

# Modeling Fecal Coliforms in Oakland Bay

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## Introduction

- Fecal coliform (FC) levels in Oakland Bay suggest that pathogens may threaten human health, recreation, and shellfish harvesting.
- The Department of Ecology developed a model of Oakland Bay to assess the impact of nonpoint pollution source control on bacteria concentrations.
- The “GEMSS” model provides a “TMDL” management tool.
- Approach to improve water quality in Oakland Bay:
  - Predict FC concentrations at Department of Health (DOH) marine water quality stations.
  - Establish target reductions at the tributary mouths to meet marine standards in the bay.
  - Assess role of sediment and wind as a secondary source of FC.

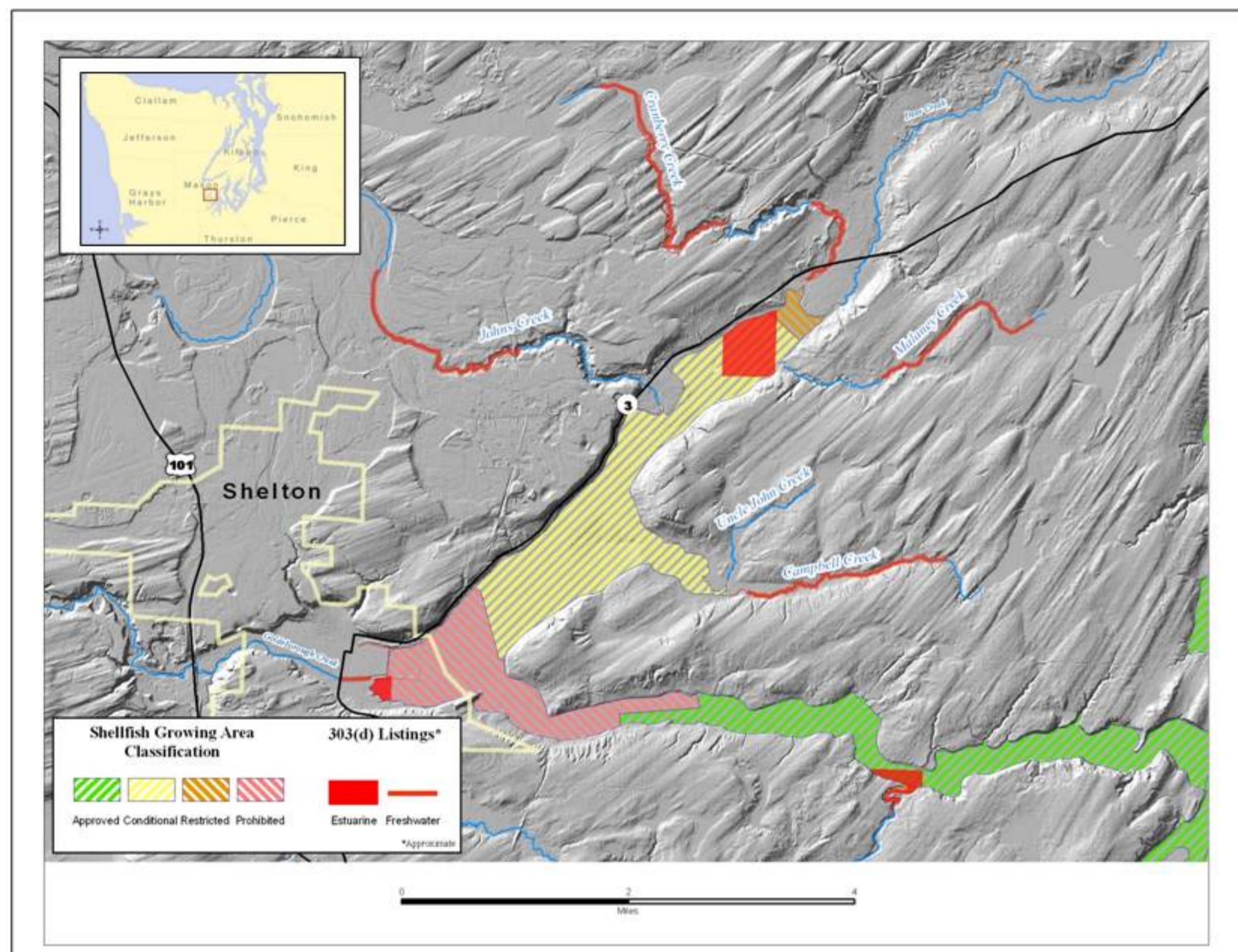


Figure 1. 303(d) listed waters and shellfish growing areas in Oakland Bay/ Hammersley Inlet



Figure 2. Shoreline nonpoint sources of FC bacteria: 122 pipes/culverts, 43 seepages, 27 unnamed tributaries and 87 drainages.

## Materials and Methods

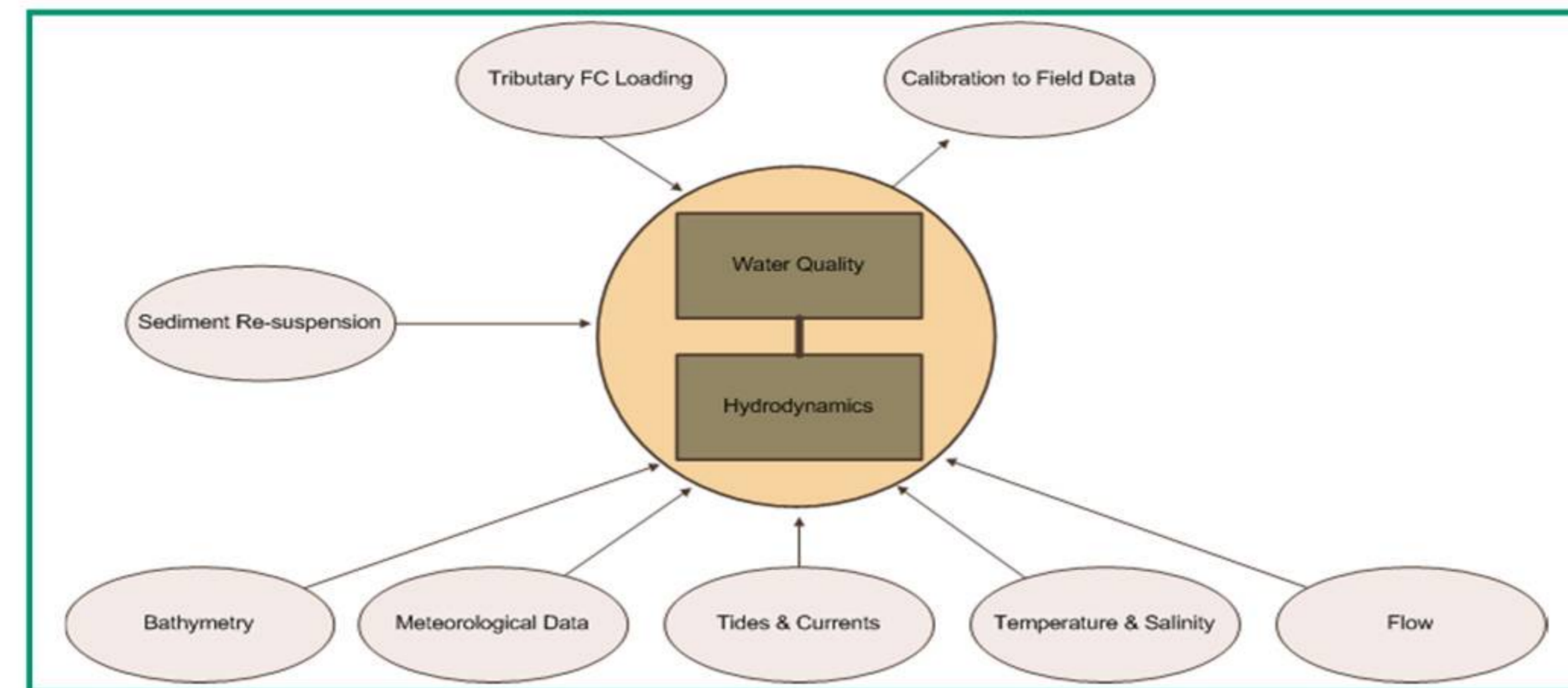


Figure 3. GEMSS model (Generalized Environmental Modeling System for Surface Water) components used to develop the TMDL (total maximum daily load) analysis.

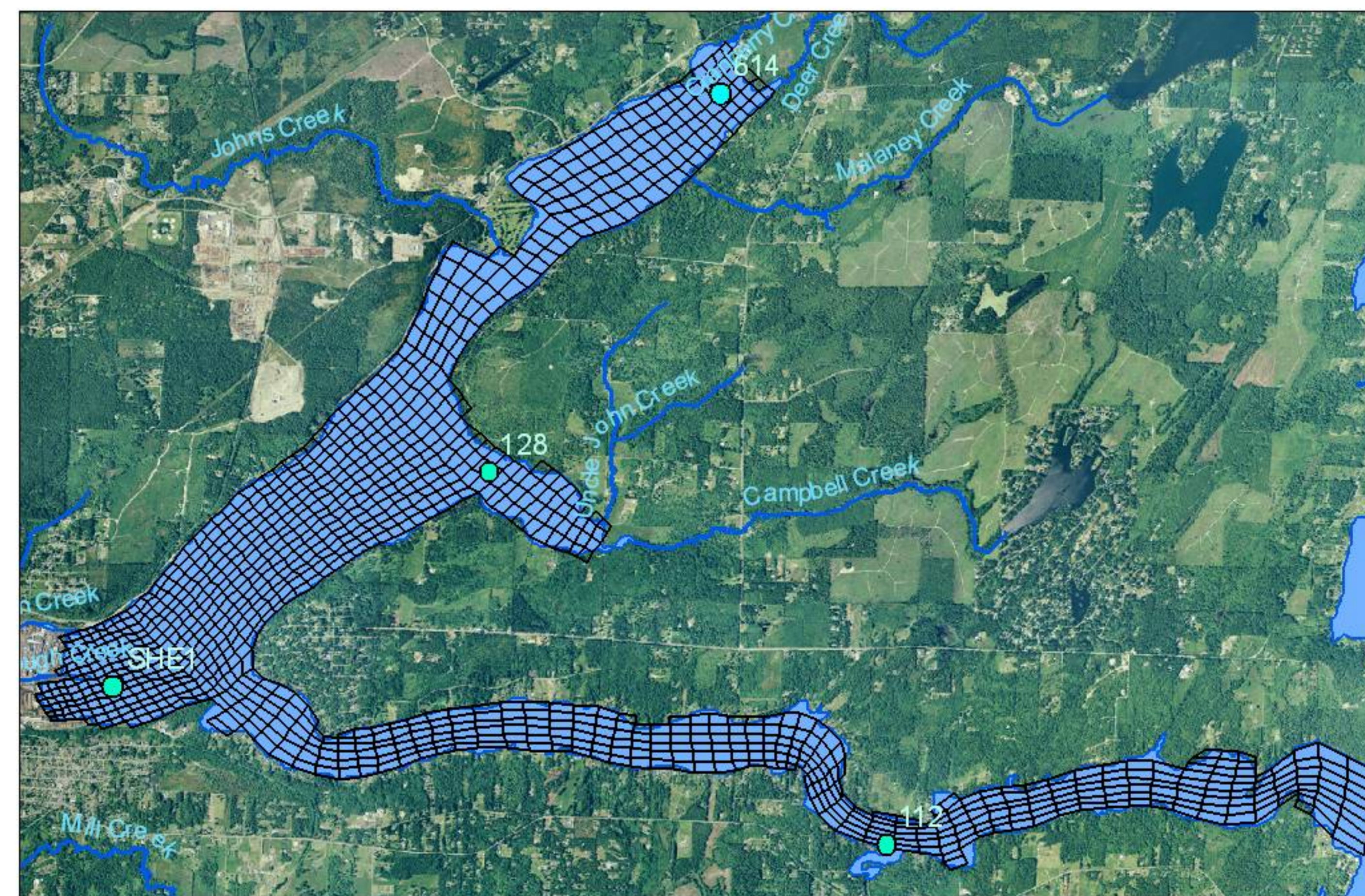


Figure 4. FC calibration stations for GEMSS model: DOH 614, DOH 128, DOH 112 and SHE 1.

## Results

- Model calibration based on freshwater tributary loading rates of FC underpredicted observed concentrations at DOH Station 614.
- Sediments were established as a secondary source of bacteria.
- A multiple regression analysis using wind speed, wind direction and FC concentrations showed that wind speed and direction was ten-times better at predicting observed FC concentrations relative to tributary loading alone.
- If all tributaries meet marine standard at their mouths, there is a 4% reduction in 90<sup>th</sup> percentile concentrations, but no change in geometric means.
- With no load from the tributaries, there is a 11% reduction in 90<sup>th</sup> percentile concentrations and a 6% reduction in geometric means.

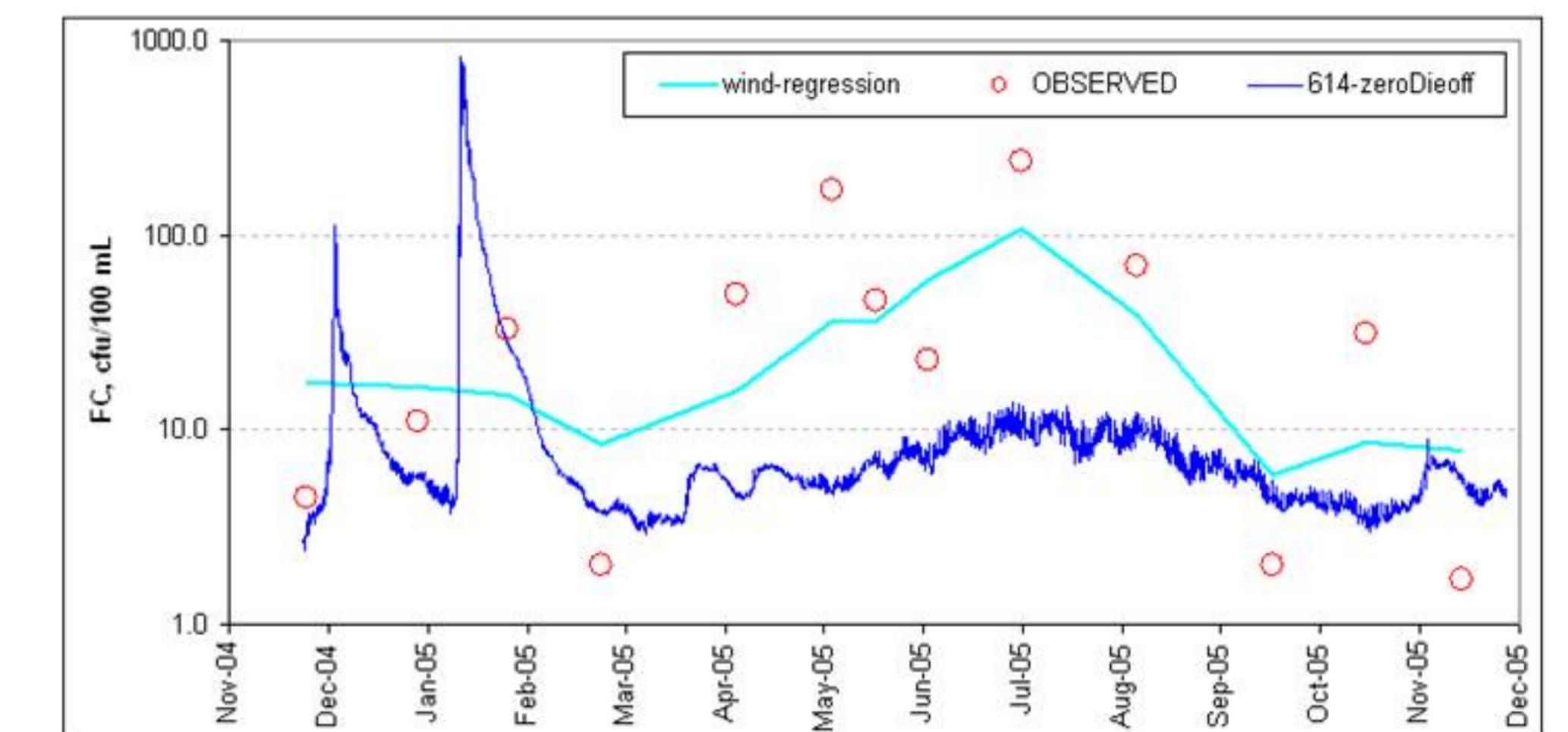


Figure 6. Calibration to field FC data: the red circles represent observed FC concentrations at DOH 614, the dark blue line represents model predictions based on freshwater tributary loading, and the light blue line represents model predictions based on wind speed.

## Conclusions: to meet water quality standards and protect beneficial uses like recreation and shellfish harvest—

- Meet marine FC standards at the mouths of all creeks and outfalls discharging directly to the bay.
- Eliminate all human sources of bacteria especially in upper Oakland Bay and Chapman Cove.
- Implement best management practices to reduce FC bacteria and sediment transport at all potential sources including State Hwy 3 outfalls.
- Minimize suspended solids discharge at all outfalls to reduce sediment load.

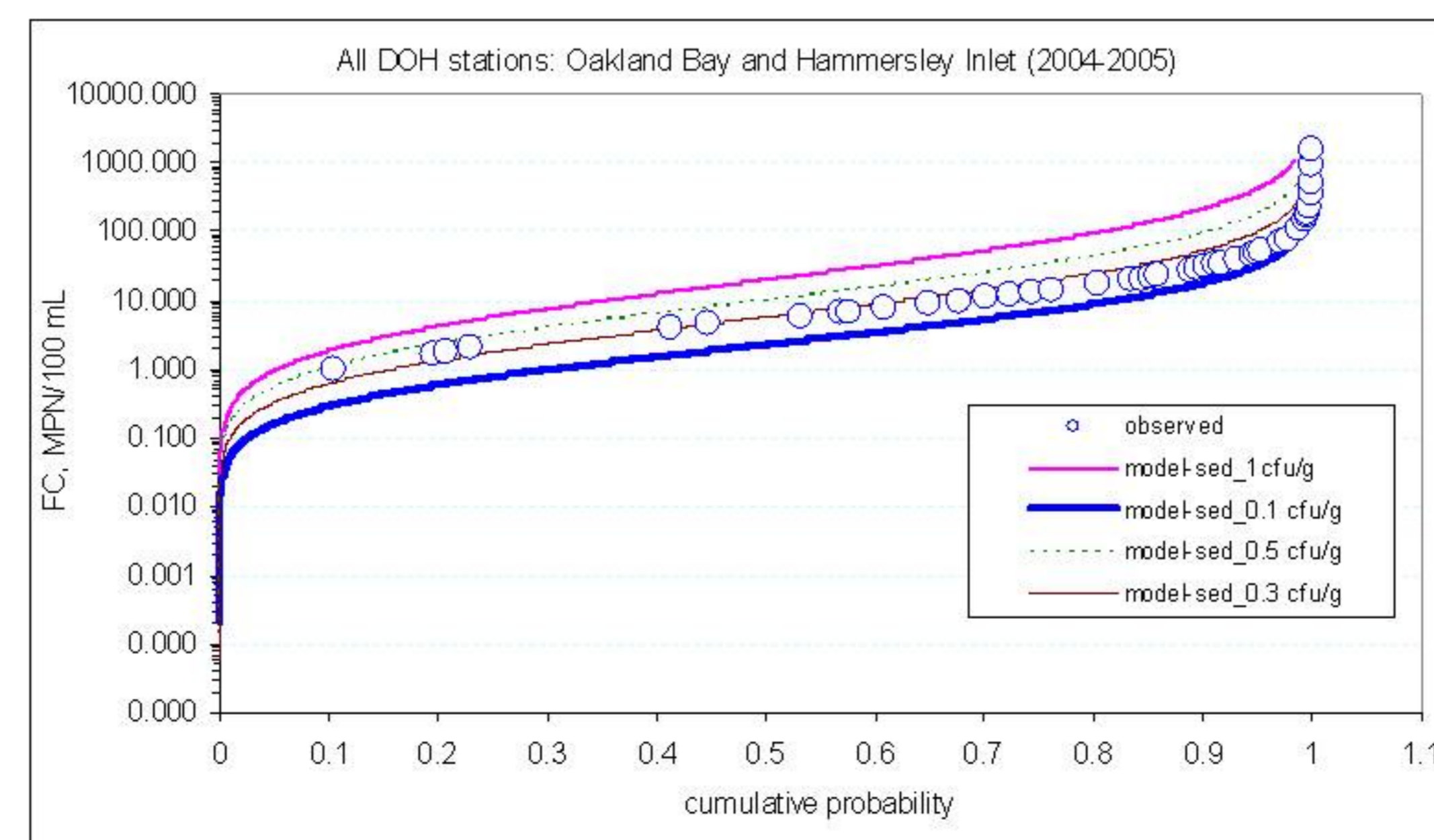


Figure 5. FC Calibration: pooled FC bacteria population at all DOH stations comparing modeled sediment FC concentrations to observed water column FC levels.