



Overview of the UNRBA Modeling to Support the Re-examination



Purpose of the Modeling Effort

- Re-examine Stage II of the Falls Lake Nutrient Management Strategy
- Better understand sources of nutrient loading to Falls Lake
- Evaluate nutrient management options to improve water quality and continue to protect designated uses
- Consider cost and technical feasibility in the revised strategy
- Work with stakeholders throughout the process
 - Hear concerns and address issues
 - Build a workable strategy with buy-in across organizations

Overview of Four UNRBA Models

Watershed loading model (WARMF)

1. WARMF: Watershed Analysis Risk Management Framework

Two lake water quality response models

2. Segment-based, less complex model (WARMF Lake)
3. Grid-based, hydrodynamic model (Environmental Fluid Dynamics Code, EFDC)

Statistical lake model

(water quality and designated uses)

4. Falls Lake Statistical Model

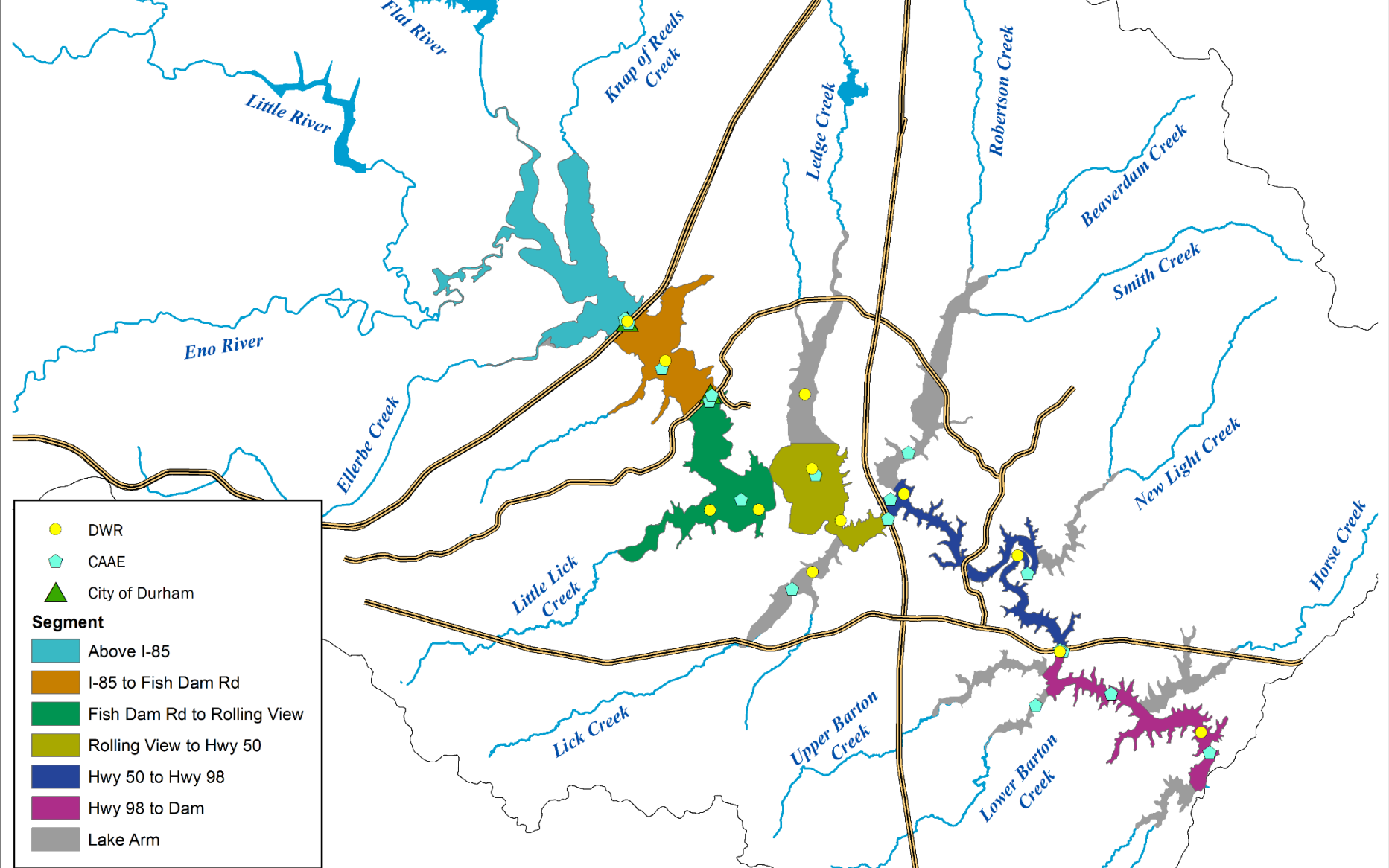
1. Watershed Loading Model

Watershed Analysis Risk Management Framework (WARMF)

- Predict flow, nutrient, and carbon **loading** to Falls Lake
- Based on weather, land use, wastewater treatment, nutrient application, atmospheric deposition, etc.
- Calibrate to data collected by UNRBA, DWR, and others (2015-2018)
- Evaluate how **nutrient management scenarios** affect loading to the lake (changing land uses or nutrient application rates, best management practices, etc.)

The State also developed a WARMF model of the Falls Lake watershed. It was not used to set loading targets, but it was used to account for controllable/uncontrollable sources in the required reduction amounts. It did not link directly to the State's EFDC lake model.

Scale of the WARMF Lake Model: Less complex, segment-based lake model



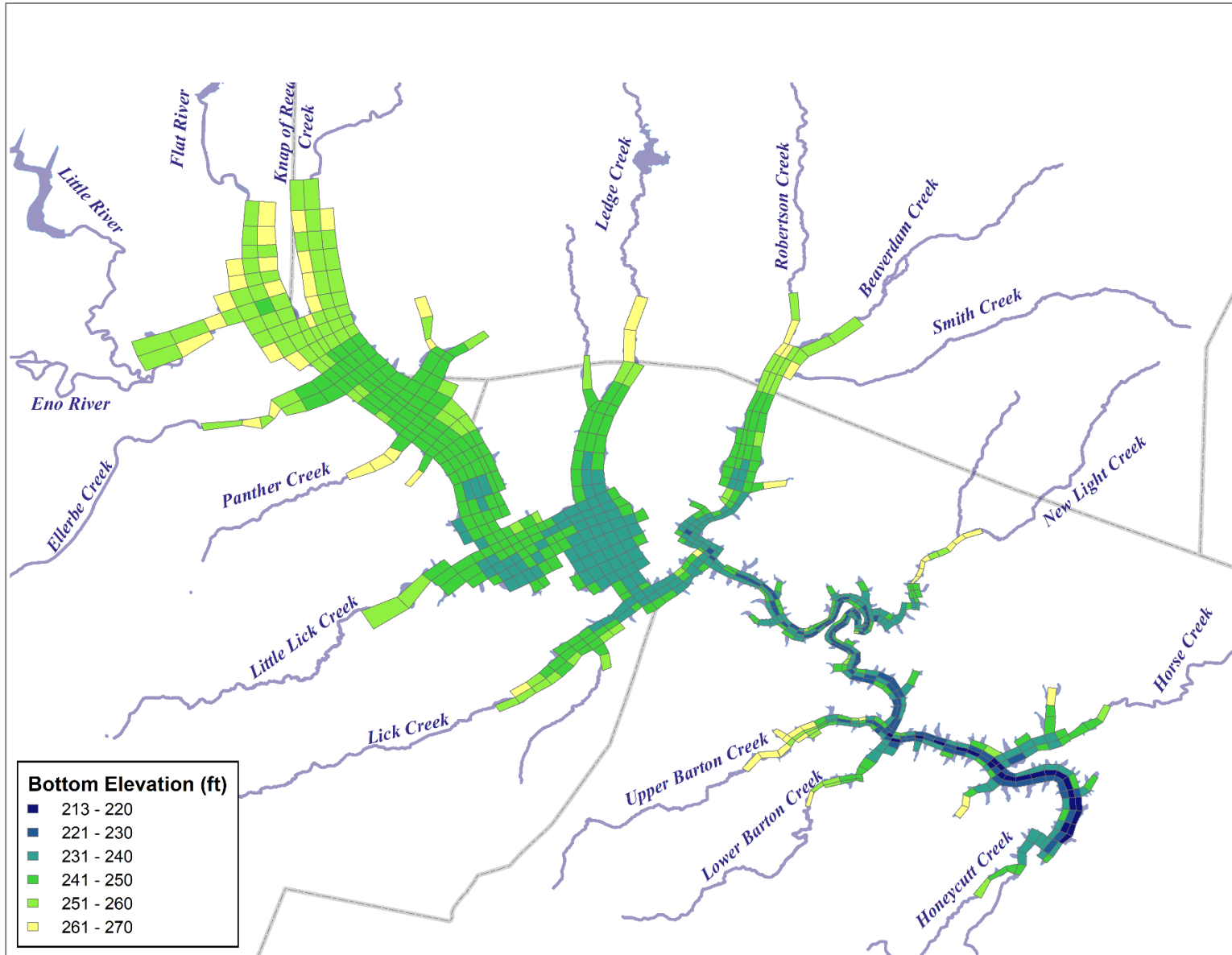
2. Lake Model: WARMF

- Link to WARMF watershed loading model
- Calibrate to Falls Lake data collected by DWR and others (2015-2018)
- Predict **water quality concentrations** in each segment (nutrients, carbon, and **chlorophyll-a**)
- Evaluate how **nutrient management scenarios** affect water quality (**chlorophyll-a**) in Falls Lake
- Provide faster scenario evaluations compared to EFDC; use for screening scenarios

This component was not included in the State's modeling.

Scale of the EFDC Lake Model:

Grid-based lake model of Falls Lake and Beaverdam Impoundment



3. Lake Model: EFDC

Environmental Fluid Dynamic Code

- Complex 3-D hydrodynamic model of water movement and **water quality** through hundreds of model ‘cells’
- Link to WARMF loading model and calibrate to Falls Lake data collected by DWR and others (2015-2018)
- Evaluate how **nutrient management scenarios** affect water quality (nutrient, carbon, **chlorophyll-a**) at specific locations
- Include simulation of nutrients stored in lake sediments, including long-term depletions
- Use to **support evaluation of regulatory options** outlined in the UNRBA Outline of Alternative Regulatory Strategies (B&T 2020, draft: e.g., variance, site specific standard)

The State developed an EFDC model of Falls Lake which was used to develop the load reduction targets in the current rules.

4. Falls Lake Statistical Model

- Segment-based model that incorporates many different types of information (data, existing empirical models, new models, literature, expert opinion)
- Predict **water quality** concentrations in each segment (nutrients, carbon, and **chlorophyll-a**)
- Predicts the likelihood of meeting water quality standards
- Links water quality to **designated uses**
- Supports evaluation of potential **regulatory options** (site-specific criteria, sub-classification use attainability analyses, variance)
- Supports cost-benefit, risk assessment, and uncertainty analyses to support decision making
- Used to evaluate how **nutrient management scenarios** affect water quality and designated uses in Falls Lake (link to WARMF loading model or run simple scenarios)

Potential Endpoints for FL Statistical Model

Designated Uses

- Safe drinking water
 - Taste, Odor
 - DBPs
 - TOC removal
- Aquatic Life
 - Dissolved Oxygen
 - Fish Kills
- Recreation
 - Fishing
 - Swimming
- Flood control

Water Quality Standards

- Dissolved oxygen
- pH
- Chlorophyll-a

The statistical modeling team will be seeking input from the Path Forward Committee and the legal team on evaluation metrics for these endpoints.