

The Cedar Bayou Watershed Protection Plan: A Case Study in Tidal Watershed Modeling Challenges

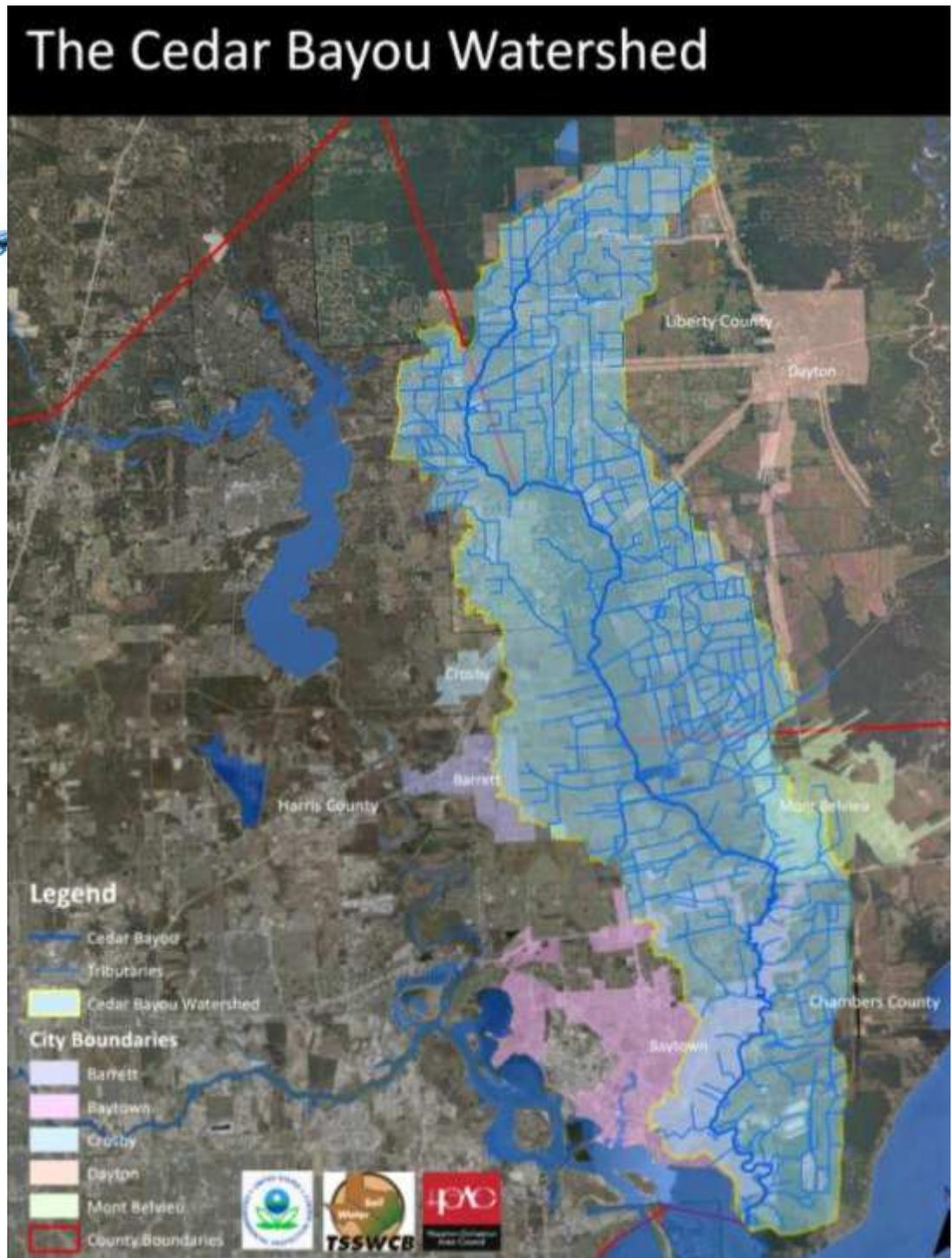
WCSC, 3/10/16



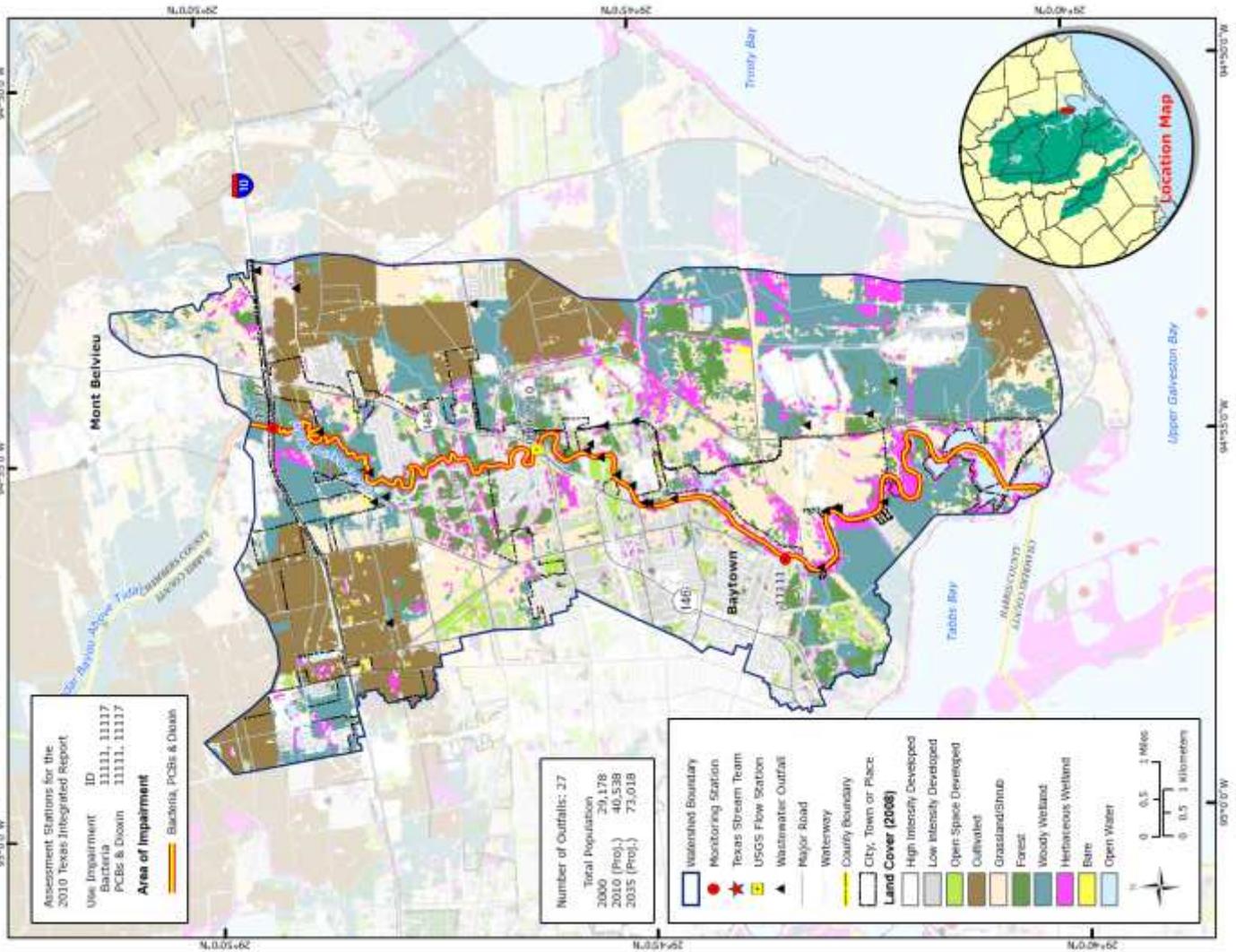
Cedar Bayou



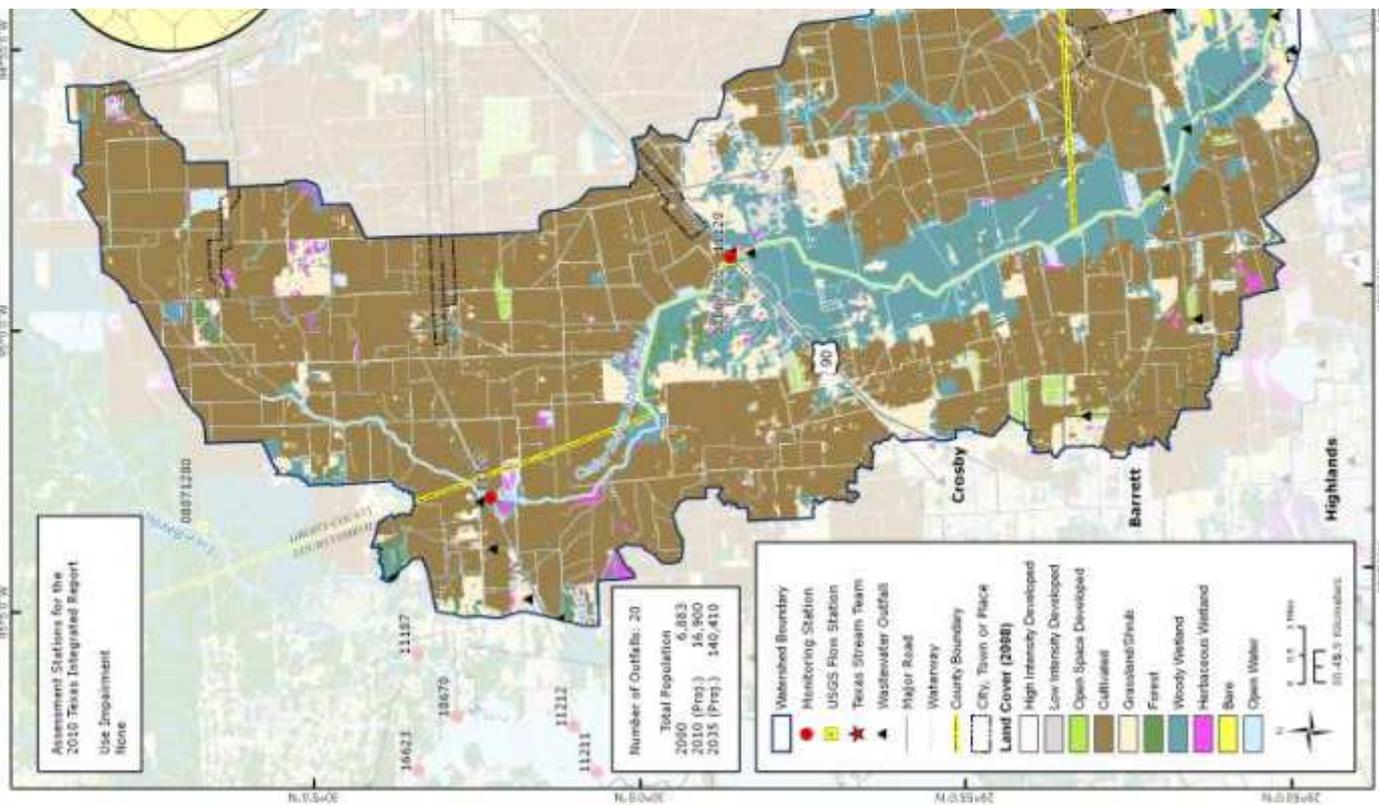
- 200 square miles
- East Harris, west Chambers / Liberty Counties
- 2 segments, Tidal/Above tidal
- Tributary of Galveston Bay



CEDAR BAYOU TIDAL - SEGMENT 0901



CEDAR BAYOU ABOVE TIDAL - SEGMENT 0902

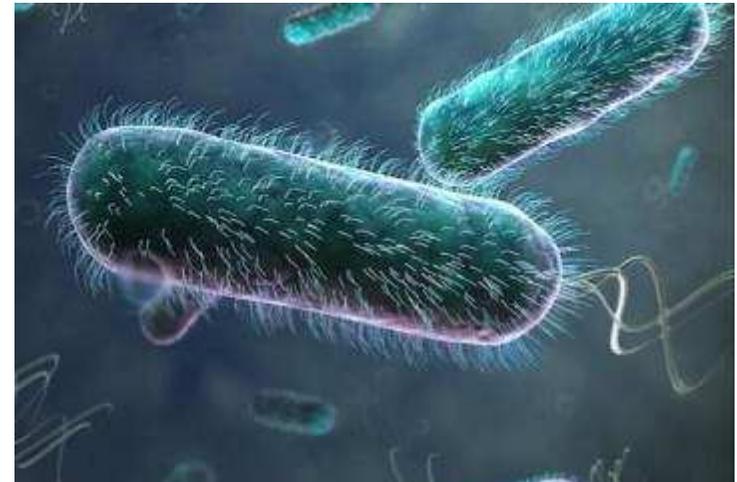


Water Quality Issues



Impairments

- Bacteria (Tidal)
- Macrobenthic communities (Above T)
- PCBs/Dioxins in fish tissue (Tidal)

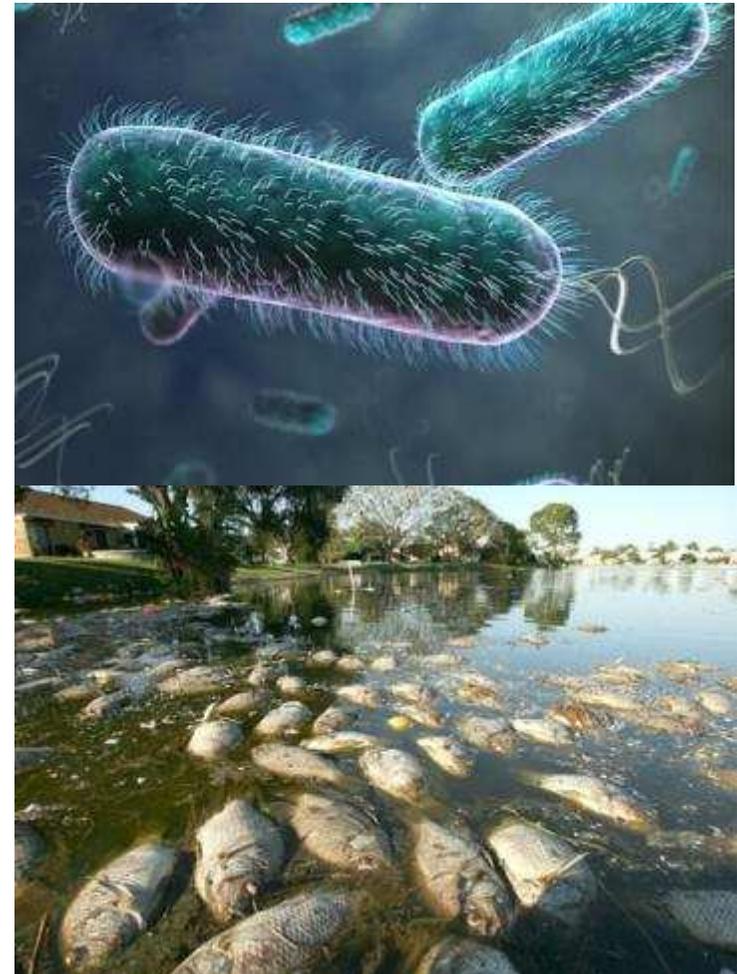


Water Quality Issues



Concerns

- Depressed DO (both)
- Chlorophyll-a (Tidal)
- Macrobenthic Communities (Above T)



Other Issues



- Rapid development
- Trash/aesthetics
- Invasive species
- Hydrologic modification
- Abandoned vessels



WPP Project History



- 2010 CWA 319(h) grant project facilitated by TSSWCB, H-GAC
- Cedar Bayou Watershed Partnership met for ~4 years
- Completed WPP in 2015 (under review)





**Containerized Cargo
Barge Terminal**

**Roseland
Park**

Baytown homes

Analysis Approach



- Large sampling project
 - Increased ambient, biased flow, WWTF, biological, 24 hour DO
- Multi-level modeling
 - SELECT, LDCs, Above Tidal watershed (SWAT), Tidal watershed/prism (SWMM5), CADDIS



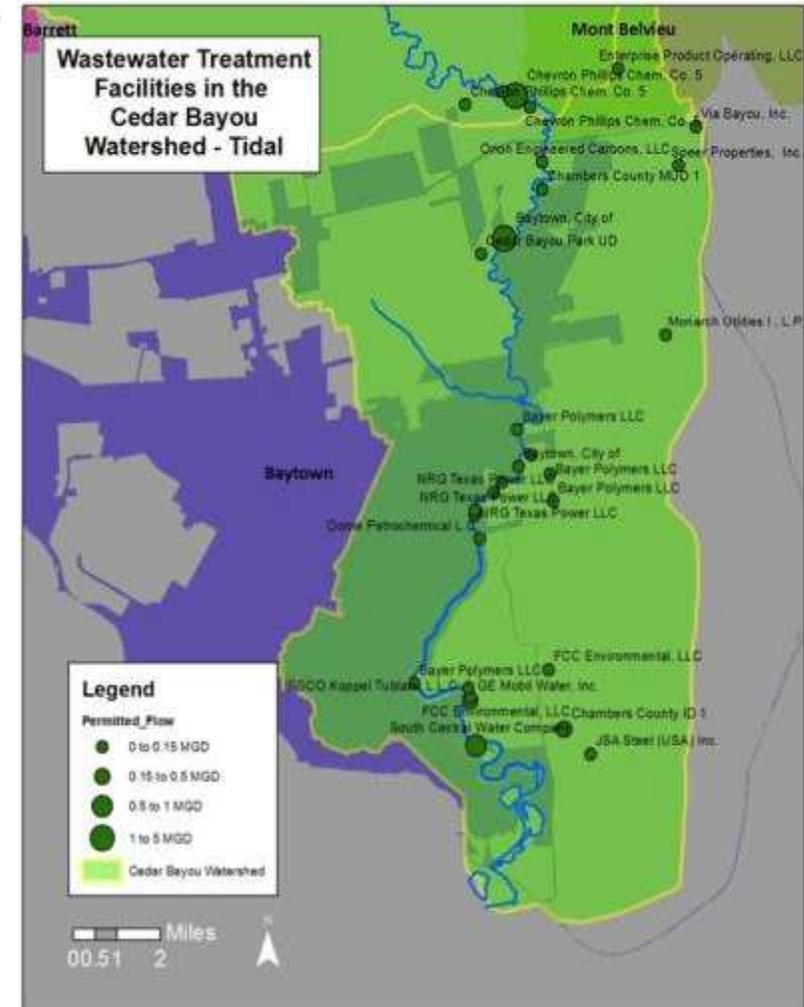
Modeling Overview



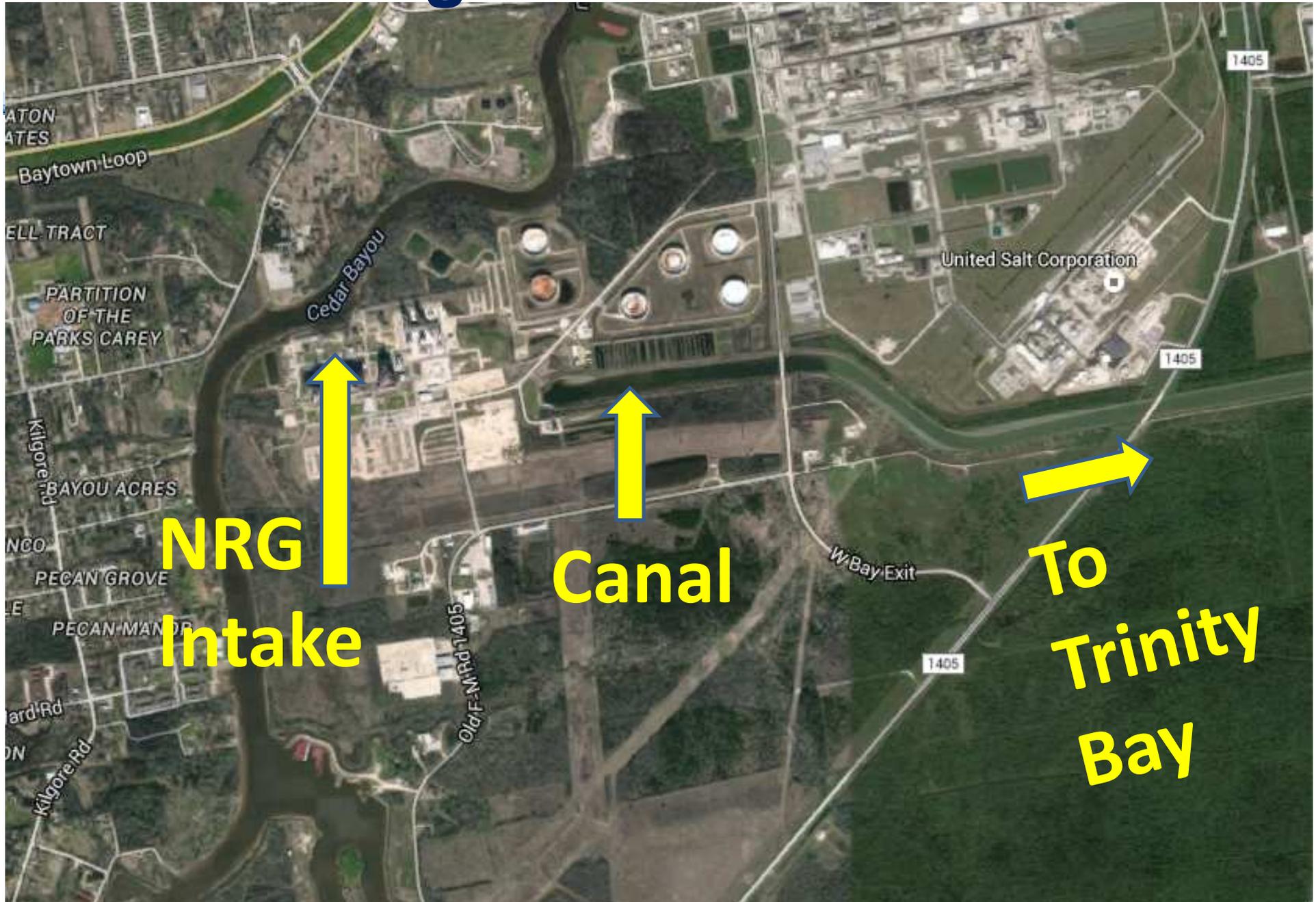
Segment	Source Load/ Priority	Comparison of Load versus Flow	Load Reductions / Instream Impacts	Biological Stressors
Above Tidal	SELECT	LDCs	SWAT	CADDIS
Tidal	SELECT	NA	SWMM5	NA

Tidal “Final” Modeling Challenges

- LDCs not useful; no SWAT
- Complicated hydrology
 - “Cut”, estuarine lakes, navigation channel, etc.
- Other complicating factors
 - NRG water diversions, many point sources, change



NRG Cooling Water Intake



Cut Channel between Cedar/Bay



Landfill and Gulls



Tidal Modeling Assumptions

- Segment alone; no change upstream
- Compliance based on CRP sites, not whole system
- Not specifically consider potential severe weather events, modifications



Deciding on Approach



Stakeholder Considerations

- Level of Detail? → Sufficient for sources, moderate
- Cost → Resources can't cover complex models
- Timing → Sooner preferred
- Potential to impact decisions → Moderate

Tidal Modeling Alternatives



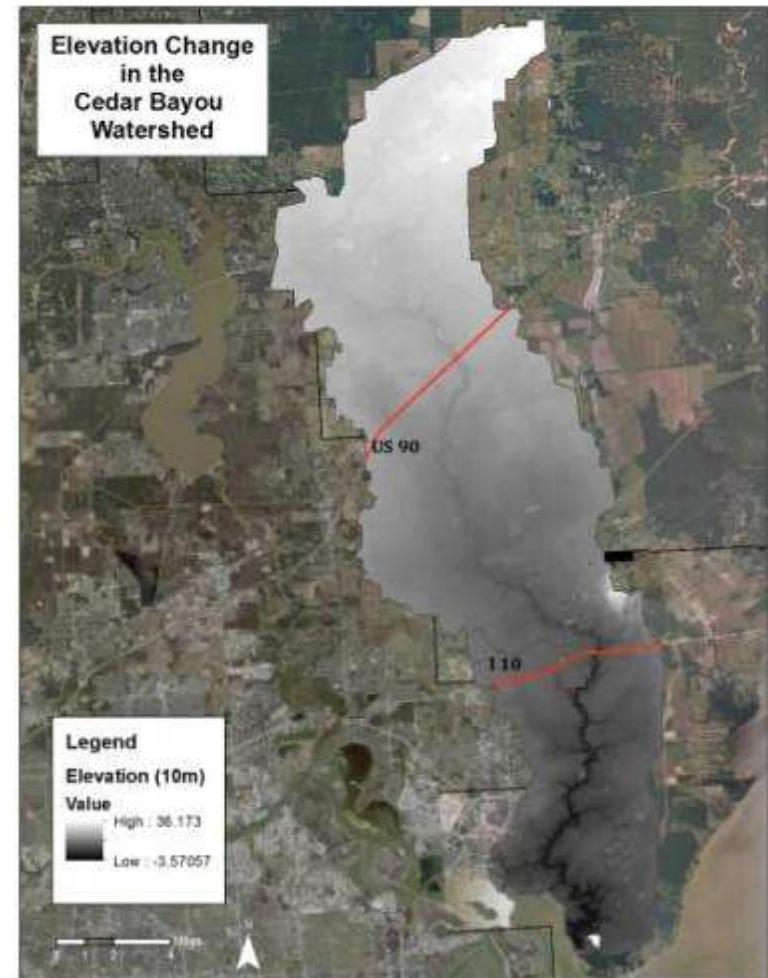
- Simple - Tidal Prism: low cost/effort; representative?
- Moderate – SWMM5, etc.: medium cost, more representative (cut, etc)
- Complex – SWAT/EPDRiv1, etc.: higher cost/effort;



Modeling Approach



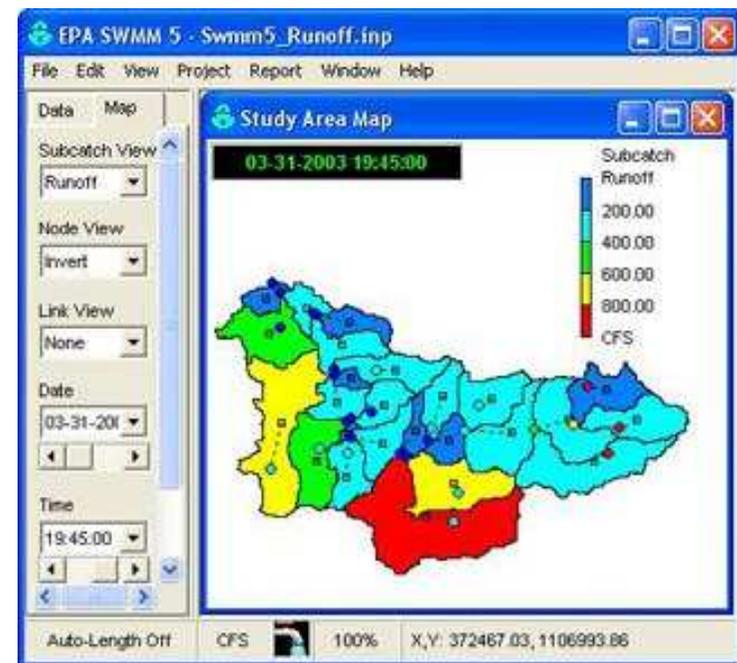
- Moderate complexity
- Worked with CDM/Tina Petersen
- Evaluated several potential models (Tidal Prism, SWMM5, QUAL2K, etc)
- Selected SWMM5



SWMM5 (EPA)



- Urban area focus, stormwater origins
- Can account for:
 - point sources
 - multiple channels/tidal processes
 - detention, infiltration, percolation, gw interflow



SWMM5 Implementation



Four scenarios:

- Current conditions
 - Full Compliance
 - CRP station compliance
- Future Conditions
 - Full Compliance
 - CRP station Compliance

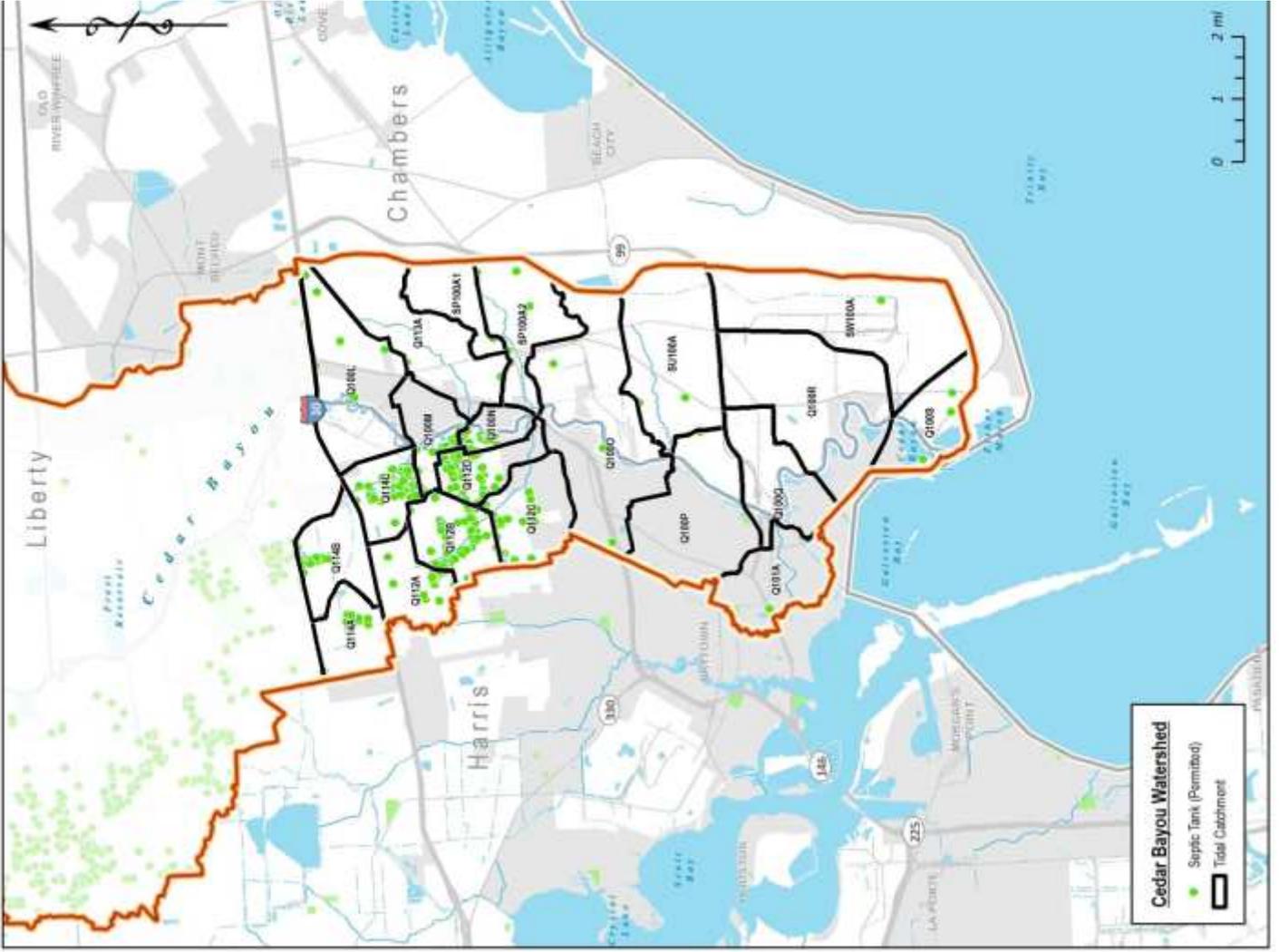


SWMM5 Implementation



- Salinity used as conservative tracer, paired data set comparison
- Pumpage data from NRG modeled
- Focused on compliance at CRP stations
- “Aggregate” loading for NPS





SWMM5 Outcomes

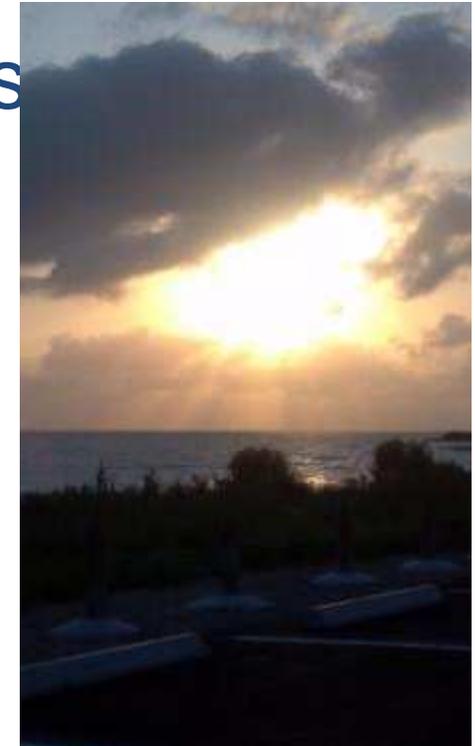


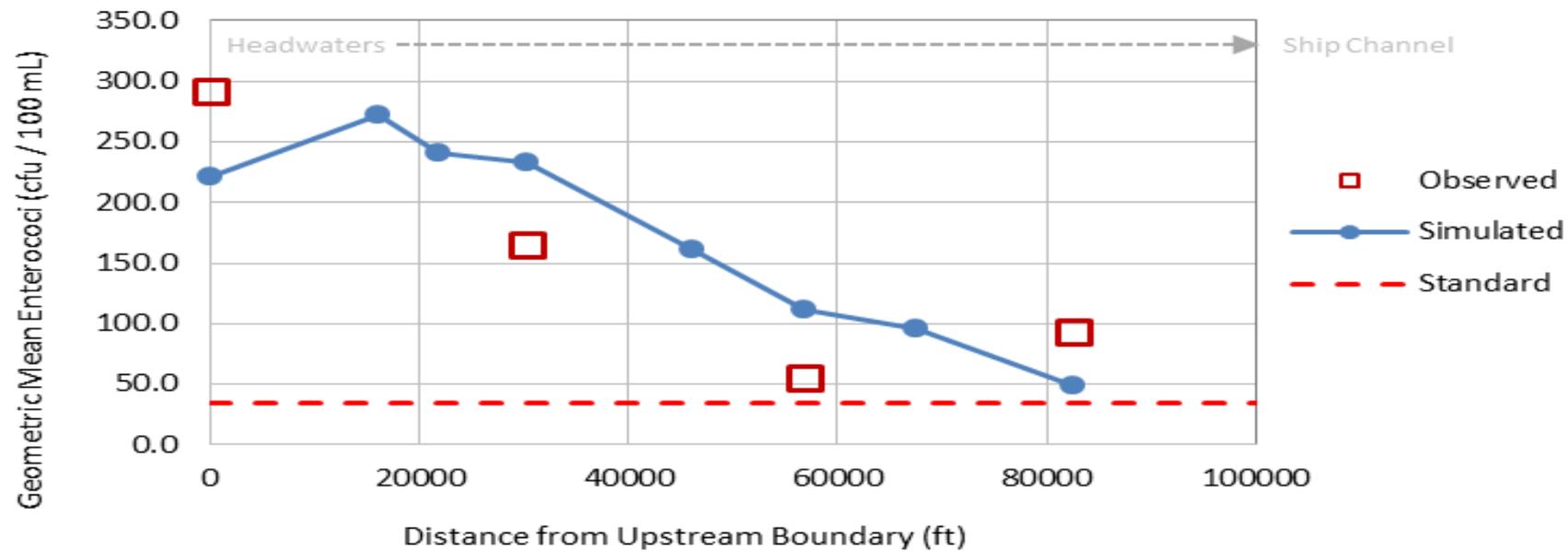
Timeframe	Full compliance	CRP station compliance
Current	87%	76%
Future	87%	77%

SWMM5 Outcomes

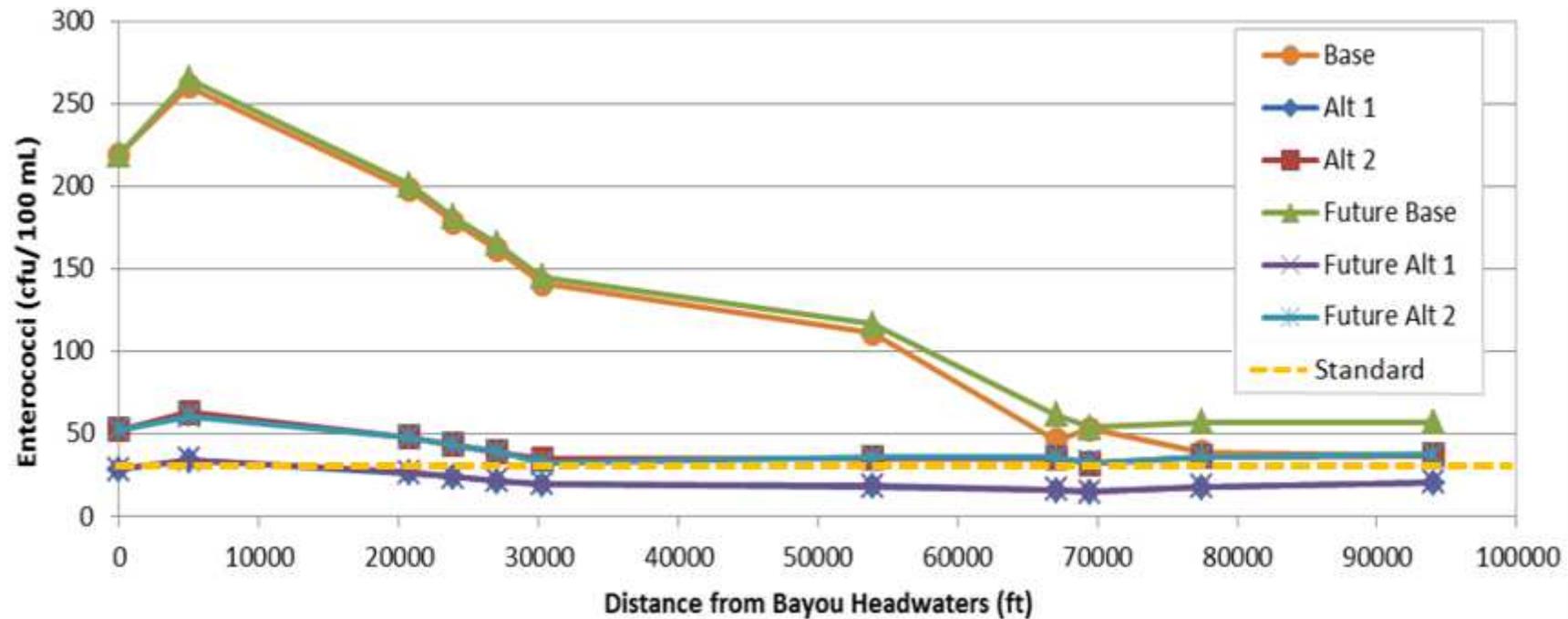


- Significant reductions
- Doesn't assume upstream changes
- NRG pumpage has appreciable impacts on flow
- Groundwater/surface water interchange is important factor





Note: Outliers for Station 11117 excluded.



Lessons Learned



- Match complexity to stakeholder decisions
- Don't overlook the impact of individual sources/factors
- Consider groundwater/ surface water interaction
- Better method for some sources needed (SSO, gulls)

Putting it together



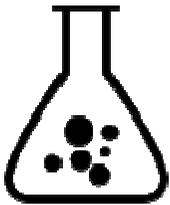
- SWMM5 - reduction %s
- SELECT – source %s
- Reductions to be made proportionally to source %s
- Mix of sources, BMPs



Project Progress



- **WPP under EPA review**



- **Water quality monitoring ongoing**



- **Implementation begun**
 - **SSO data**
 - **Pet waste stations**
 - **OSSFs**

Early Implementation



- CBF Trash Reduction

- GBF rain barrels

- AgriLife education



- **GLO/GBF/CBF/et al.**
abandoned vessel
removal

Any Questions?



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