Investigating White Oak Shellfish Restoration

TMDLs and Implementation Plans

Baker

North Carolina Coastal Federation

STATE OF NORTH CAROLINA • DEPARTMENT OF TRANSPORTATION •

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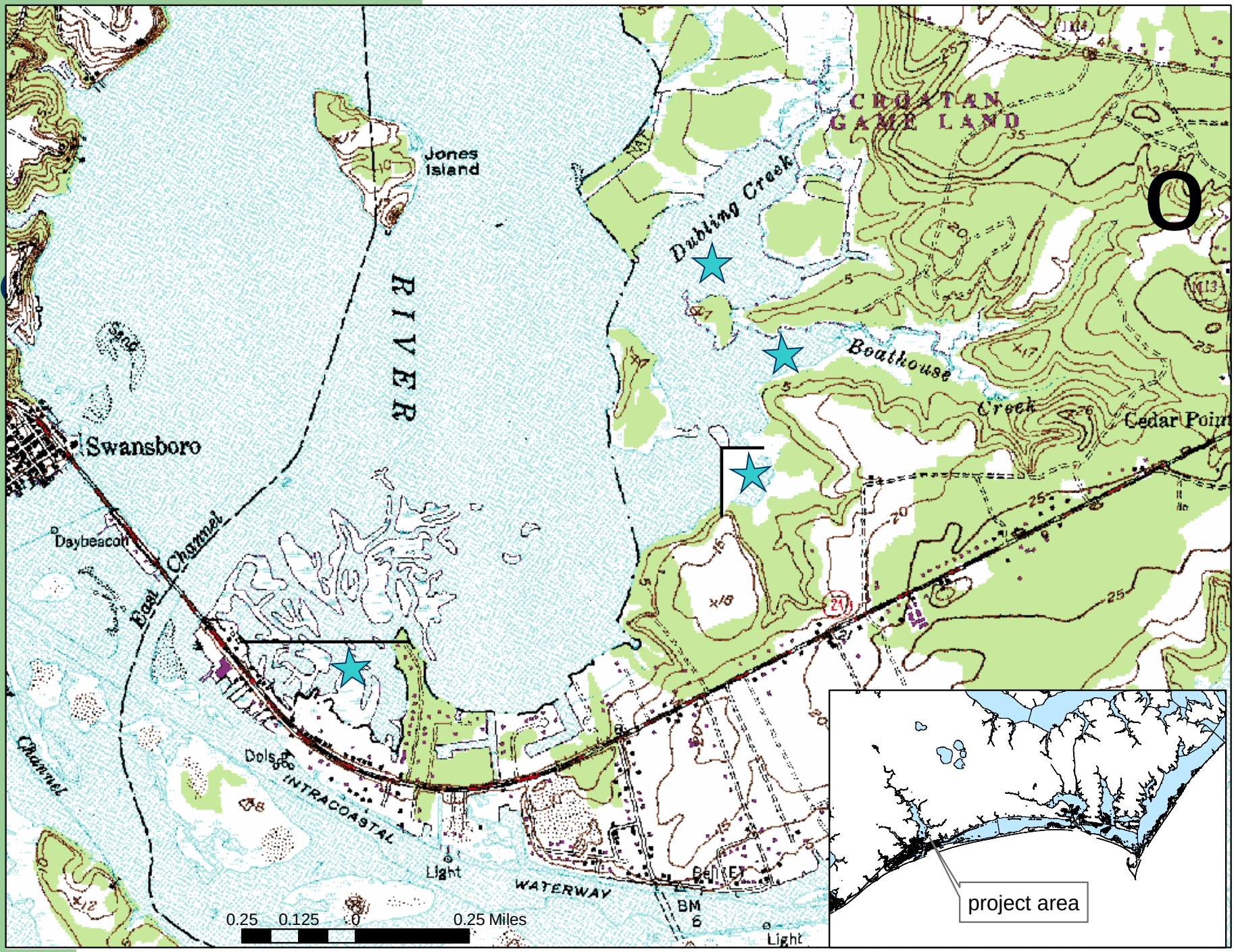
CROATAN
GAME LAND
Jones
Island
RIVER
Dubling Creek
Boathouse
Creek
Cedar Point
Swansboro
Daybeacon
Boat Channel
Channel
INTRACOASTAL
WATERWAY
Light
Light
BM
6
0.25 0.125 0 0.25 Miles
project area

What is a TMDL?

- The maximum amount of a pollutant that a waterbody can receive and still meet w.q. standards, and an allocation of that amount among point and nonpoint sources, plus a margin of safety.

- A TMDL is a written, quantitative plan and analysis for attaining and maintaining WQ standards in all seasons for a specific waterbody and pollutant.

Project Goals

- Planning Phase -> Build foundation for shellfish restoration
  - Understand fecal coliform sources and delivery pathways
  - Identify and prioritize bacteria reduction strategies
  - Set stage for funding and implementation of recommended measures
  - Public education
  - **Assess use attainability**

Project Sampling Sites

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Project Monitoring Stations
Figure 2.1.1

0 0.25 0.5 Miles

Source Assessment

- Estimate pets through telephone surveys
- Septic systems through identification of inhabited and uninhabited homes, failing systems.
- Wildlife estimates from a variety of sources.

Watershed Model

- LSPC (Loading Simulation Program C++)
- Simulation model that is hydrologically driven. Pollutants accumulate on ground surface and are washed off during rainfall events.
- Accumulation rates are determined by the source assessment and land cover.
- Simulate surface and sub-surface drainage.

Table 3.2.1: Resulting Fecal Coliform Accumulation Rates from Boathouse Creek

Land use	Loading Counts/day	Loading Percent
Wetland	7.35E+11	10.8
Pasture/Herbaceous	1.96E+11	2.9
Forest	1.51E+12	22.1
Urban	**4.17E+12**	**61.1**
NCDOT	2.19E+11	3.2
Total	6.83E+12	100

Table 3.2.2: Resulting Fecal Coliform Accumulation Rates from Dubling Creek

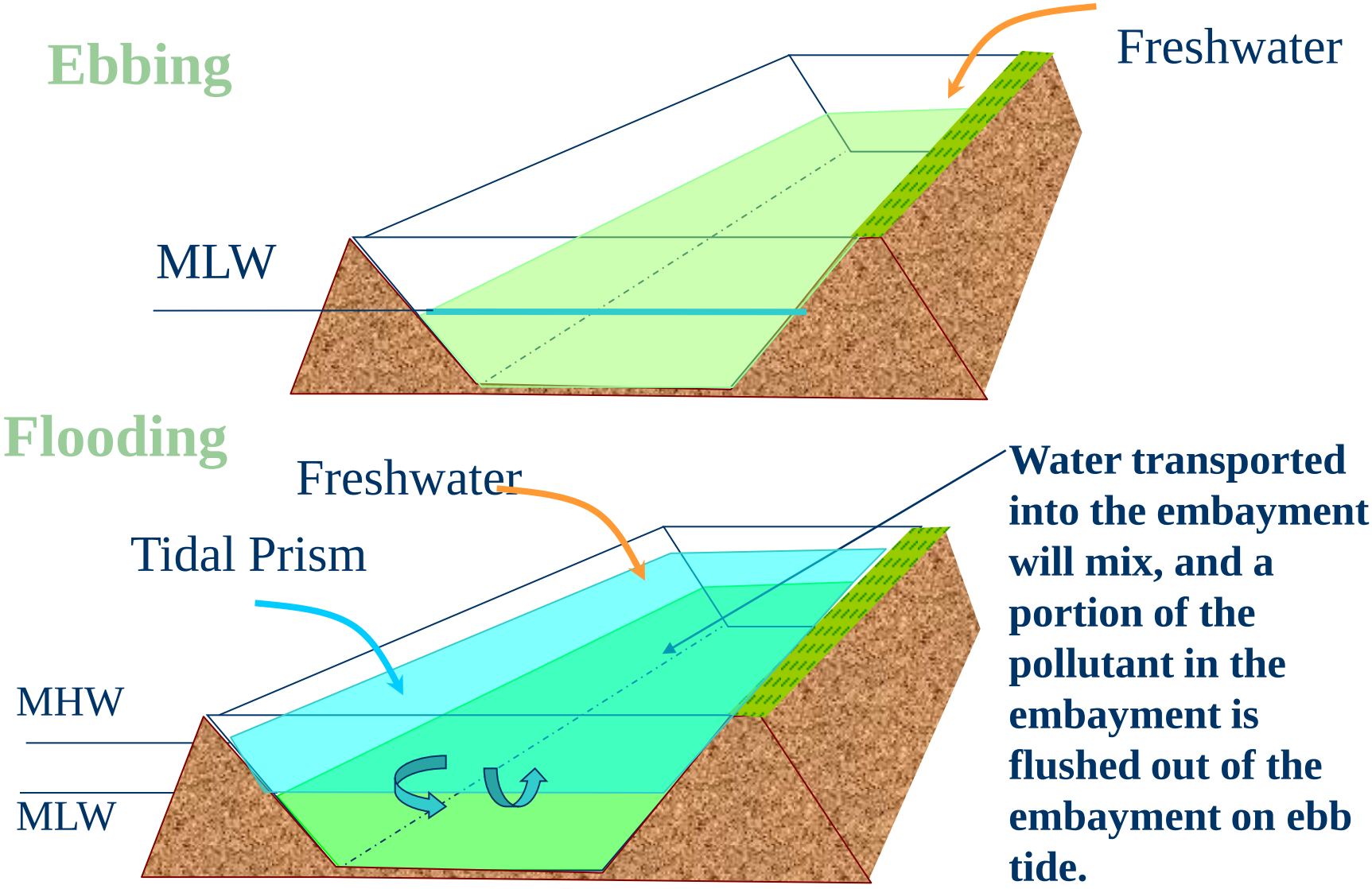
Land use	Loading Counts/day	Loading Percent
Wetland	**2.62E+12**	**68.4**
Pasture/Herbaceous	5.85E+10	1.5
Forest	9.42E+11	24.6
Urban	2.10E+11	5.5
NCDOT	NA	0.0
Total	3.83E+12	100

Table 3.2.3: Resulting Fecal Coliform Accumulation Rates from Hills Bay Embayment

Land use	Loading Counts/day	Loading Percent
Wetland	3.21E+10	5.6
Pasture/Herbaceous	**1.74E+11**	**30.2**
Forest	9.81E+10	17.0
Urban	**1.90E+11**	**33.0**
NCDOT	8.15E+10	14.2
Total	5.76E+11	100

Tidal Prism Model

- Simulates fecal coliform in small coastal embayments that are influenced by both tide and surface runoff
- Water transported into the embayment completely mixes (at high tide) and a portion of the pollutant in the embayment is flushed out on ebb tide
- Time step is a full tidal cycle
- Assume a fecal coliform decay rate (T, salinity, solar rad)
- Has been applied in Virginia and in North Carolina (Jarrett Bay for TMDL development).


Ebbing
Freshwater
MLW
Flooding
Freshwater
Tidal Prism
MHW
MLW
Water transported into the embayment will mix, and a portion of the pollutant in the embayment is flushed out of the embayment on ebb tide.

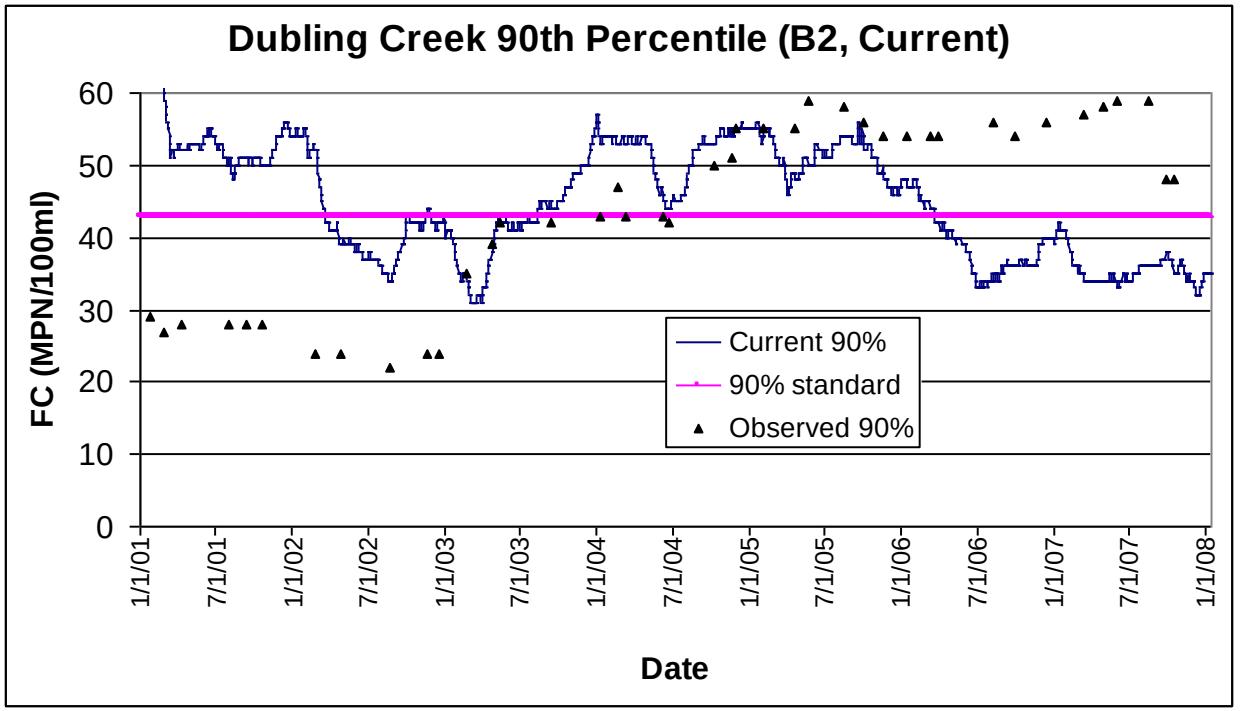


Figure 3.2.7: Comparison of 90th Percentile of fecal coliform from model simulation and observations (Dubling Creek)

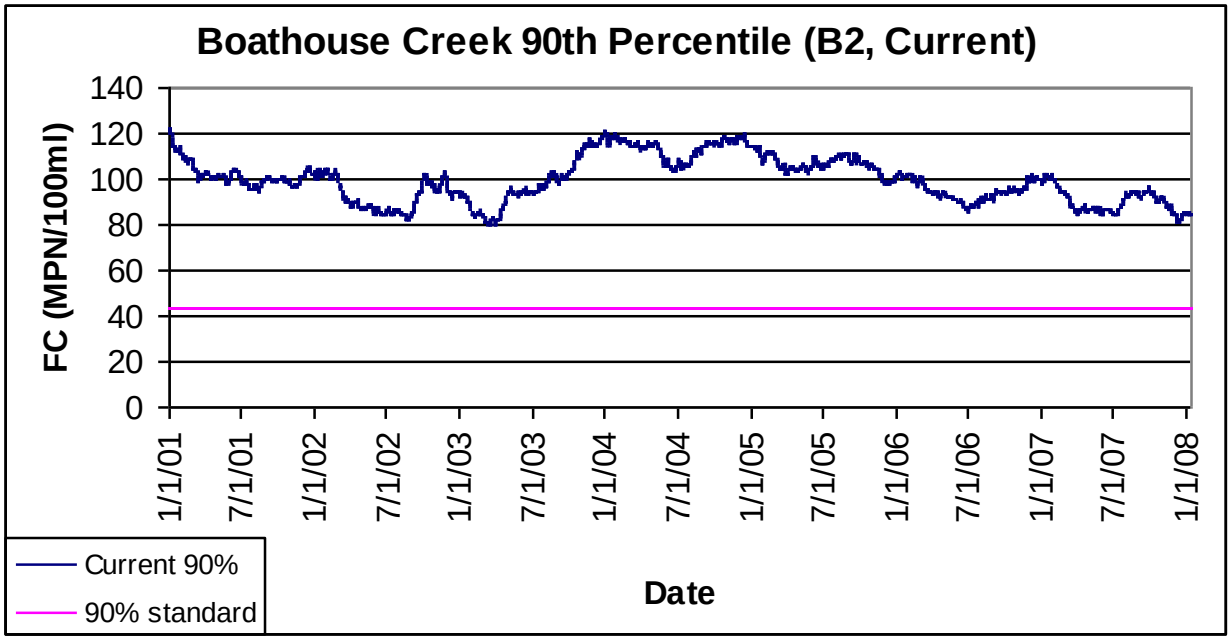


Figure 3.2.8: 90th Percentile of fecal coliform from model simulation (Boathouse Creek).
Note: Sampling began at this station in January 2004 so 30 samples on which to base Observed 90th percentile had not yet been collected.
90th percentile based on 27 samples was 119 in October 2007.

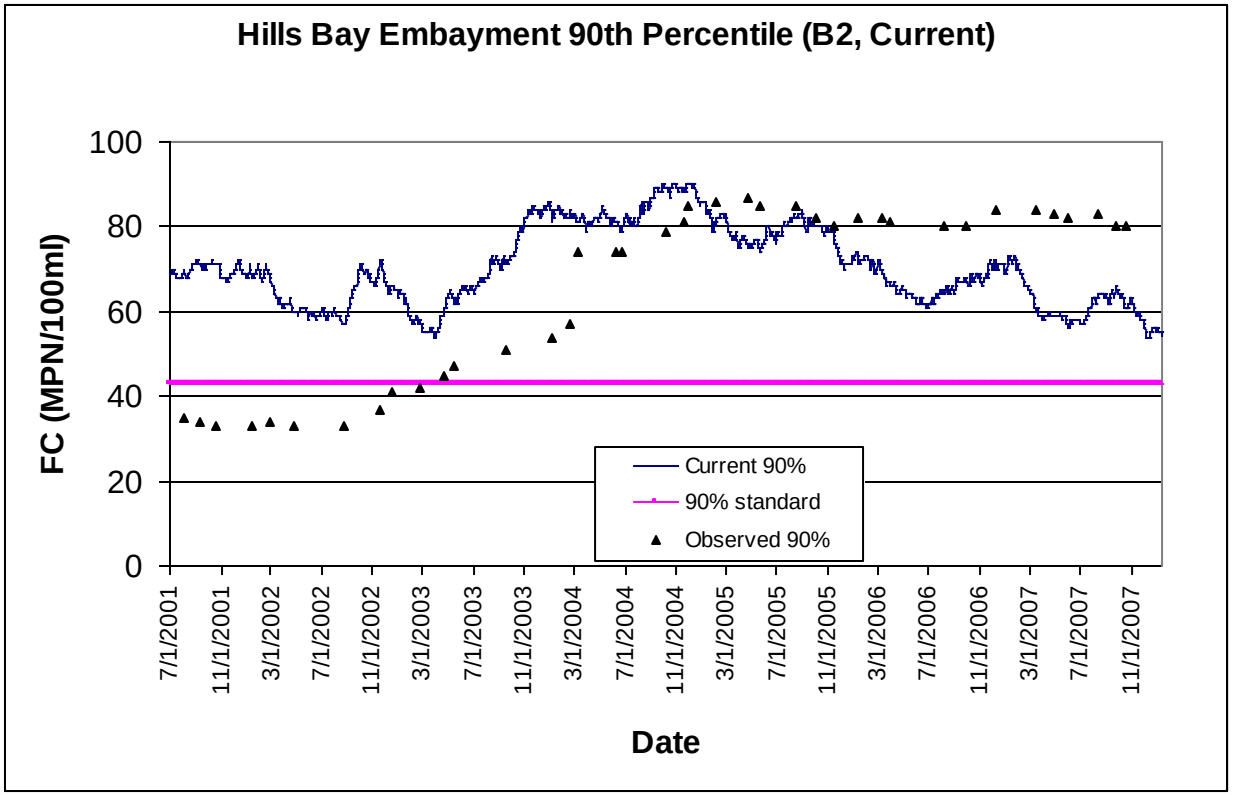


Figure 3.2.9: Comparison of 90th Percentile of fecal coliform from model simulation and observations (Hills Bay Embayment)

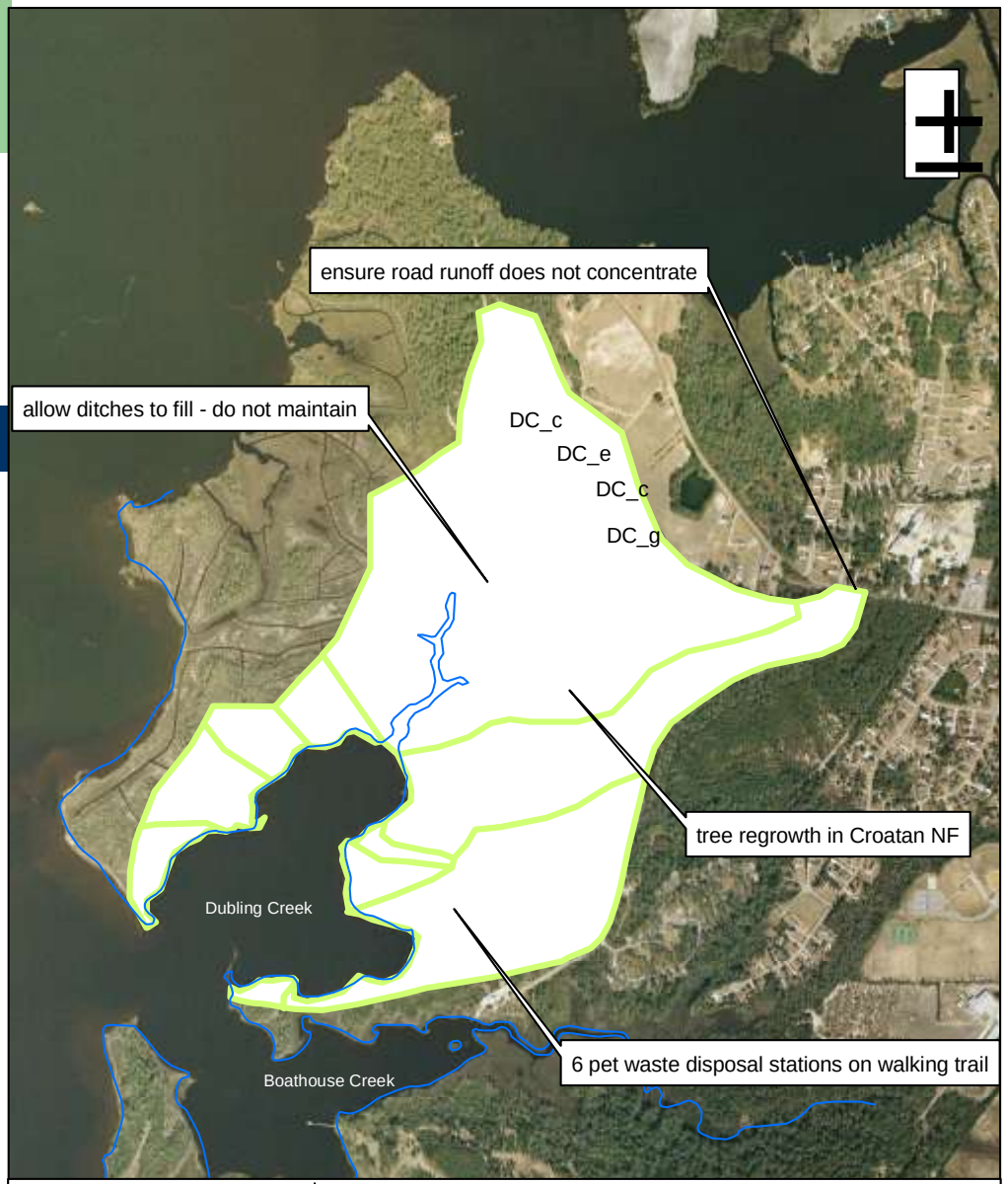
TMDLs for Fecal Coliform

Waterbody	TMDL	WLA	NCDOT Reduction Required	LA	NPS Reduction Required
Boathouse Creek	2.09×10^{11}	9.91×10^{9}	72%	1.75×10^{11}	72%
Dubling Creek	1.58×10^{11}	0.00	0%	1.53×10^{11}	14%
Hills Bay embayment	1.45×10^{10}	6.60×10^{8}	60%	1.24×10^{10}	57%

Notes: WLA = wasteload allocation for point source (NCDOT), LA = load allocation for nonpoint sources. The margin of safety is not shown but is the difference between the TMDL and the WLA + LA.

Watershed Implementation Plans

- Follow EPA's Nine Key Elements
- Based on TMDLs and source assessment
- Prescribe specific BMPs at specific locations



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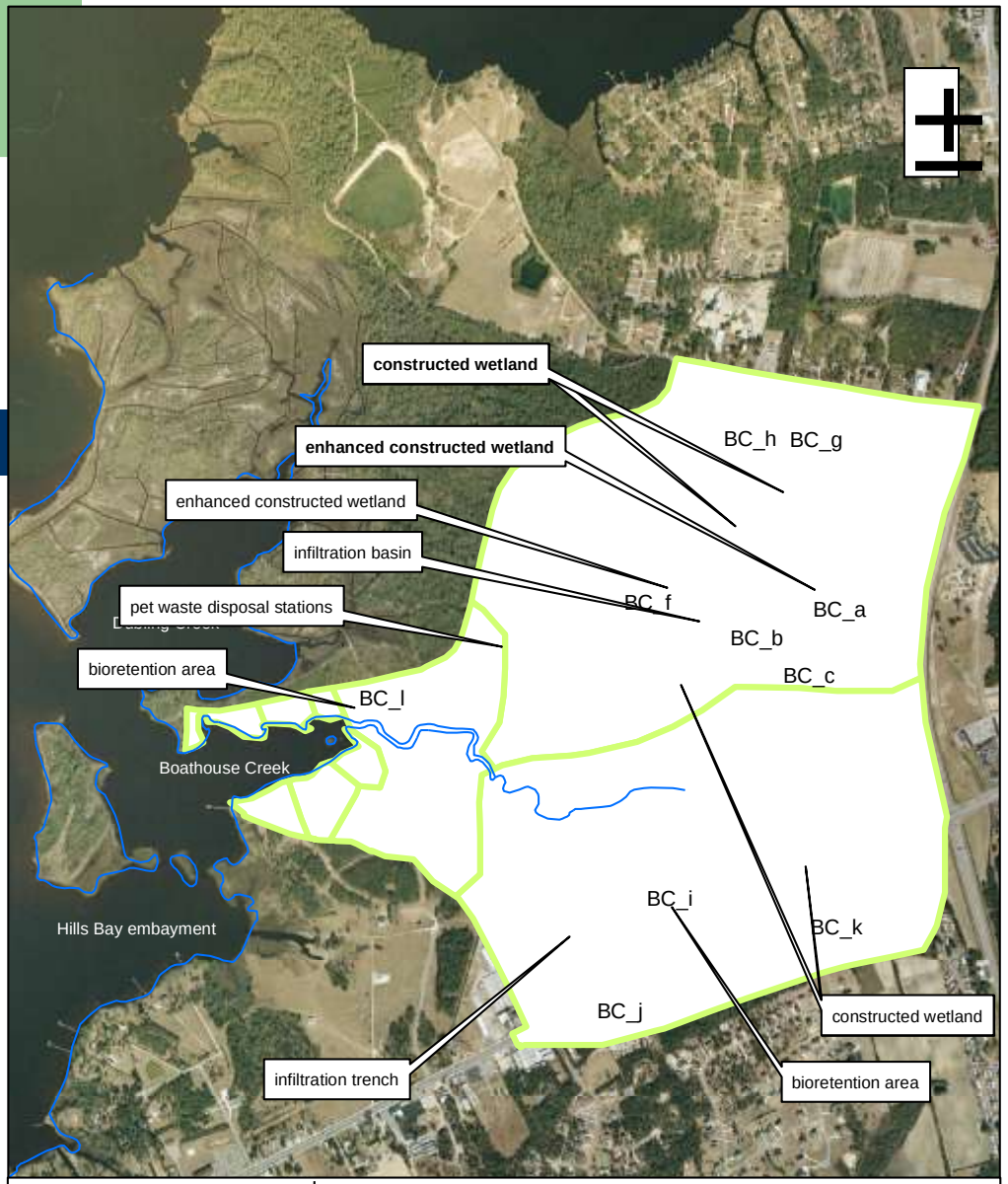
Dubling Watershed Recommended BMPs

Figure E9

0 0.25 0.5

Miles

BMP drainage areas



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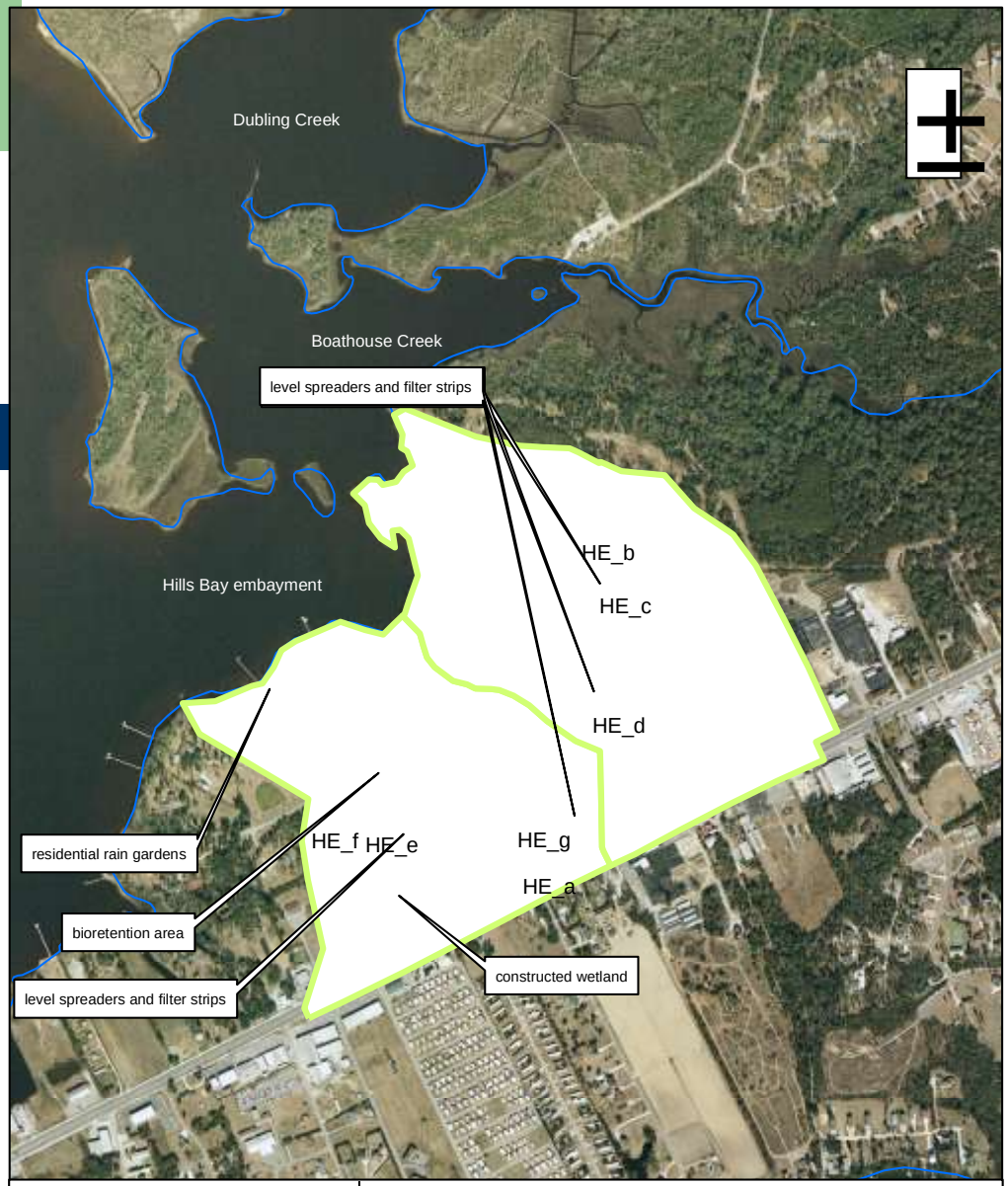
Boathouse Creek Watershed Recommended BMPs

Figure E10

0 0.25 0.5

Miles

BMP drainage areas



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Hills Bay Embayment
Recommended BMPs

Figure E11

0 0.25 0.5
Miles

BMP drainage areas

N.C. Coastal Federation

NC 24 Bridge Area
BMP Recommendations

Figure E12

0 0.125 0.25
Miles

Implementation in modeling

- Buffer – 50%
- Stormwater Wetland – 70%
- Bioretention Area – 90%
- Level Spreader & Filter Strip – 55%

- Applied these reductions to land use in BMP drainage areas. Combined with remainder of subwatershed at calibrated accumulation rate.

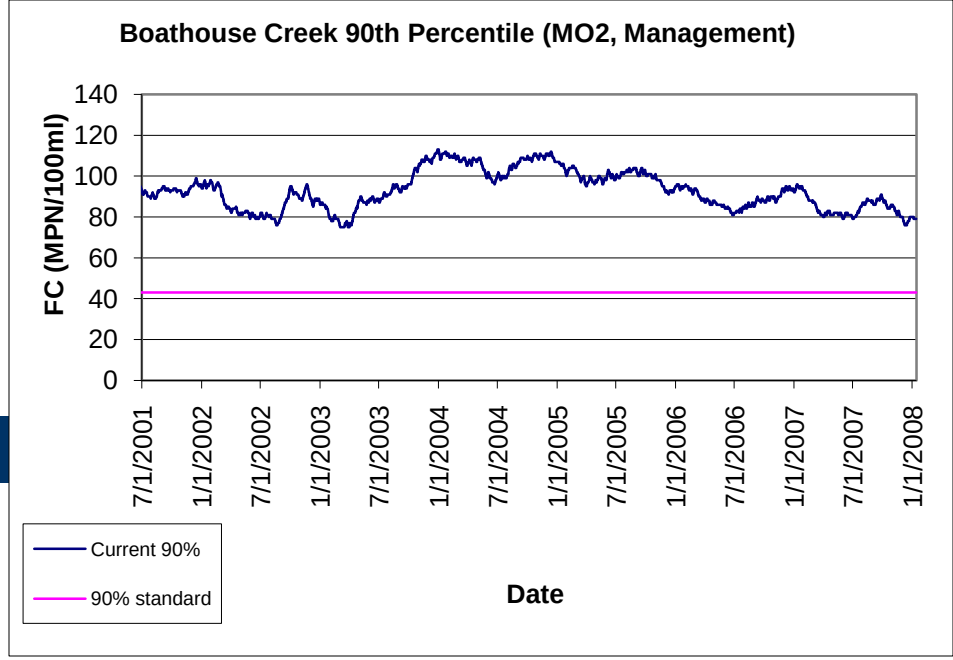
Effects of identified BMPs

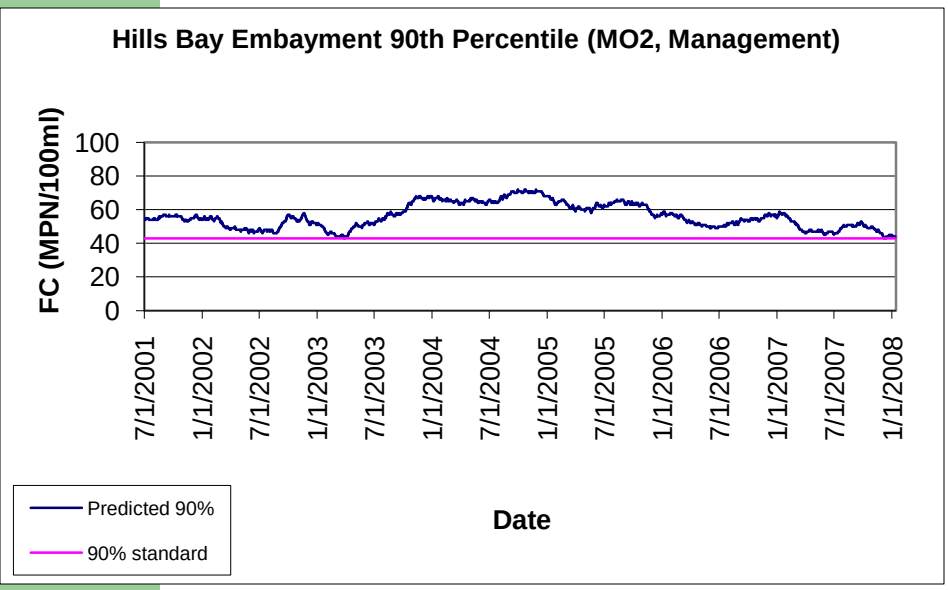
- Boathouse Creek: 17% reduction overall.
  9-23% reduction in urban loads, minimal reduction in forest and mgd herbaceous load. 67% reduction in DOT load.

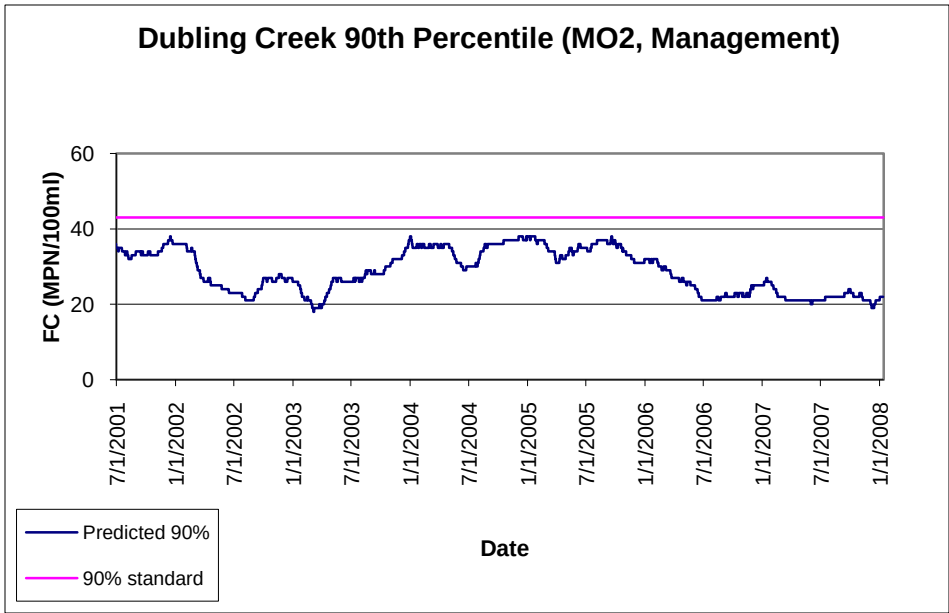
- Hills Bay embayment: 23% reduction overall.
  13-45% reduction in urban loads, 9-18% reduction in forest and pasture loads. 70% reduction in DOT load.

- Dubling Creek: 14% reduction overall.
  50% reduction in limited urban load, 40% reduction in pasture load, and 10% reduction in forest and wetland loads.

Mgmt effects







Conclusions

- Meeting w.q. standards appears to be achievable in Dubling Creek.
- Boathouse Creek and Hills Bay embayment have more intractable impairments. A BMP is probably necessary on nearly every developed parcel. Would appear to require rule making.

- Education, focused on source reduction, may prove to be critical.
- Wildlife loading is difficult. Focus on hydrology, where possible.
- Model predictions are uncertain. Monitor to see how bacteria levels change over time.

- The situation in this area is repeated across NC's coast. Consider focusing resources on implementation & monitoring, not TMDLs.