UNRBA Fall 2018 Stakeholder Meeting

MRS Project
Status Update

October 24, 2018

Brown AND Caldwell

SYSTECH WATER RESOURCES

Dynamic Solutions LLC

Goals of Stakeholder Meeting

Attendees understand UNRBA's Modeling and Regulatory Support project

- Progress made so far
- Current activities
- Future milestones

UNRBA understands how attendees will use the modeling results

- Desired outputs
- Resolution
- Applications

Agenda

Present background information	• Falls Lake Nutrient Management Strategy • Re-examination
Share progress on modeling	• Data collection • Model setup
Hear from stakeholders	• Data sources • Uses of model results

Ground Rules

- Begin and end on time
- One speaker at a time
- Share the time available for speaking
- Stick to the tasks and topics that are on the agenda
- Listen attentively to each other
- It is OK to disagree with each other…
  please do so respectfully

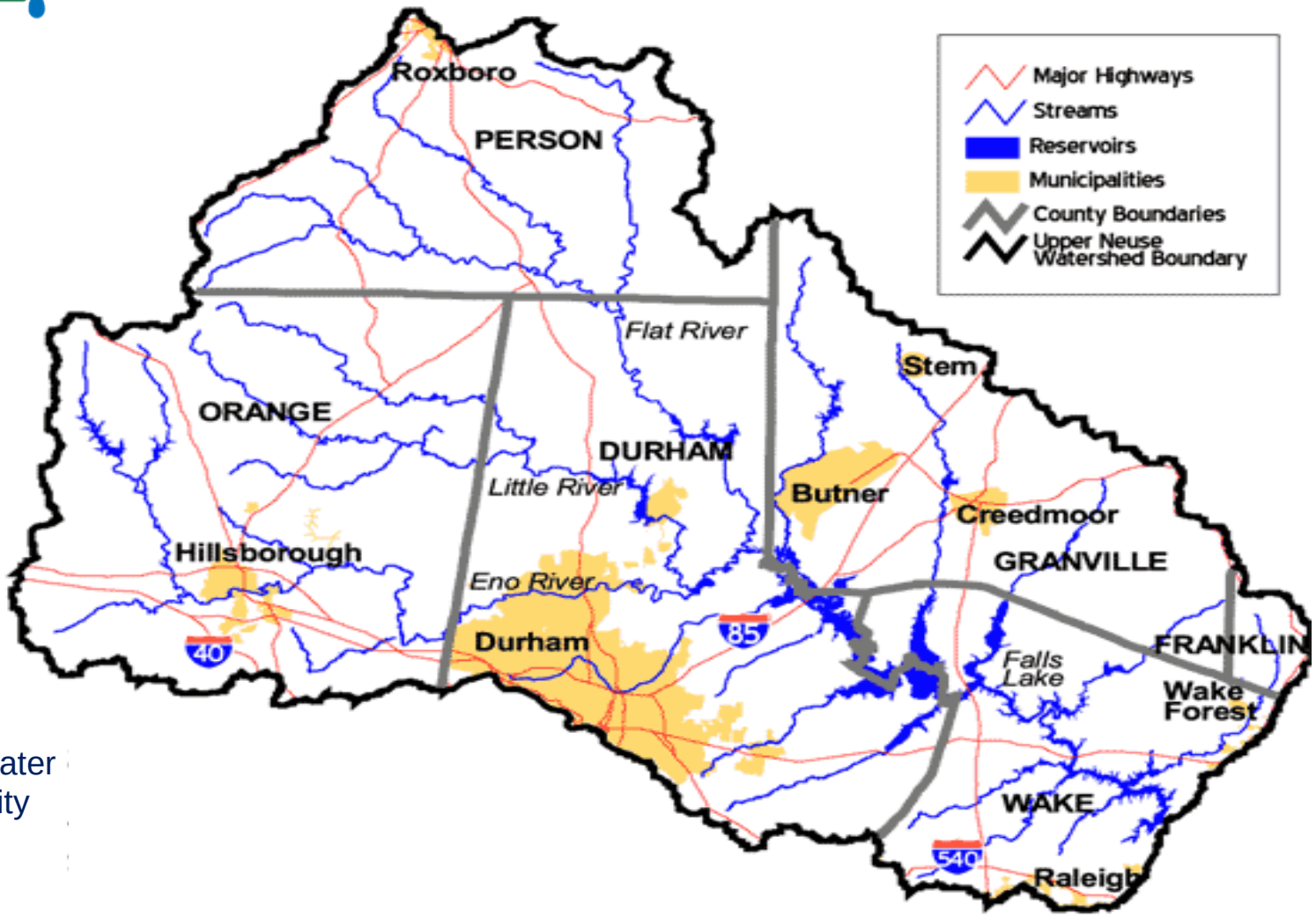
Background Information

Municipalities
Butner
Creedmoor
Durham
Hillsborough
Raleigh
Stem
Wake Forest

Counties
Durham
Franklin
Granville
Orange
Person
Wake

South Granville Water and Sewer Authority (SGWASA)

Soil and Water Conservation Districts (Ex Officio)

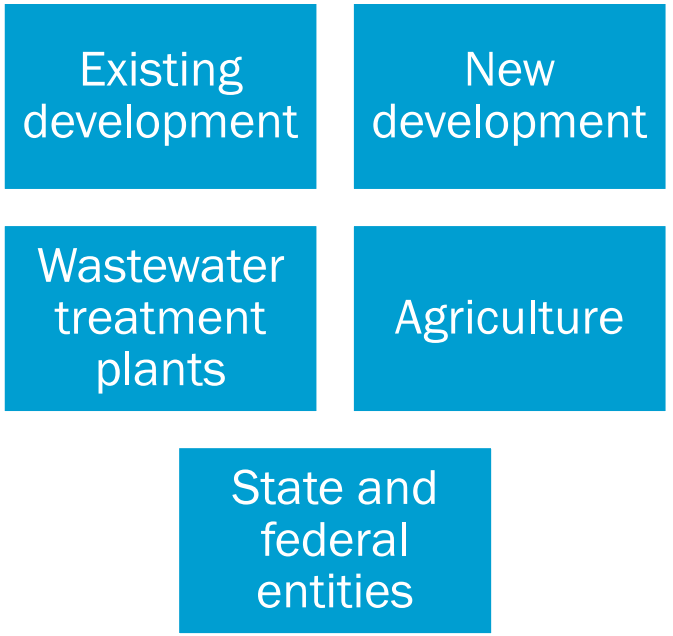


Falls Lake Challenges and the UNRBA

- Falls Lake is a valuable, regional resource
  - Provides drinking water for 550,000 customers
  - Regional recreational facility
  - Provides habitat to aquatic and terrestrial wildlife
  - Protects water quality downstream
- Exceedances of the 40 µg/L chlorophyll a standard resulted in the lake being listed as impaired and development of a nutrient management strategy

Falls Lake Nutrient Management Strategy

- Developed by the Division of Water Resources
- Passed by the Environmental Management Commission in 2010
- Assigns load reduction targets for individual sectors
- Includes the highest nutrient reductions ever passed in NC
- Very expensive to implement



Uncertainties and Questions

- Insufficient time for DWR to collect data and build models
- Baseline year for the rules was during a major drought and affected by a large tropical storm
- Reservoir of nutrients stored in the bottom of Falls Lake and how long it would take to deplete
- Whether not the chlorophyll *a* standard could be met everywhere in the lake
- What would happen if the entire watershed was forested

Falls Lake at I-85 in November 2007
Source: Southeast Regional Climate Center

Consensus Principles

- Consensus Principles were established by UNRBA members
  - Resulted in language in the Rules that allowed for re-examination if certain steps were taken
  - Provided the framework for the UNRBA re-examination process
  - Parties agreed to the protection of Falls Lake as a drinking water supply

Rule Language: Re-examination

- **“Recognizing the uncertainty** associated with model-based load reduction targets…a person may at any time during implementation of the Falls nutrient strategy develop and submit for Commission approval **supplemental nutrient response modeling**” requiring
  - Division review and approval of any **monitoring study plan** and **description of the modeling framework**
  - A minimum of **three years** of lake water quality data
  - Supplemental modeling is conducted in accordance with the **quality assurance requirements** of the Division

UNRBA PLAN FOR THE REEXAMINATION

Coordination with agencies and stakeholders

2010

Falls Lake Strategy is passed ✓

Consensus Principles adopted ✓

2011

UNRBA decides to initiate a reexamination of Stage II ✓

2012-2013

UNRBA contracted work to develop a strategy for the Reexamination process

2013-2014

Developed monitoring plan to support Reexamination and obtain DWR approval ✓

2014-2018

Collected monitoring data for 4 years ✓

2018-2021

Revise watershed and lake models; evaluate nutrient management strategies

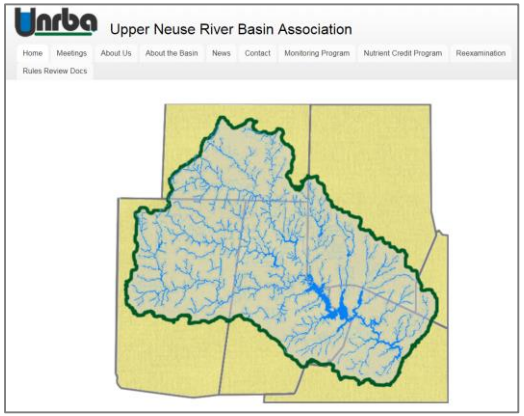
2022-2023

Develop the UNRBA Reexamination package

UNRBA Monitoring Program Website

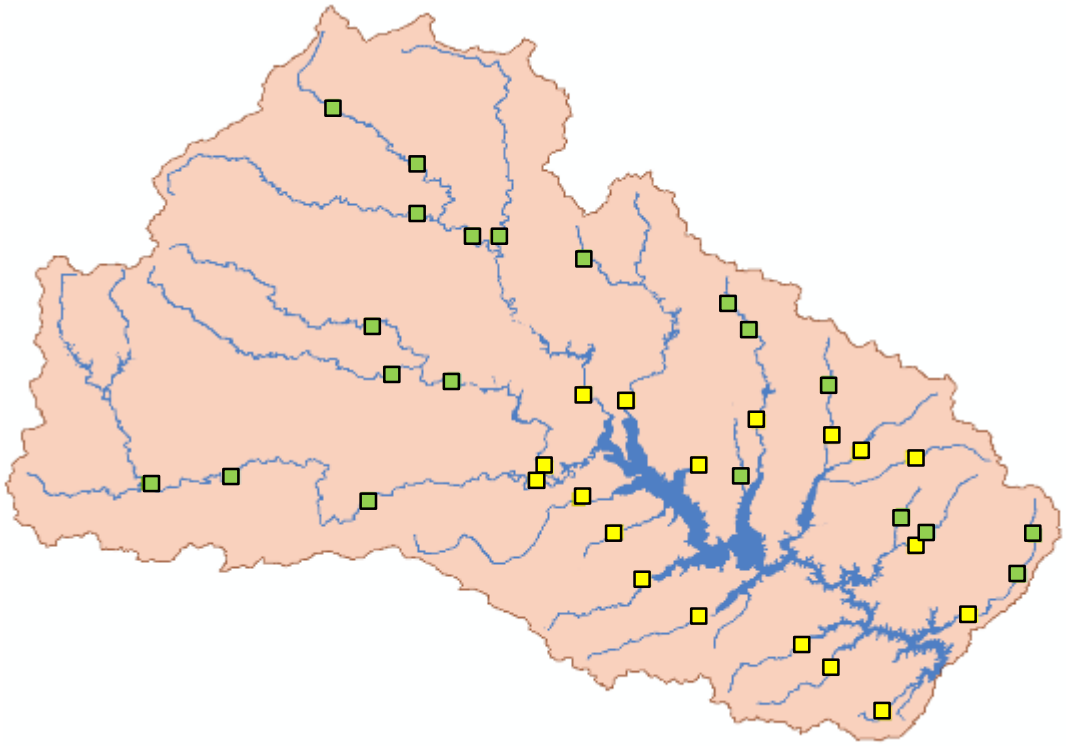
https://www.unrba.org/monitoring-program

- DWR-Approved documents as required by the Falls Lake Rules
  - UNRBA Monitoring Plan
  - UNRBA Monitoring Quality Assurance Project Plan
  - UNRBA Description of the Modeling Framework
- Interim and annual reports that summarize the data collected and provide preliminary analyses
- Link to the UNRBA Monitoring Database and User Documentation
- Study Plans for the Special Studies
- Additional analyses
  - Flow estimation methods
  - Model performance and sensitivity



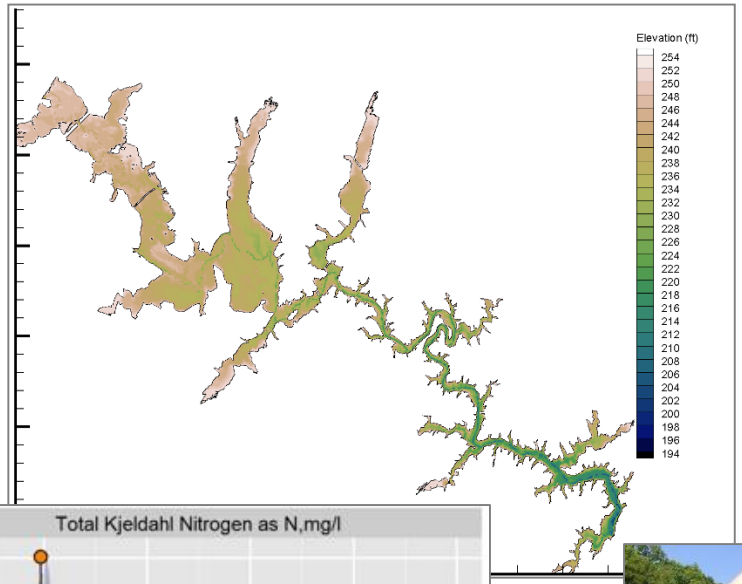
UNRBA Monitoring Program

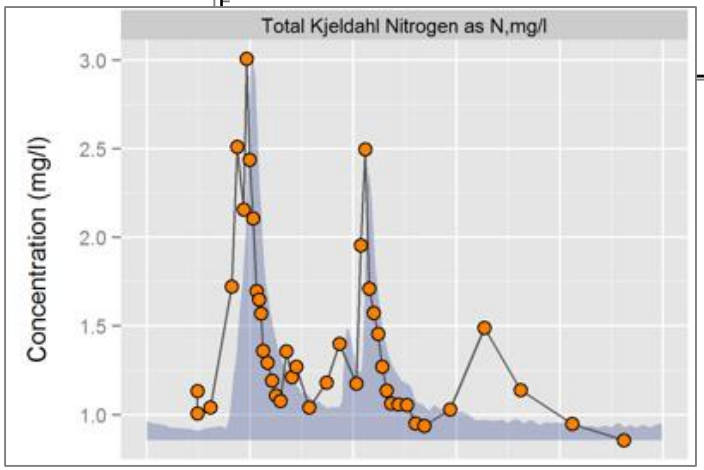
- Developed to support revising the lake and watershed models
- Routine data collection began in August 2014
- 38 watershed stations
- 12 inlake (supplemental data)
- Parameters
  - Field parameters
  - Nutrients
  - Carbon
  - Chlorophyll *a*
- Over 32,500 additional data points as of June 2018



UNRBA Special Studies

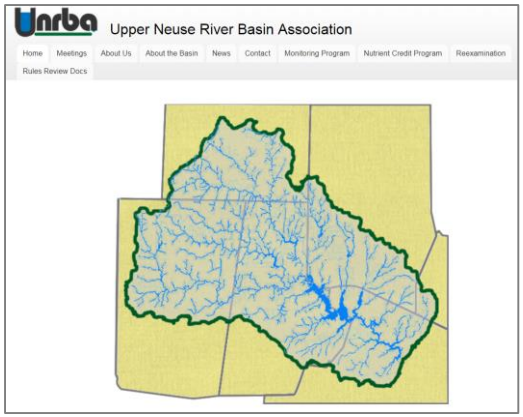
- High flow grab sampling
- Storm event sampling
- Light extinction data
- Lake sediment quality
- Lake bathymetry
- Lake constriction point study
  - Velocity
  - Water Quality





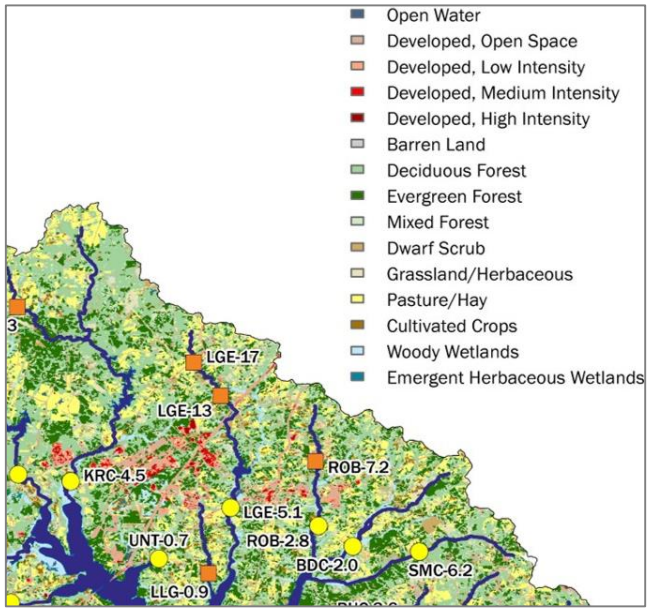
UNRBA Re-examination Program Website

- https://www.unrba.org/reexamination
  - Data Management Plan and Description of the Modeling Process (new)
  - Modeling Quality Assurance Project Plan (Approved by DWR)
  - Stakeholder meeting materials
    - October 2018 (focus on data compilation)
    - October 2017 (focus on watershed modeling)
    - September 2016 (project kickoff/stakeholder concerns)
  - Model selection process
  - Conceptual modeling plan
  - Planning phase of the project (2012 to 2014)
    - Task 1 – Re-examination strategy
    - Task 2 – Review existing data and reports (through 2011)
    - Task 3 – Review methods for estimating nutrient loads
    - Task 4 – Recommend future monitoring and modeling studies ->
      - UNRBA Monitoring Program
      - UNRBA Modeling and Regulatory Support Project

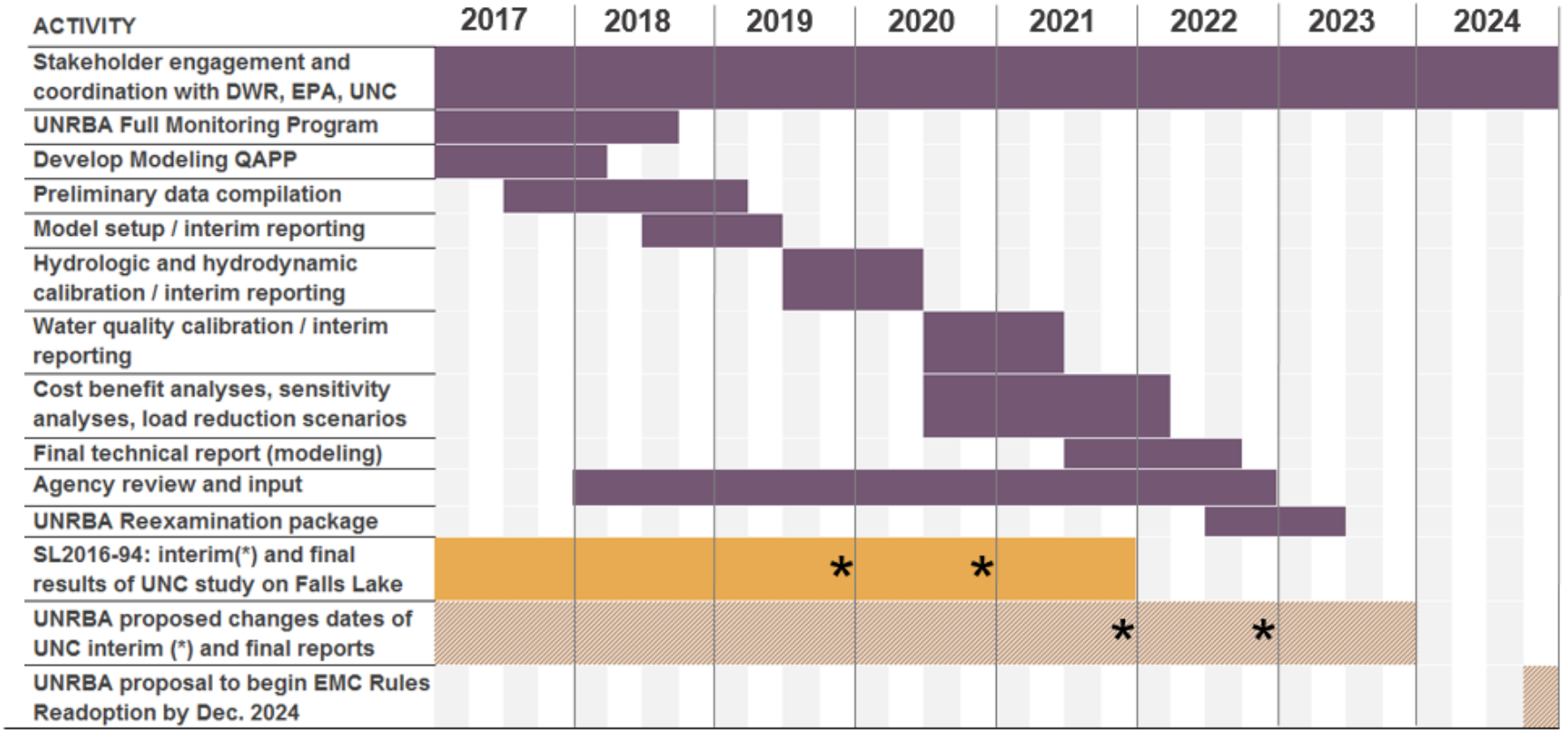


Data Management Plan and Description of the Modeling Process

- Describes the procedures for managing model inputs and outputs
  - Time series
  - Spatial data
- Describes development of the input files
  - WARMF watershed and lake model
  - EFDC lake hydrodynamic/ water quality model
- Describes modeling process



Status of the Project Schedule



Current Focus for the MRS Project

- Set up the models
  - Subwatershed boundaries
  - Lake model grid
- Collect data
- Fill gaps
- Discuss assumptions
- Get stakeholder feedback
- Conduct preliminary model runs

Decisions we make now affect what we can get out of the models later.

Model Overview

Two Model Periods

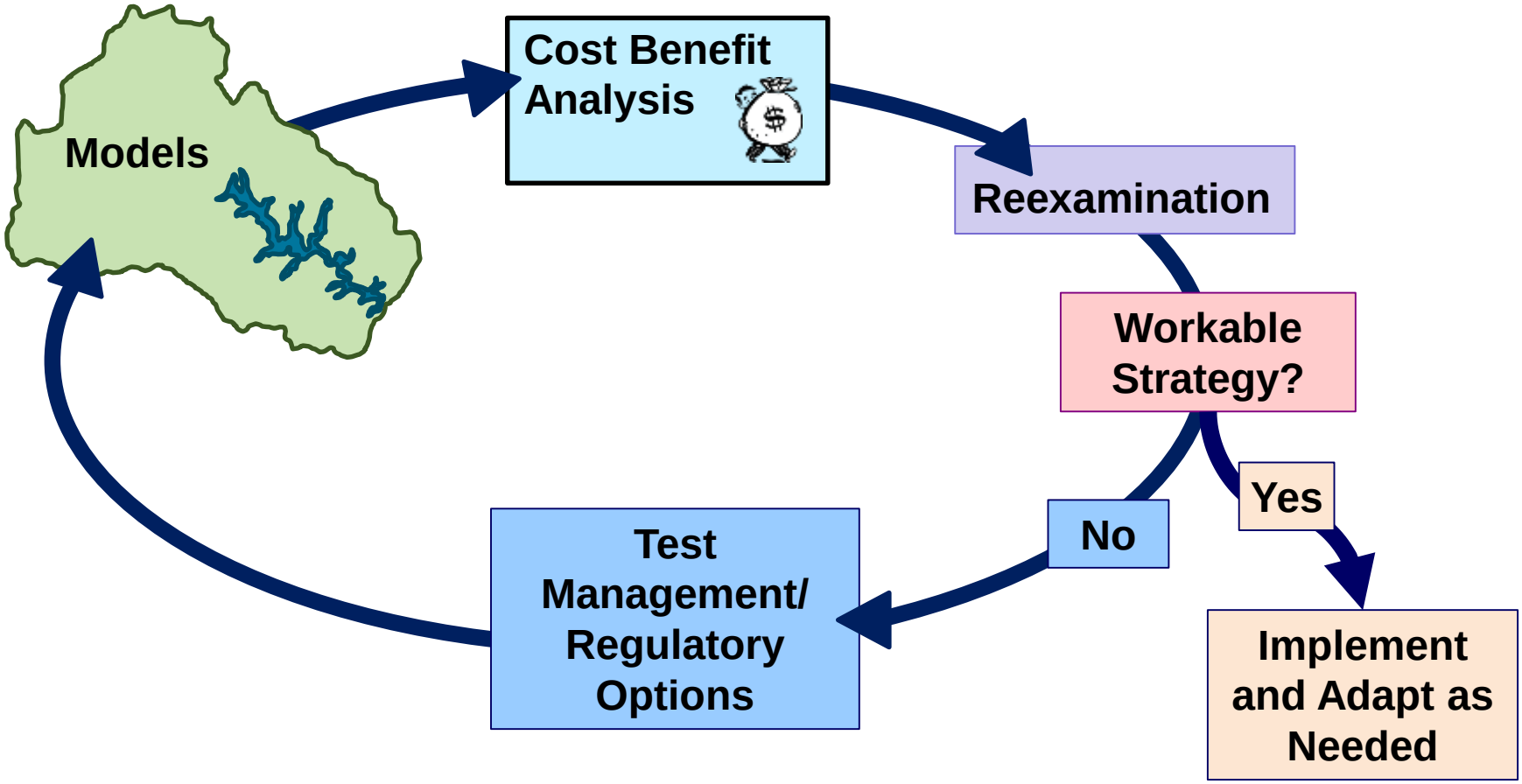
2005 to 2007

- Corresponds to the original modeling period (DWR models)
- Includes the baseline year (2006) that provides the “starting point” for the Stage II load reductions

2014 to 2018

- Corresponds to the UNRBA Monitoring Program
- Incorporates new data and information collected since the original model was developed

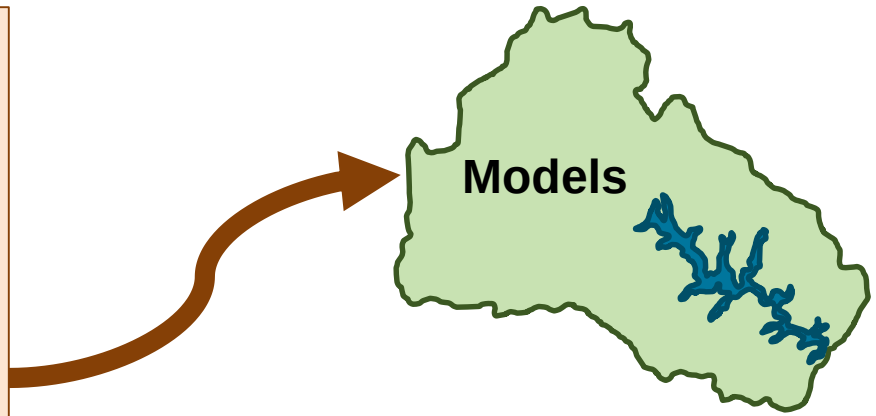
Framework for the Reexamination



Watershed Model

- Watershed Analysis Risk Management Framework (WARMF)
- Uses information about the watershed and weather data to simulate pollutant loading
- Accounts for interactions among land use, soils, and land management
- Develop and calibrate to flow and water quality data collected in the watershed
- Use the calibrated model to predict loading to Falls Lake
- Run scenarios to see how management activities affect loading

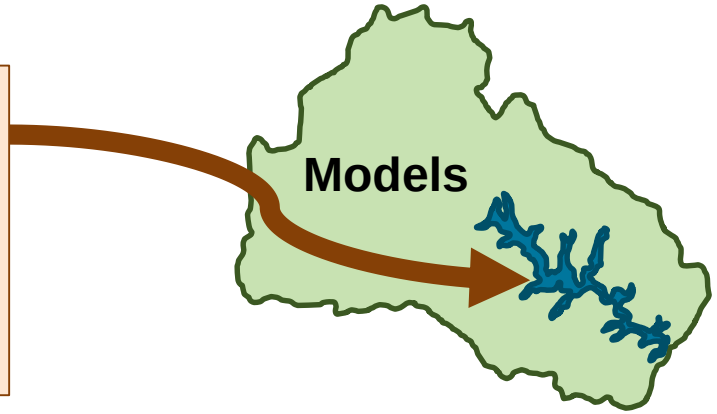
Inputs:
- **Atmosphere/weather**
- **Soils**
- **Land use**
- **Topography**
- **Wastewater**
- **Streams**
- **Lakes**
- **Management practices**



Lake Modeling

- Environmental Fluid Dynamics Code (EFDC), WARMF, and a statistical model (to be discussed at subsequent meeting)
- Simulated flows and pollutant loads from the watershed model become inputs to the lake models
- EFDC and WARMF use similar datasets in terms of weather data and atmospheric deposition to the lake surface
- Develop and calibrate EFDC and WARMF to water levels and water quality observed in the lake
- Use the calibrated model to run scenarios and simulate how management activities affect concentrations in the lake

Inputs:
- **Flows and loading to the lake**
- **Atmosphere/weather**
- **Bathymetry**
- **Management practices**



Cost Benefit Analyses

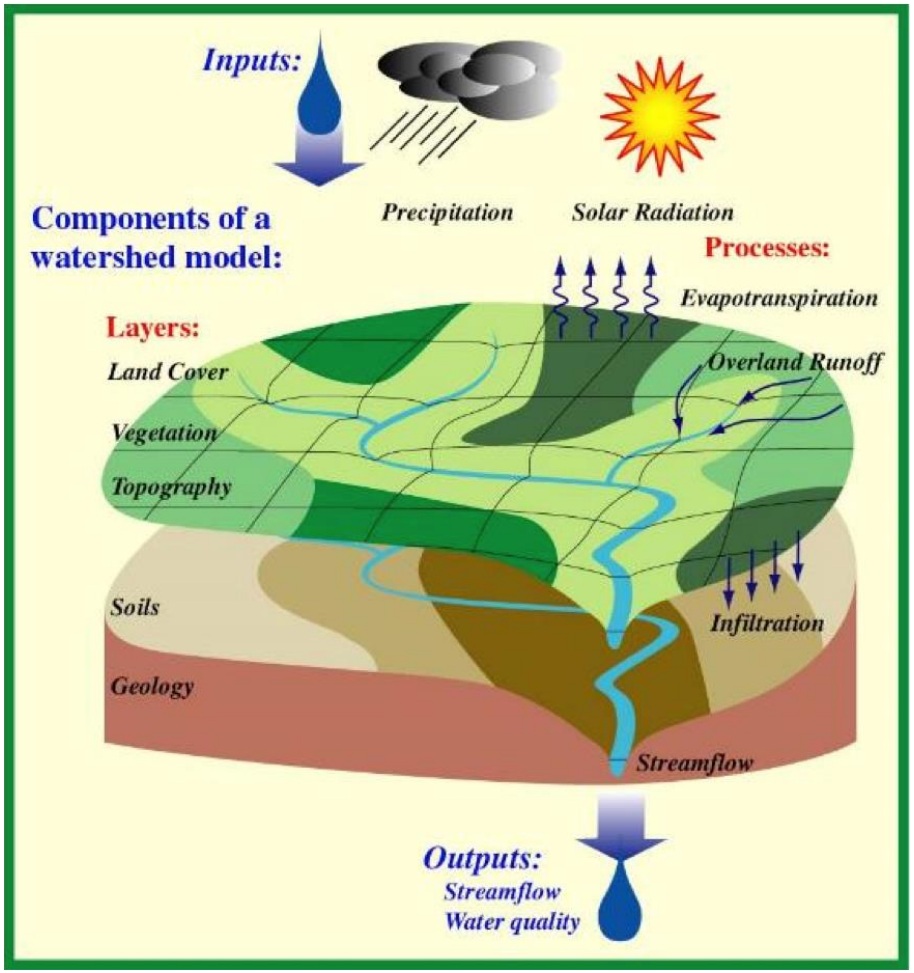
- Use the WARMF and EFDC models to evaluate how management actions affect
  - Nutrient loading to the lake
  - In lake water quality
- Use the statistical model to link water quality to designated uses and evaluate
  - Impacts to recreational use and water treatment costs
  - Risks of hazardous algal blooms, taste and odor problems, and violations of drinking water standards
- Compile data on management costs and constraints to evaluate feasibility
- Weigh the costs, benefits, and likelihood of success associated with potential management options
- Provide transparency for decision making

Cost Benefit Analysis

Meteorological Data

Importance of Accurate Meteorology Data

- Meteorology data is the principal driver of the WARMF model
  - Rainfall -> Runoff or Infiltration -> Pollutant Loading
- Complete time series are required for several parameters
- Data is spatially variable
- Time series for sites distributed across the watershed will be essential

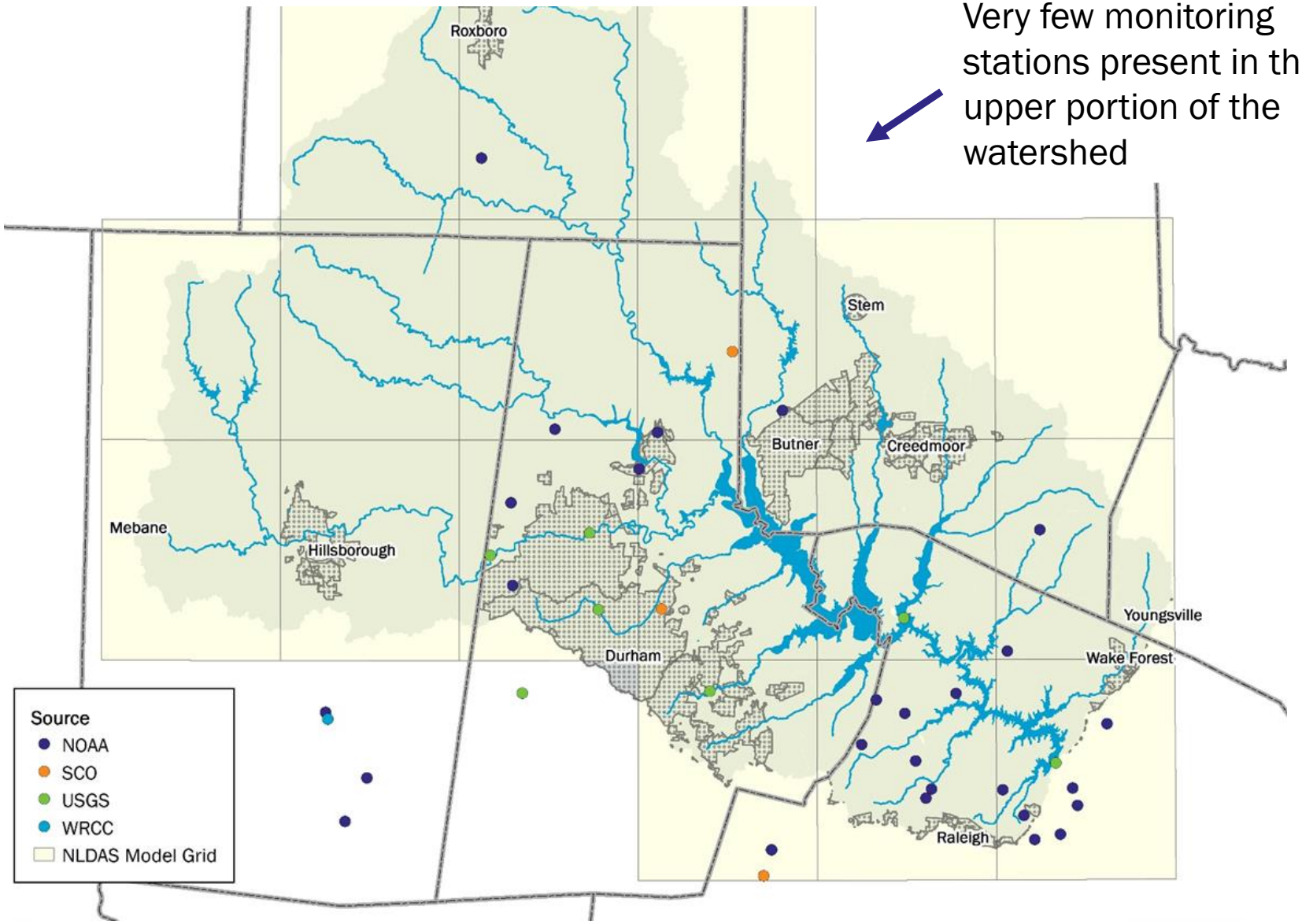


https://scwrs.files.wordpress.com/2016/04/model-components.png

Sources of Meteorology Data for the Modeling

- NC CRONOS/ECONet
  - Database developed by the State Climate Office of North Carolina
- USGS
- Western Regional Climate Center (WRCC)
- National Climatic Data Center (NCDC)
  - Clearinghouse for weather measurements collected by various organizations across the US including NOAA
- North American Land Data Assimilation System (NLDAS)
  - Spatially and temporally consistent, land-surface model (LSM) datasets from the best available observations and model output
  - Higher spatial resolution than other datasets
- NEXRAD Radar Data
  - NOAA data that can be processed to generate precipitation estimates
  - Highest spatial resolution for precipitation data

Locations of Weather Data Sources

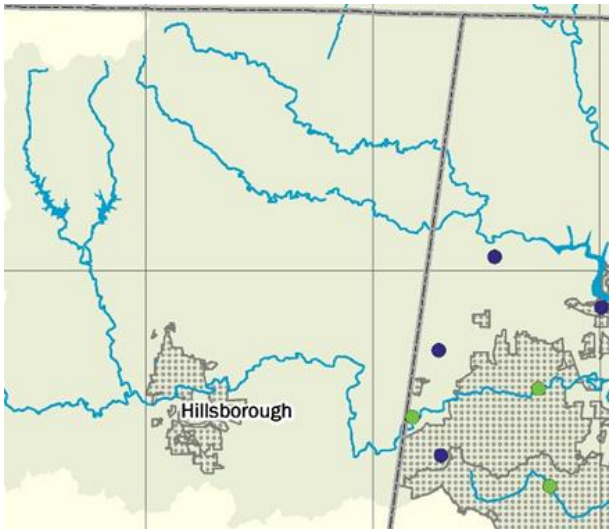


NEXRAD Precipitation Data

- NOAA operates the Next Generation Weather Radar (NEXRAD) system
- Comprised of 160 regional radar sites in the US
- **NC DOT and the State Climate Office have offered to generate time series files for this effort once the watershed modeling units are finalized with the Modeling and Regulatory Support Workgroup**

National Land Data Assimilation System (NLDAS) Data

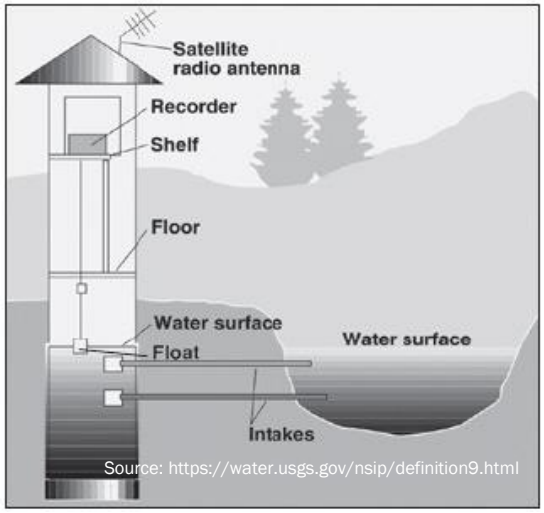
- NLDAS uses remote sensing data to provide meteorology data
- Values are provided for grids cells that are approximately 7 miles by 8.6 miles in area
- Provides data for areas of the watershed that do not have weather monitoring stations
- Provides the parameters needed for the WARMF watershed model
- Modeling team is evaluating these data against measured data for applicability to this modeling effort
  - Accuracy
  - Bias
  - Corrections



USGS Data: Flow and Water Levels

Importance of USGS Data

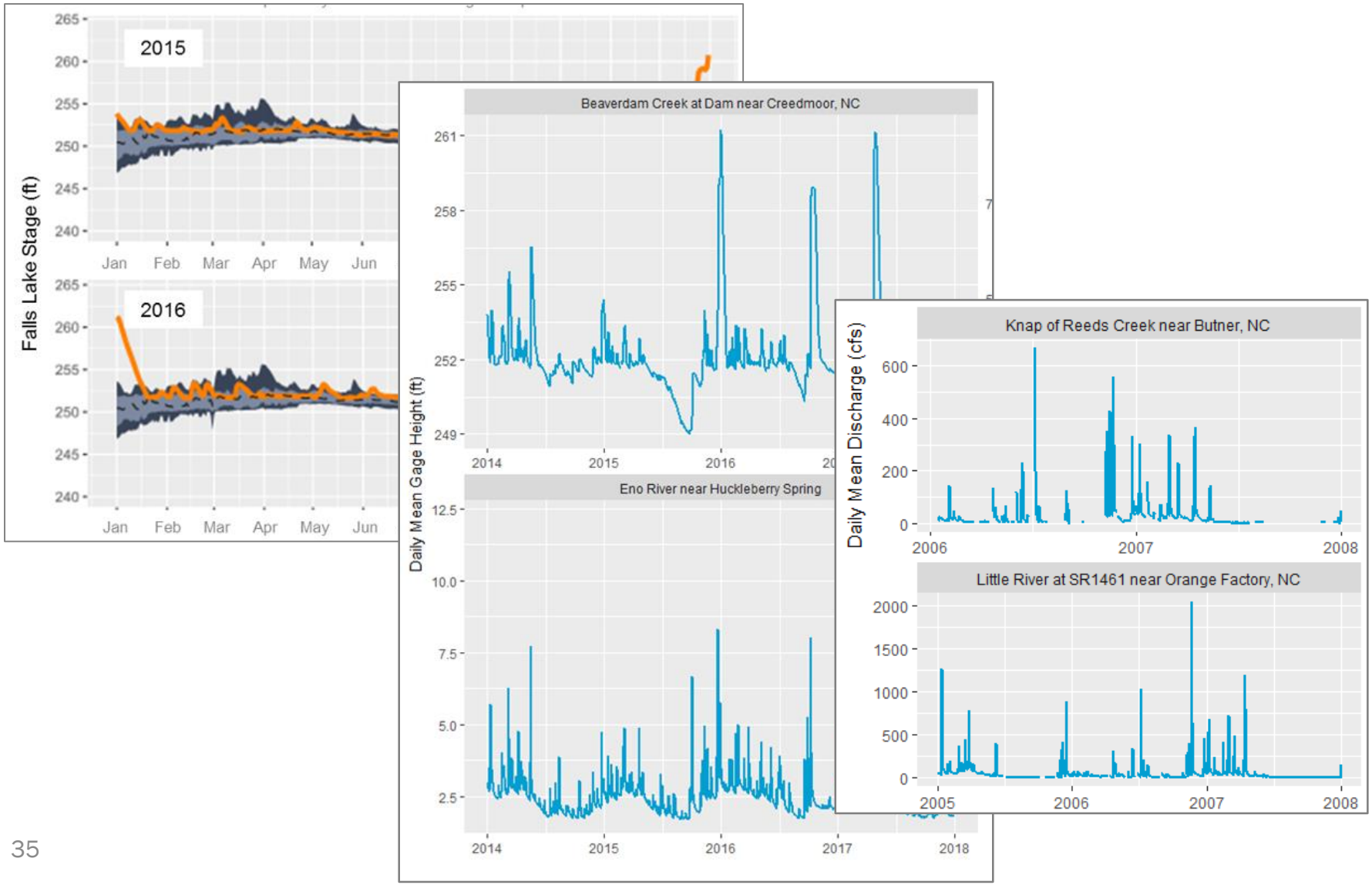
- Provides stream flow, stream elevation, and lake elevation data at different stations in the watershed
- Data will primarily be used to calibrate the watershed model (stream flows in the watershed) and the lake hydrodynamic model (water surface elevation)
- Accurate hydrologic and hydrodynamic calibrations are essential for
  - Estimating flows and nutrient loads to Falls Lake
  - Apportioning loads among sources
  - Simulating lake response in terms of nutrients and algal growth
- Model parameters are adjusted and model output is compared to observations until a good fit is achieved



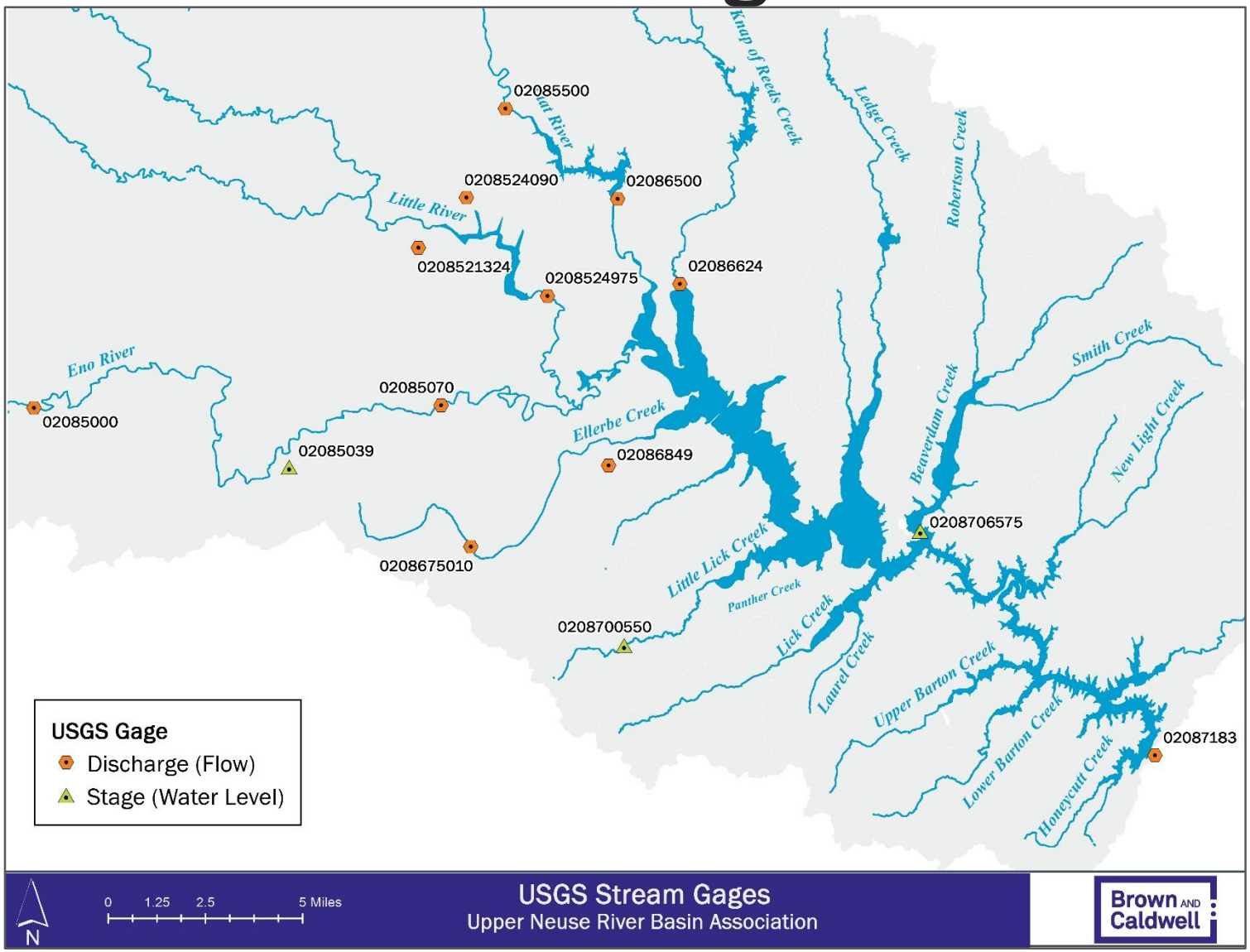
USGS Discharge and Stage Gages

Active USGS Stream Gages							
Gage Number	Waterbody	Drainage Area (mi^2)	Gage Name	Type	Upstream Reservoir	Upstream Major WWTP	Earliest Available Data
02086849	Ellerbe Creek	21.9	Ellerbe Creek near Gorman, NC	Discharge and Stage	No	Yes	1/8/2006
0208675010	Ellerbe Creek	6.01	Ellerbe Creek near Durham, NC	Discharge	No	No	7/24/2008
02085000	Eno River	66	Eno River at Hillsborough, NC	Discharge	Yes	No	10/1/1927
02085070	Eno River	141	Eno River near Durham, NC	Discharge	Yes	Yes	10/1/2004
02086500	Flat River	168	Flat River at Dam near Bahama, NC	Discharge	Yes	No	10/5/2004
02085500	Flat River	149	Flat River at Bahama, NC	Discharge	No	No	10/1/2004
02086624	Knap of Reeds Creek	43	Knap of Reeds Creek near Butner, NC	Discharge	Yes	Yes	1/14/2006
0208521324	Little River	78.2	Little River at SR1461 near Orange Factory, NC	Discharge	No	No	10/1/2014
0208524975	Little River	98.9	Little River at Fairntosh, NC	Discharge	Yes	No	10/24/1995
0208524090	Mountain Creek	7.97	Mountain Creek near Bahama, NC	Discharge	No	No	10/7/1994
02087183	Neuse River	771	Neuse River near Falls, NC	Discharge	Yes	Yes	10/1/2004
0208706575	Beaverdam Creek	52.5	Beaverdam Creek at Dam near Creedmoor, NC	Stage Only	Yes	No	5/3/2006
02085039	Eno River	120.79	Eno River near Huckleberry Spring	Stage Only	Yes	Yes	7/22/2008
0208700550	Little Lick Creek	4.05	Little Lick Creek at NC Hwy 98 at Oak Grove, NC	Stage Only	No	No	7/30/2008

USGS Discharge and Stage Gages

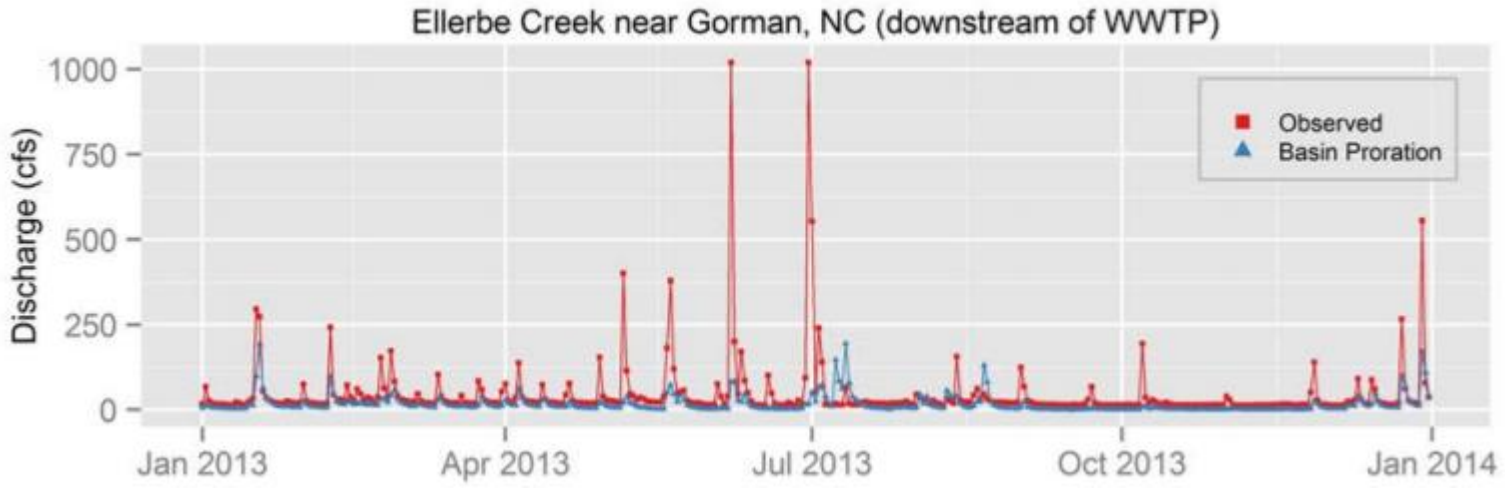


Location of USGS Gages



Flow Estimation at Ungaged Locations

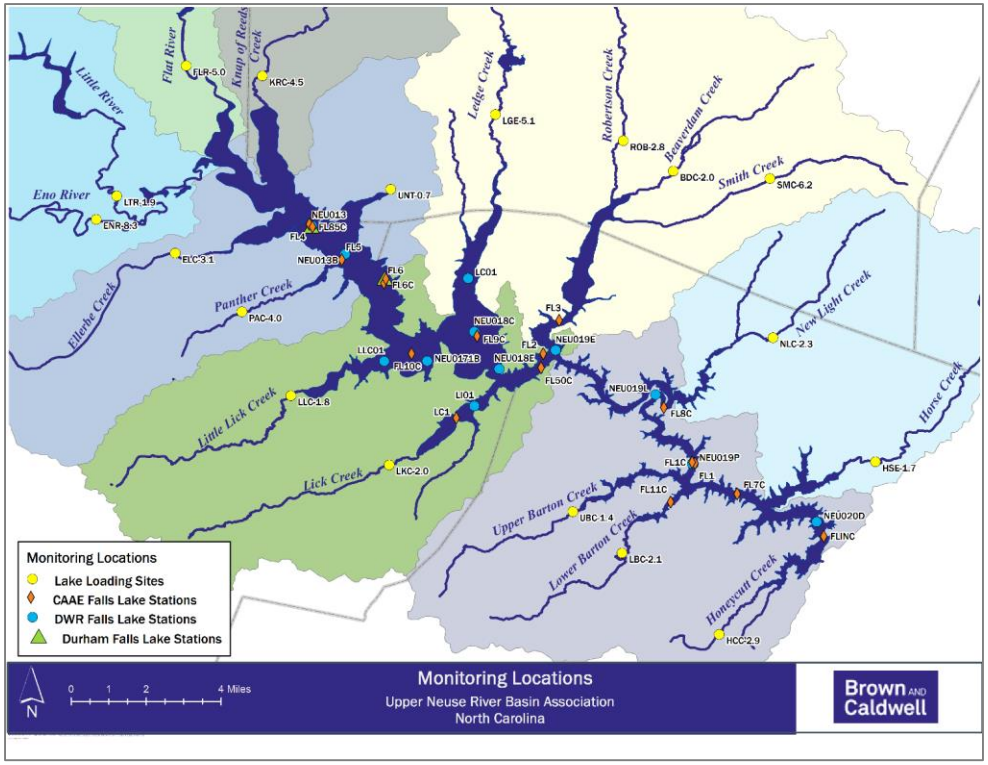
- Provides estimates of stream flow at ungaged locations
- Approach is documented in the Comparison of Flow Estimation Methods TM on the UNRBA Monitoring Page
- Will not be used for formal calibration but provides estimates of flow for loading analyses and model “gut checking”



Water Quality Observations

Sources of Water Quality Data for the Modeling

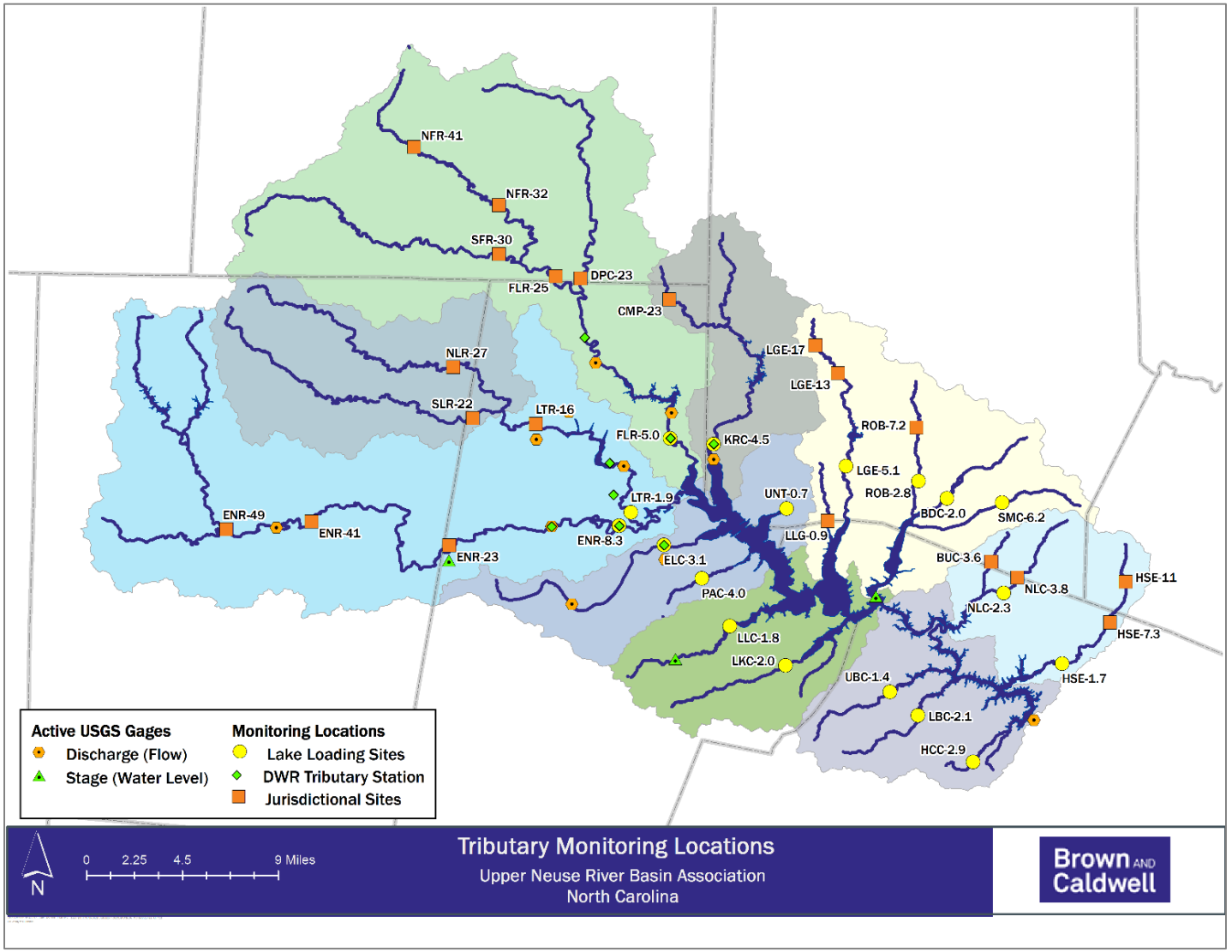
- UNRBA Monitoring Program
  - Routine monitoring and special studies
- NC DEQ
  - Ambient watershed and lake monitoring
- Local governments
  - Ambient watershed and lake monitoring
- Universities/researchers
  - Ambient lake monitoring
  - Special studies



Importance of Water Quality Data

- Provides measurements of parameters at different stations in the watershed and the lake
- Data will primarily be used to calibrate the models
  - Water quality in the streams and rivers
  - Water quality in the lake
- Accurate water quality calibrations are essential for
  - Estimating nutrient loads to Falls Lake
  - Apportioning loads among sources
  - Simulating lake response (nutrients and chlorophyll a)
- Model parameters are adjusted and model output is compared to observations until a good fit is achieved

Location of Water Quality Monitoring Stations



Major and Minor Wastewater Facilities

Importance of Accounting for Major and Minor Wastewater Facilities

- Wastewater facilities can alter in-stream water quality and stream flows
- Accurate accounting of discharges is essential for accurate model development and calibration to observations
  - In stream flows (USGS)
  - Water quality (UNRBA, DEQ, UNRBA members, etc.)
- Revised nutrient management strategy will need to address
  - Reductions achieved to date
  - Cost and benefits of additional technologies
  - Roll of wastewater treatment plants in the revised nutrient management strategy

Differences Between Major and Minor Wastewater Facilities

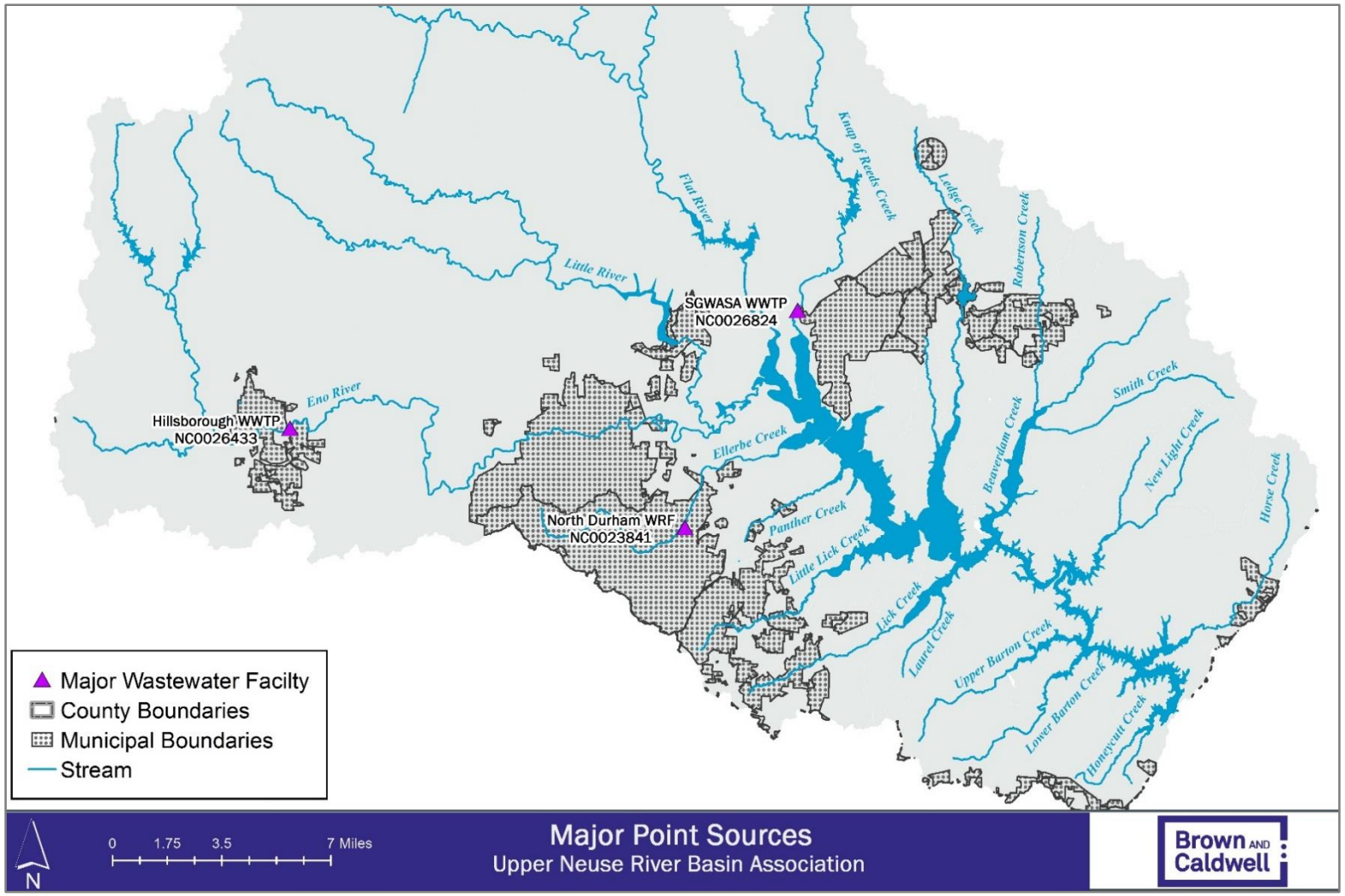
- Wastewater facilities are designated as minor/major based on the permitted daily discharge
- Major facilities generally have advanced (secondary or tertiary) treatment technologies to reduce the concentrations of pollutants in their effluent
- Minor facilities discharge small quantities of water, compared to major facilities
- Minor facilities typically employ less sophisticated water treatment procedures than major facilities, resulting in higher pollutant concentrations in their effluent
- While discharge flowrate from minor facilities may be low, pollutant load may be high depending on the characteristics of the receiving stream

Major Wastewater Facilities

- Three major wastewater treatment facilities in the watershed (discharging more than 1 million gallons per day of treated effluent)

Major Wastewater Treatment Facilities in the Watershed		
NPDES Permit Number	Facility Name	Receiving Water
NC0023841	North Durham WRF	Ellerbe Creek
NC0026433	Hillsborough WWTP	Eno River
NC0026824	SGWASA	Knap of Reeds Creek

Location of Major Wastewater Facilities



Summary of Effluent Data Provided by the Three Major Facilities in the Watershed							
Owner:	SGWASA			NDWRF	Hillsborough		
Permit Number:	NC0026824			NC0023841	NC0026433		
	Jan-Mar 2006, Sep-Dec 2007	Apr 2006-Aug 2007	2014-2017	2014-2018	2006-2010	Jan 2011-Aug 2013	Sept 2013-Dec 2017
Flow (MGD)	D	D	D	D	D	D	D
Temperature (°C)	5/W	D	5/W		5/W	5/W	5/W
pH	5/W	D	5/W		5/W	5/W	5/W
Dissolved Oxygen (mg/l)	5/W	D	5/W		5/W	5/W	5/W
Conductivity (UMHOS/cm)	3/W	3/W	5/W				
BOD_5 (20°C) (mg/l)	5/W	5/W	5/W		5/W	5/W	2/W
Total Suspended Residue (mg/l)	5/W	D	5/W		5/W	5/W	2/W
Ammonia Nitrogen (mg/l)	5/W	5/W	5/W		5/W	5/W	2/W
Nitrate plus nitrite (mg/l)	W	W	W		W	W	W
Total Kjeldahl Nitrogen (mg/l)	W	W	W	W	W	W	W
Total Nitrogen (mg/l)	W	W	W	W	W	W	W
Total Phosphorus (mg/l)	W	W	W	W	2/W	W	W

D: daily, /W: per week, W: weekly

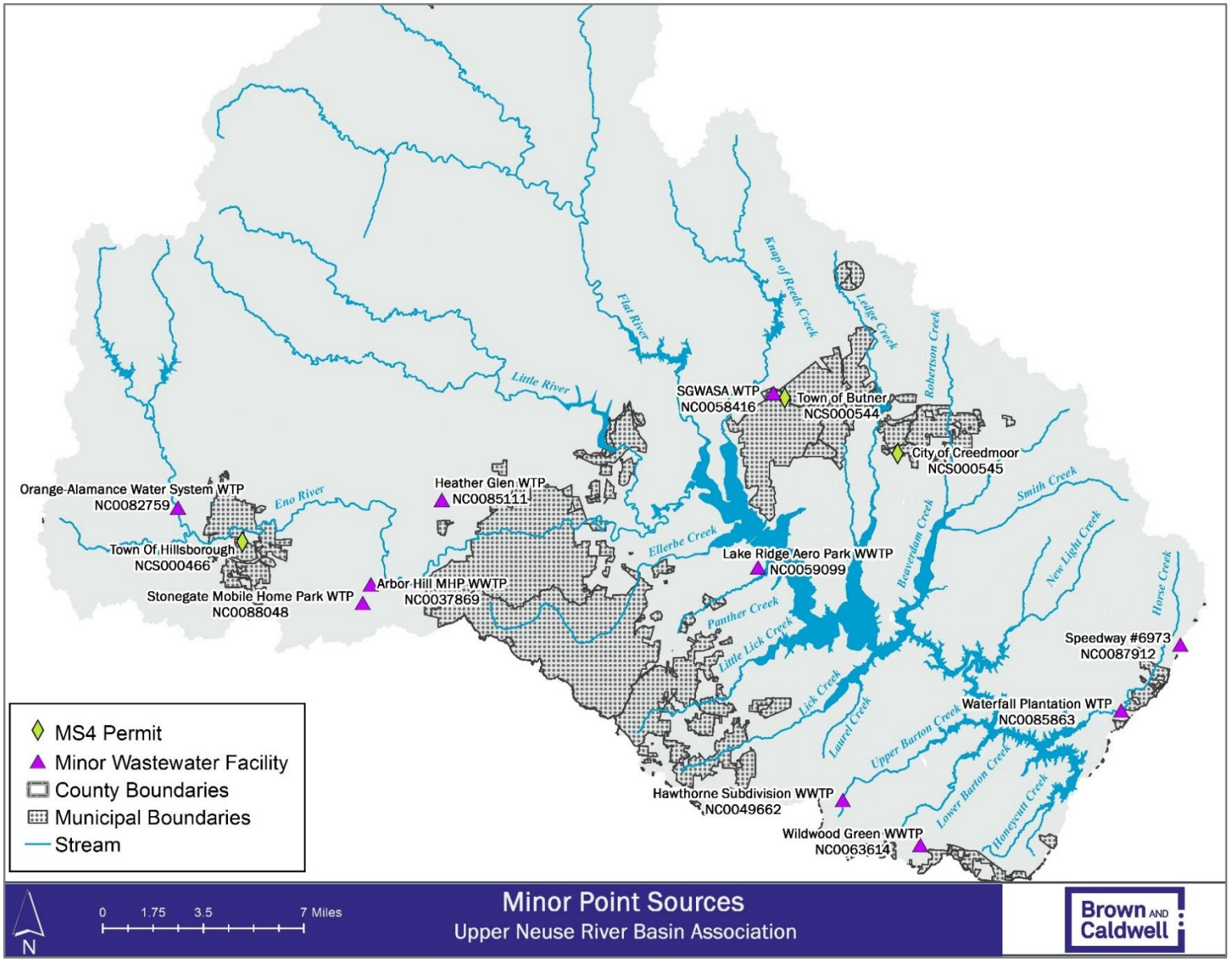
Minor Facilities

- Several minor water or wastewater treatment facilities are located in the watershed
- DEQ provided information on discharge flow rate and concentrations

Table 3-3. Minor Wastewater Treatment Facilities

Permit Number	Facility Name	Type	Permitted Flow (MGD)	Receiving Stream
NC0037869	Arbor Hills MHP WWTP	Discharging 100% Domestic < 1MGD	0.0060	Stony Creek
NC0049662	Hawthorne Subdivision WWTP	Discharging 100% Domestic < 1MGD	0.2500	Upper Barton Creek
NC0082759	Orange-Alamance Water System WTP	Water Plants and Water Conditioning Discharge	0.3000	Eno River
NC0059099	Lake Ridge Aero Park WWTP	Discharging 100% Domestic < 1MGD	0.016	Panther Creek
NC0063614	Wildwood Green WWTP	Discharging 100% Domestic < 1MGD	0.1	Lower Barton Creek
NC0085111	Heather Glen WTP	Water Plants and Water Conditioning Discharge	not limited	Sevenmile Creek
NC0085863	Waterfall Plantation WTP	Water Plants and Water Conditioning Discharge	0.0050	Horse Creek

Location of Minor Facilities



Summary of data from minors

Table 3-4. Summary of Effluent Data Provided by Minor Facilities in the Watershed														
Facility:	Arbor Hills MHP		Hawthorne Subdivision		Lake Ridge Aero Park		Wildwood Green		Orange-Alamance Water System		Heather Glen		Waterfall Plantation	
Permit number:	NC0037869		NC0049662		NC0059099		NC0063614		NC0082759		NC0085111		NC0085863	
	Apr '05– Dec '07	Jan '14 – Jun '18	Apr '05 – Dec '07	Jan '14 – Jun '18	Jan '05 – Dec '07	Jan '14 – Jun '18	Jan '05 – Dec '07	Jan '14 – Jun '18	May '05 – Dec '07	Jan '14 – Jun '18	Apr '05 – Dec '07	Jan '14 – Jun '18	Apr '05 – Dec '07	Jan '14 – Jun '18
Flow (MGD)	W	W	D	D	D	D	D	D	D	D	10 obs.	No data available[2]	2-3/W	D
Total Flow (MGD)						M		M						M
Temperature (°C)	5/W	5/W	5/W	5/W	5/W	5/W - W	5/W	5/W		3/W				
Dissolved Oxygen (mg/l)	W	W	W	3/W	5/W	W	5/W - W	W						
Total Nitrogen (mg/l)	W	alt-W/M	M	D/Alt-W	M	D - Alt-W/M	M	Alt-W	M- 3/W	2/W	7 obs.		6 obs.	42 obs.
Ammonia Nitrogen (mg/l)	W	W	W	W	W	W	W	W		2/W				
Total Kjeldahl Nitrogen (mg/l)	W	Alt-W/M	Alt-W/M	Alt-W	M		Alt-W/M	Alt-W	M- 3/W	2/W	7 obs.		6 obs.	
Nitrate plus nitrite (mg/l)	W	Alt-W/M	Alt-W/M	Alt-W	M		M	Alt-W	M- 3/W	2/W	7obs.		6 obs.	
Total Phosphorus (mg/l)	Alt-W	Alt-W/M	W	Alt-W	W	M	W	W	M- 3/W	2-3/W	7 obs.		6 obs.	68 obs.
Total Nitrogen (calculated) (lb/yr)		M		M				M						
Total Nitrogen (calculated) (lb/month)		Alt-W/M		Alt-W/M				Alt-W/M						12 obs.

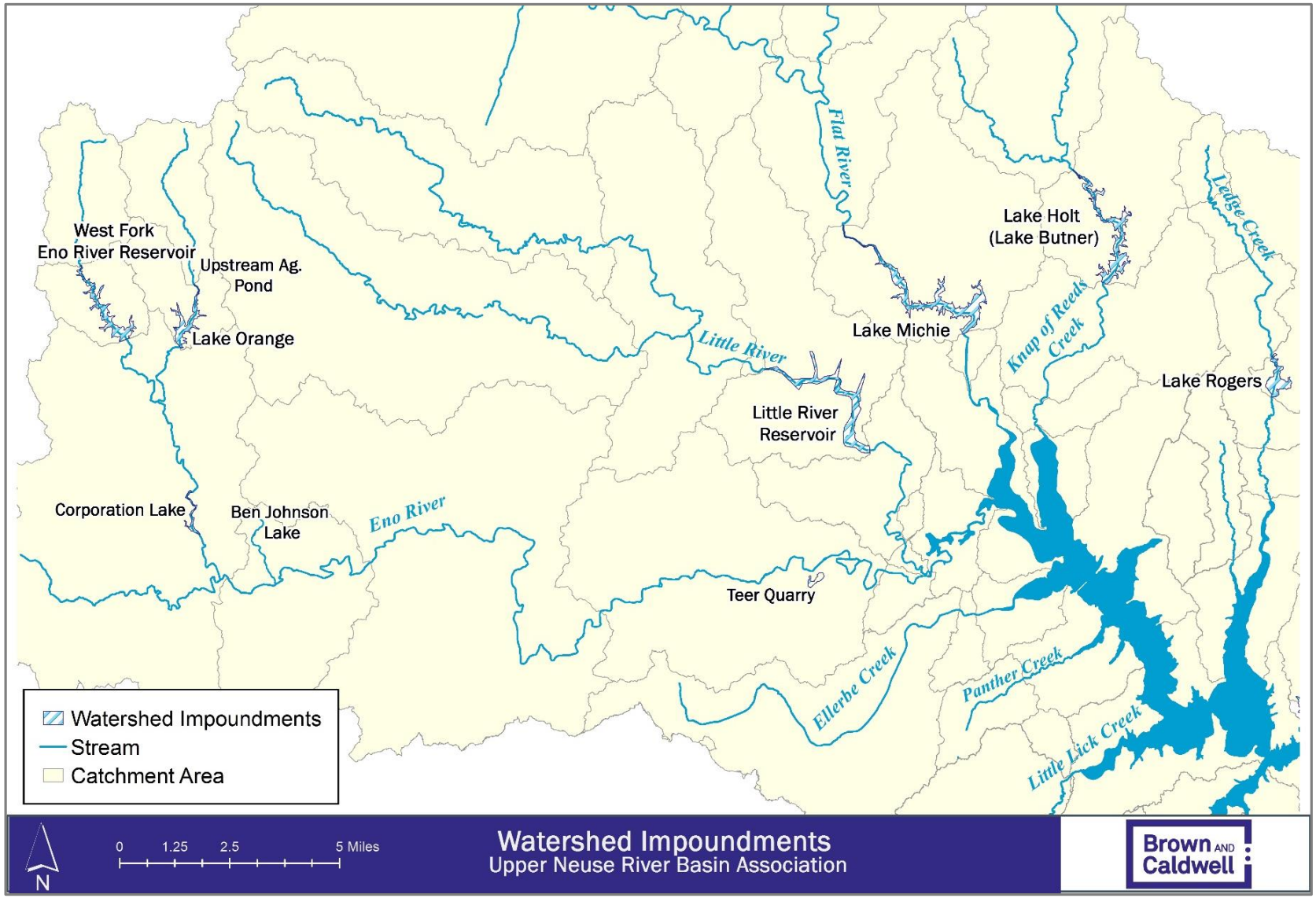
D: daily, /W: per week, W: weekly

Watershed Impoundments

Importance of Accounting for Impoundments in the Watershed

- Impoundments in the watershed can have significant effects on the storage and release of water and resulting impacts on water quality
- WARMF requires time series information to simulate impoundments that are managed (e.g., water withdrawals, reservoir releases, etc.)
- Accurate hydrology simulation can only be achieved if time series for each actively managed water body are available
- There are a significant number of small, unmanaged impoundments in the watershed
  - Unmanaged impoundments reduce overland flow, and increase evaporative water loss
  - These processes will be accounted for during hydrology calibration

Significant Impoundments



Sources of Water Withdrawal Data

Impoundment	Primary Sources of Information	Resolution of Primary Data Source	Secondary Sources of Information
Lake Butner	SGWASA (2005 to 2007 and 2014 to 2018)	Daily withdrawal rates for both modeling periods	DEQ WARMF files and OASIS modeling files for 2005 to 2007
Lake Michie	City of Durham (2014 to 2018) City of Durham revised WARMF model (2005 to 2007)	Daily withdrawal rates for both modeling periods	DEQ WARMF files and OASIS modeling files for 2005 to 2007
Little River Reservoir	City of Durham (2014 to 2018) City of Durham revised WARMF model (2005 to 2007)	Daily withdrawal rates for both modeling periods	DEQ WARMF files and OASIS modeling files for 2005 to 2007
Teer Quarry	Not available (emergency supply)	Not applicable	Not applicable
Lake Orange	Not applicable	Not applicable	Not applicable
Compton's Pond	Not applicable	Not applicable	Not applicable
West Fork Eno River Res.	Not applicable	Not applicable	Not applicable
Corporation Lake	DEQ (2005 to 2017)	Daily withdrawals	OASIS (2005 to 2007)
Lake Ben Johnson	Town of Hillsborough (2005 to 2007 and 2014 to 2018)	Daily withdrawal rates for both modeling periods	OASIS modeling files for 2005 to 2007
Lake Rogers	Population based estimates (2005 to 2007) No water supply withdrawals from 2014 to 2018	Monthly estimates based on historic withdrawals (1997) and census data.	Not applicable

Sources of Release Data

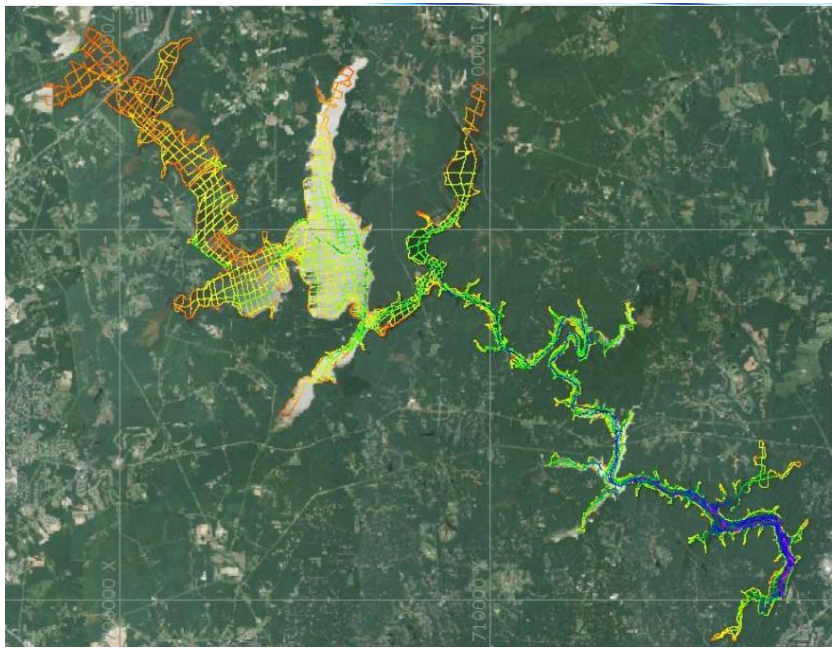
Impoundment	Primary Sources of Information	Secondary Sources of Information
Lake Butner	WARMF Stage-Release curves	OASIS model (2005 to 2007 time series of releases)* OASIS stage-storage data
Lake Michie	Flows observed at USGS Gage 02086500 just downstream (both periods)	City of Durham revised WARMF model (2005 to 2007) WARMF Stage-Release curves
Little River Reservoir	Flows observed at USGS Gage 0208524975 just downstream (both periods)	City of Durham revised WARMF model (2005 to 2007) WARMF Stage-Release curves
Lake Orange	OASIS time series of releases (2005 to 2007) Orange County time series of releases (2014 to 2017)	WARMF Stage-Release curves
Compton's Pond	Simulate as a river reach consistent based on analysis of OASIS model output	Not applicable
West Fork Eno River	Town of Hillsborough (both periods)	WARMF Stage-Release curves
Lake Ben Johnson	Simulate as a river reach consistent based on analysis of OASIS model output	OASIS model (2005 to 2007) OASIS stage-storage data (2014 to 2018)*
Lake Rogers	Simulate as a river reach consistent based on analysis of OASIS model output	OASIS model (2005 to 2007) OASIS stage-storage data (2014 to 2018)*
Corporation Lake	Simulate as a river reach consistent based on analysis of OASIS model output	OASIS model (2005 to 2007) OASIS stage-storage data (2014 to 2018)*
Teer Quarry	Does not release water downstream	Not applicable: provides offline emergency storage

*DWR may update the OASIS Model which would provide release data for 2014-2018.

Lake Model Grid Development

Purpose of Lake Grid Development

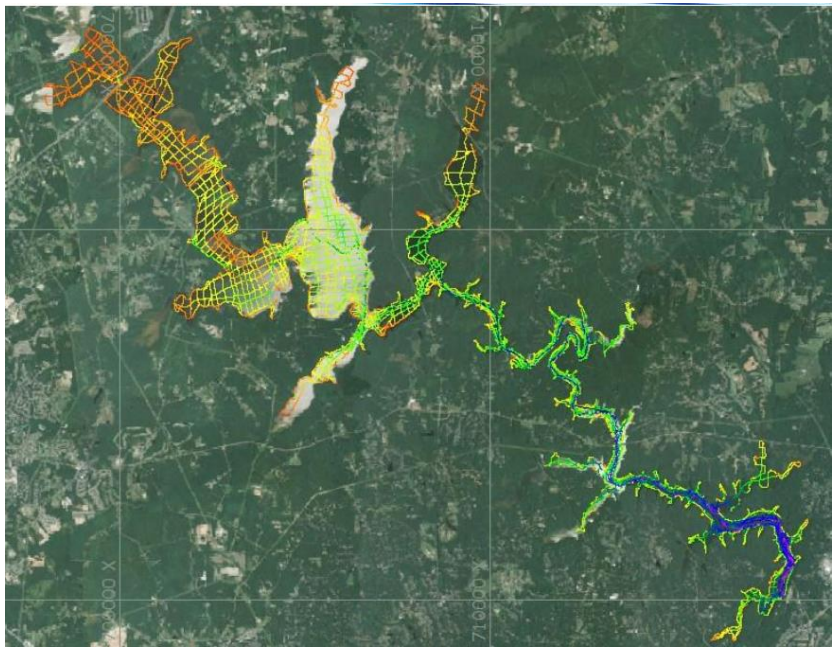
- The lake grid divides the lake into small modeling units
- The grid is divided into layers to simulate stratification, settling, etc.
- Hydrodynamic and water quality calculations are performed on each grid cell
- More grid cells lead to a more refined simulation
- Selected resolution balances
  - Available information
  - Improvements in calculations
  - Model run times



UNRBA transects for the bathymetry study

Status of Lake Grid Development

- Lake modelers developed a model grid for the EFDC model
- Uses data collected by the UNRBA (Lake Bathymetry Study)
- Established 804 grid cells
  - 454 cells in lower lake
    - Smaller cells are required to capturing meandering section of the lake
  - 350 cells in upper lake
    - Lake bathymetry varies gradually, so larger cells are sufficient to capture changes in water quality

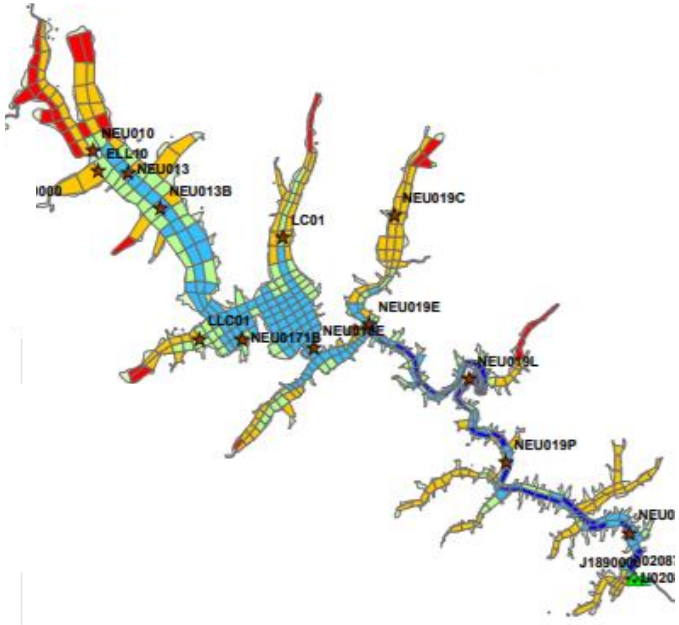


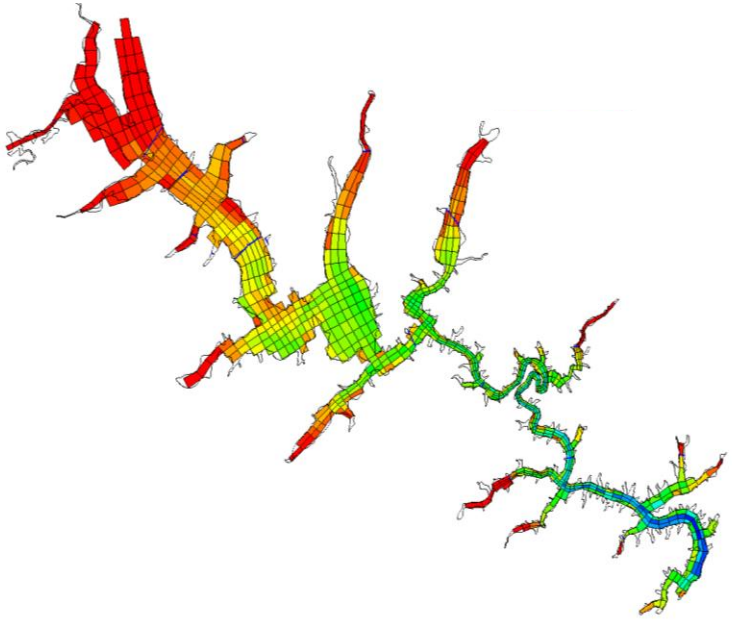
UNRBA transects for the bathymetry study

Comparison of DWR and UNRBA EFDC Model Grids

The DWR model grid had 519 grid cells. It was developed using 17 transects measured across Falls Lake.

The UNRBA model grid has 804 grid cells. It was developed using sonar data measured along many transects across Falls Lake.

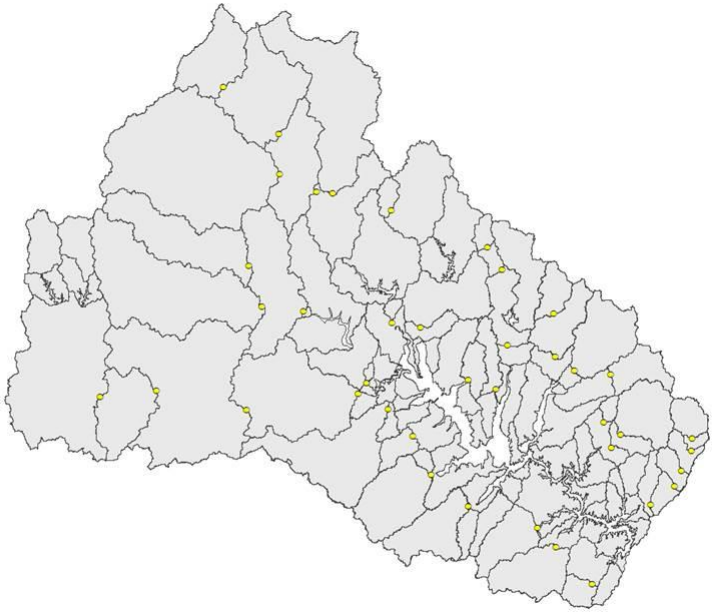




Catchment Delineation

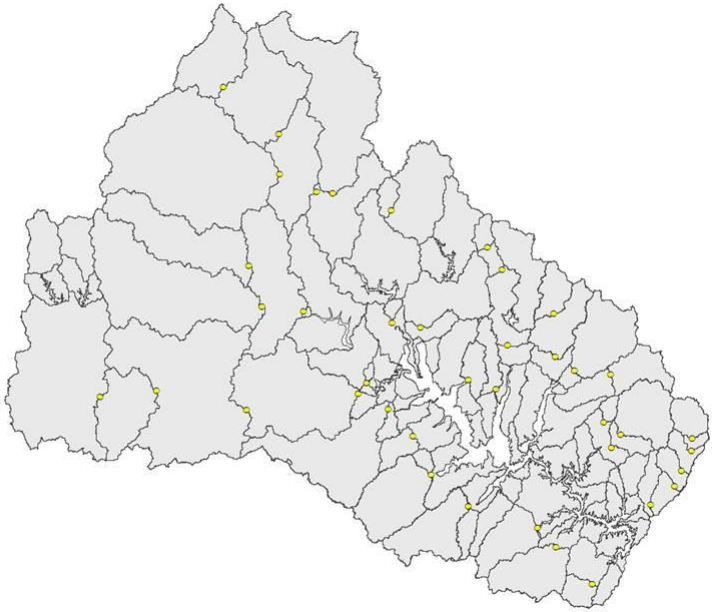
Purpose of Catchment Delineation

- Divides the watershed into smaller units to support modeling
- Input and output are “lumped” to the resolution of the catchment
- Increasing the number of catchments = increasing resolution
- Important for calibration and output interpretation



Status Catchment Delineation

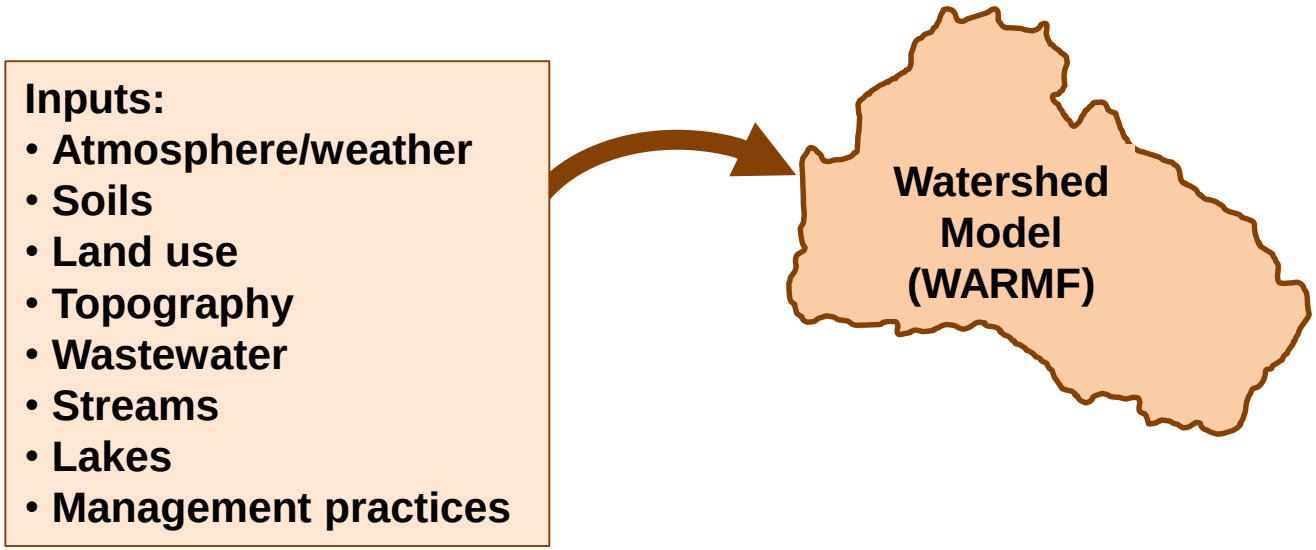
- Watershed modelers have delineated preliminary catchments for the watershed model
- Boundaries are based on topography, with outlets located at the UNRBA watershed monitoring stations
- Created using the USGS StreamStats Tool
- One goal of modeling is to assign jurisdictional loading
- Potential need for further delineations
- Input from today's meeting will help determine additional delineations to ensure modeling can generate useful output



Future Meeting Topics and Data Summaries

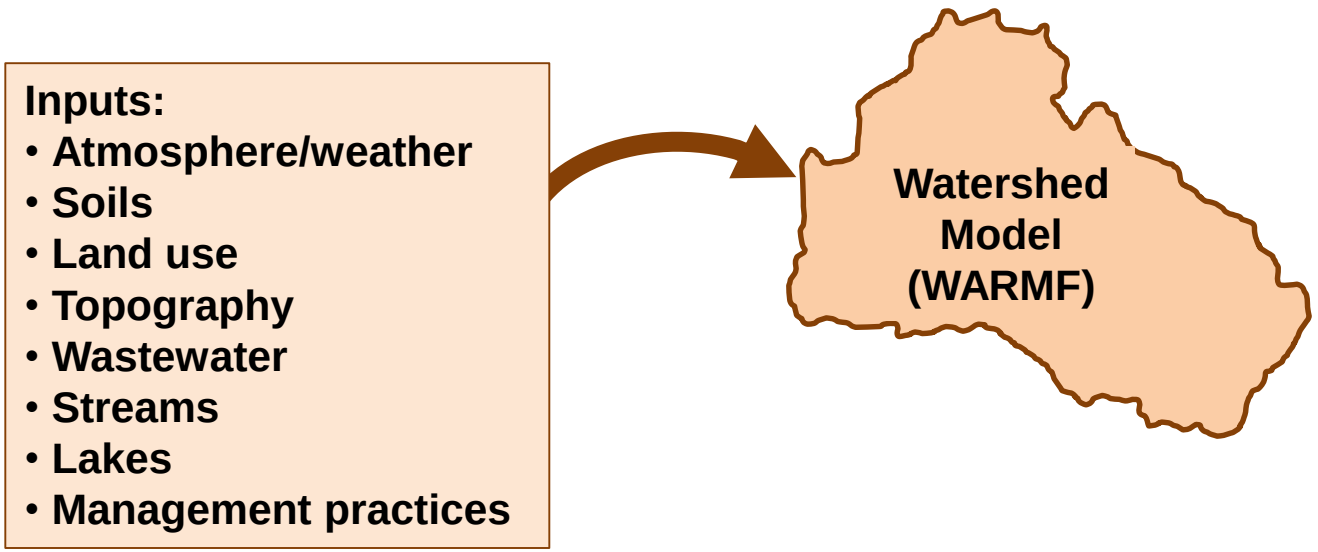
Continued Data Collection

- Received approximately 75 percent of the data expected from UNRBA members and agricultural representatives
- Continue to compile and summarize data for the watershed
- Process USGS NLCD data when released in December 2018
  - Year 2016 release
  - Years 2001, 2006, 2011 - reharmonized



Data Topics Planned for Subsequent Meetings

- Soils
- Land use and land cover
- Nutrient application rates
- Onsite wastewater treatment
- Air quality and deposition
- Best management practices



Breakout Discussions

Do you have any input on the data sets that were described today?

- Additional sources of information?
- Input on assumptions?
- Is there anything that we should know about these data sets as we develop the models?

Please provide information on the data sets to Alix Matos (amatos@brwncald.com) and Forrest Westall (forrest.westall@unrba.org)

What do you want to get out of the watershed model? Rank top 3. Examples below: [11 minutes]

- Concentrations
- Loads
- Timing with respect to storms
- Sources of loading
  - Jurisdiction
  - Land use
  - Activities
- Impacts of management options
- Answer “what if” questions
- Other

How would you prefer information from the watershed model be summarized and provided to you? [11 minutes]

- Spatially (pick 1)
  - Jurisdiction (15)
  - Perennial stream subwatersheds (~30)
  - UNRBA Monitoring Stations (38)
  - Modeling units (over 100)
  - Other
- Temporally (pick 1)
  - Hourly
  - Daily
  - Monthly
  - Seasonally
  - Annually

What do you want to get out of the lake models? Rank top 3. Examples below: [11 minutes]

- Nutrient loading/concentration relationships
- Sources of loading to the lake (internal/external)
- Differences in water quality at different locations
- Evaluation of a range of weather conditions
- Evaluation of seasonal loading and flow patterns
- Evaluation of lake management/operations
- Evaluation of watershed management options
- Answer “what if” questions
- Other

How would you prefer information from the lake models be summarized and provided to you? [11 minutes]

- Spatially (pick 1)
  - Whole lake (1)
  - Upper versus lower lake (2)
  - Each DWR monitoring station (12)
  - Separate lake arms and lake segments (~20)
  - Other
- Temporally (pick 1)
  - Daily
  - Monthly
  - Seasonally
  - Annually

Thank you for Participating