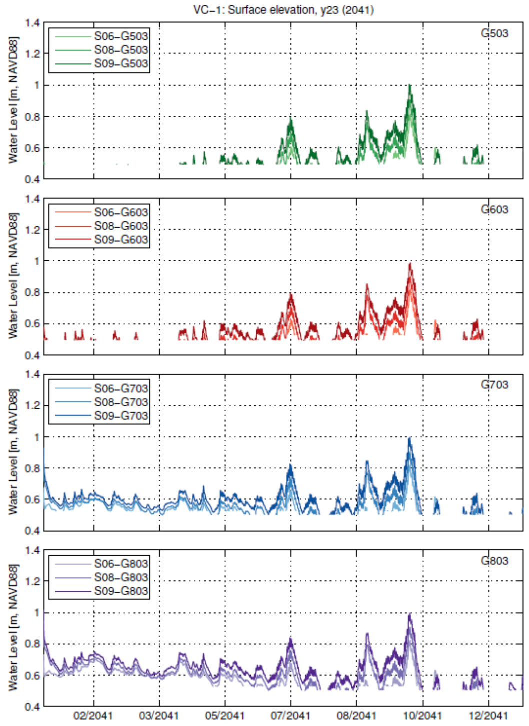
to establish

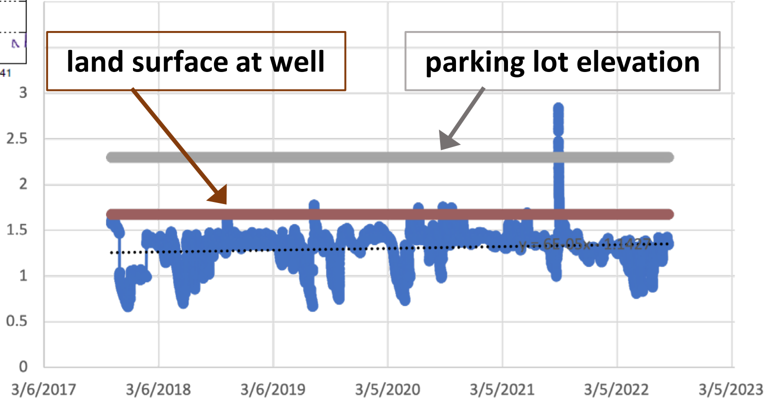
- threshold values
- change rates (e.g. regression slope)

reference up to date

- Barataria Preserve monitoring data
- regional to global scale climate & rSLR data

elicit management response





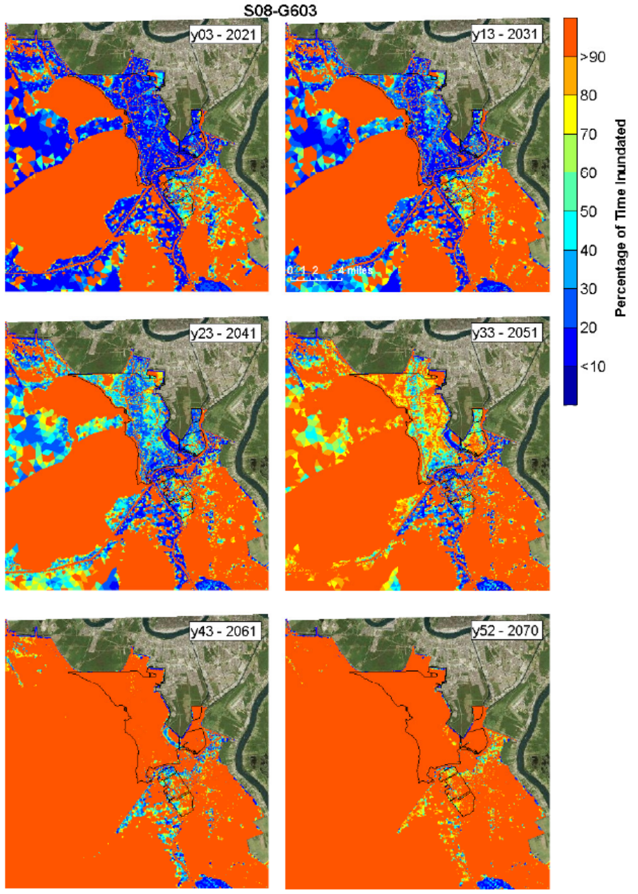
water level (m) near the Visitor Center

(relative to NAVD 88)

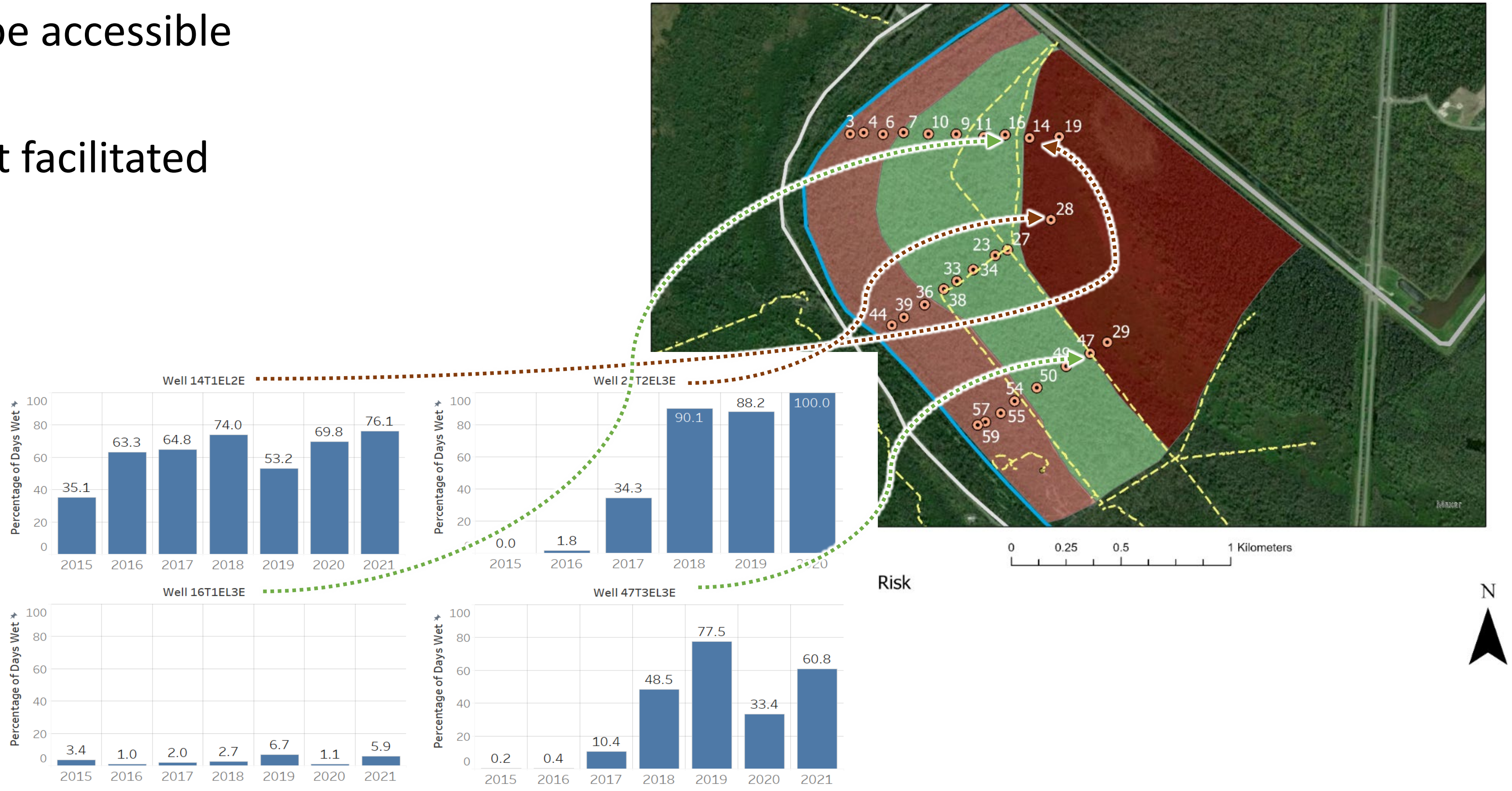
Note: sketch is not to scale!

link monitoring observations with future conditions model projections

- Until when will park trails be accessible on foot?
- Will flooding depth support facilitated swamp migration?



Intermediate high, MBSD only



annual percent days flooded

Spatial and Temporal Analysis of Water Flow
Big Woods, Barataria Preserve, Louisiana USA
https://storymaps.arcgis.com/stories/412be9ab208a4963b11266090fe20bbf

Darling, W.C., 2022. Spatial and Temporal Analysis of Water Flow in Big Woods, Barataria Preserve, MS Thesis, Earth & Environmental Sciences, Tulane University

Next Steps

- Re-measure parking area, trail & building elevations.
- Update & reference topographic map/digital elevation model.
- Develop critical value metrics for flooding level, extent, salinity, etc.
  - threshold values
  - proportion of time at/above
  - change rates
- Develop ways to present monitoring data that reference key metrics.
- Develop user interface (& links with databases & metrics).
- Develop process for park planning endeavors & management actions to use decision-support tool.
- Sustain monitoring observations, plus data processing & data visualization.
- Compare observed change trajectories with future conditions scenario model projections.
- Plan to adapt this tool as environment, landscape and manager needs change.

Questions?

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Jean Lafitte National Historical Park & Preserve

www.nps.gov/jela

National Park Service
U.S. Department of the Interior

E X P E R I E N C E   Y O U R   A M E R I C A