Nothing Compares
NORTH CAROLINA

Middle Cape Fear Modeling Project

March 28, 2018

Department of Environmental Quality

WHAT?

- Develop water quality models for Deep/Rocky Rivers and Middle Cape Fear River
- Focus of modeling is dissolved oxygen and nutrients
- Different purpose than Jordan, Falls, or High Rock Lakes, may or may not result in NMS

WHY?

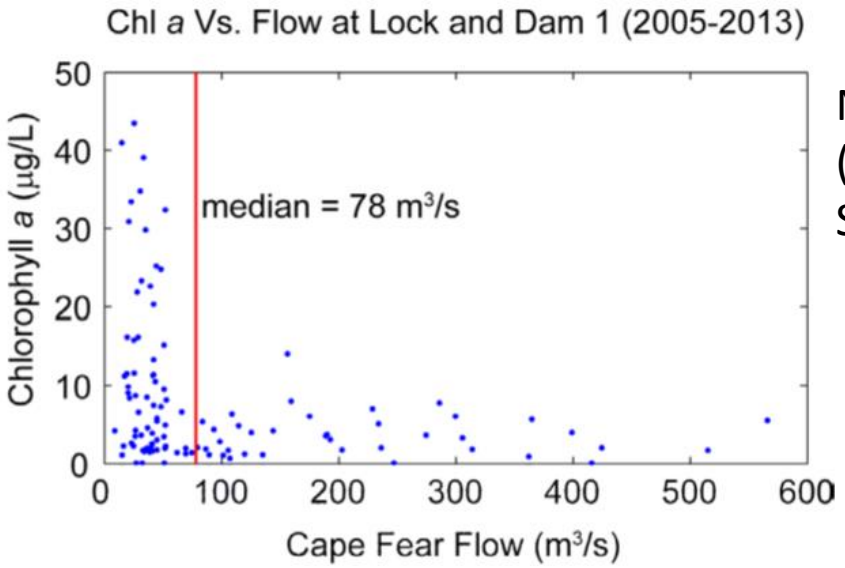
- Support NPDES permitting for nutrients.
- Provide information on conditions associated with algal bloom frequency and duration.
- Provide additional information on existing impaired waters.
- Provide additional information for public water supplies.
- Potentially support nutrient criteria, as described in the North Carolina Nutrient Criteria Development Plan (NCDP).

Where? Modeling Spatial Extent

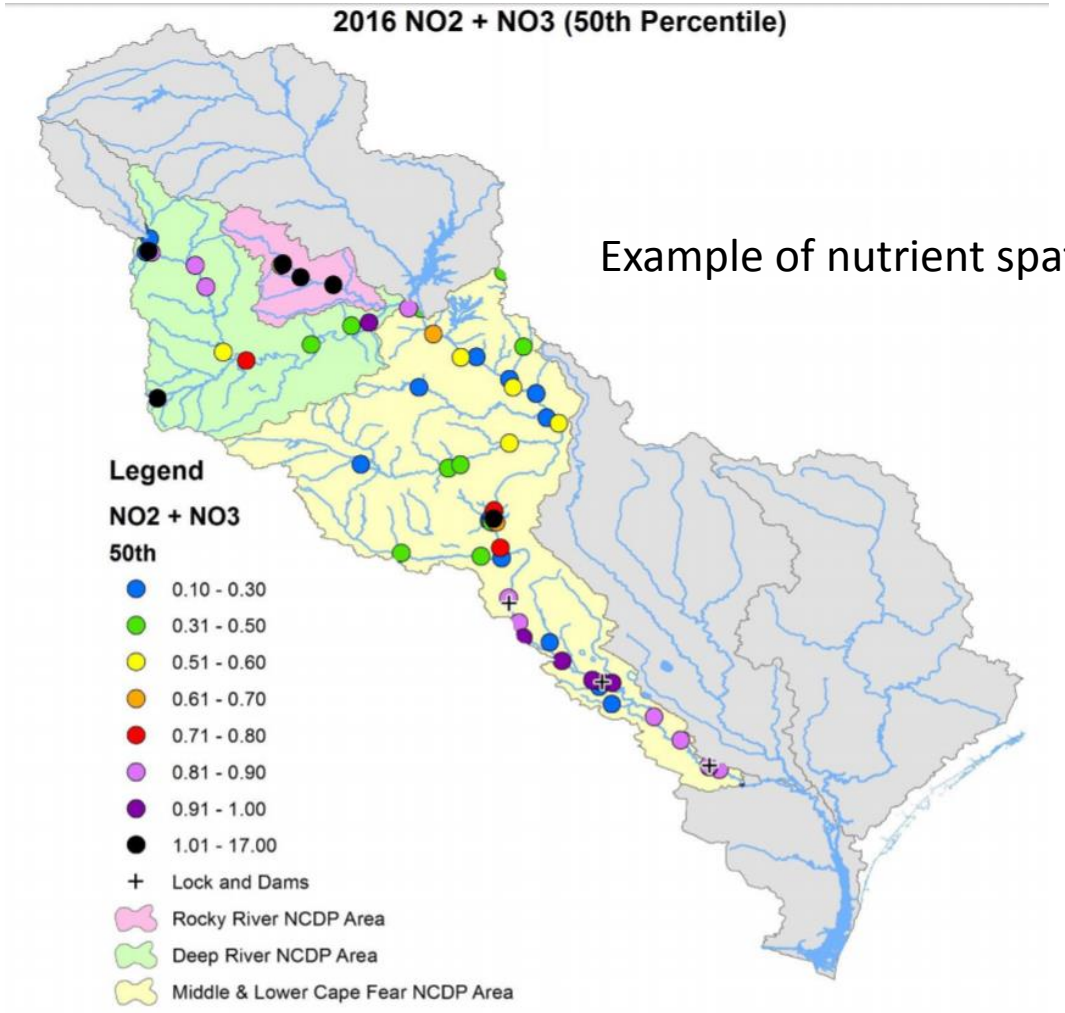
How are discharges currently impacted by lack of modeling?

- Expanding discharges
  - Loads are frozen
- New discharges
  - Need to perform their own modeling to demonstrate impact
- Without a model, permit writers have no way to determine what limitations are sufficiently protective, and this uncertainty continues to result in delays in permitting decisions

Relevant Findings of Cape Fear Water Quality



Nathan Hall (April, 2016 SAC Meeting)



Example of nutrient spatial variability

DWR (April, 2016 SAC Meeting)

Monitoring to Support Modeling

- Provide enough information to adequately characterize and represent water quality in Cape Fear
- Capture variability – spatial and temporal
- First step towards building a model
- Address known gaps
- Reduce model uncertainty, conservative assumptions
- Avoid need to remodel (e.g. Falls Lake)

Monitoring Gap Study

Started with Western Wake Nutrient Modeling and Monitoring Plan (CH2M Hill, 2011)

Targets:

1. Calibration and validation at critical sub watersheds
2. Calibration at headwater steams: characterize headwater conditions.
3. Characterize tributary inputs

Cape Fear Monitoring Plan

1. Two year study
2. Begin January 2019
3. 9 new monitoring locations identified – DWR has secured partial funding through NFWF Grant
4. Increased frequency at selected stations
5. Additional parameters at selected stations
6. Storm event characterization
7. Algae characterization
8. Toxin analysis?

Documentation

Division of Water Resources
Cape Fear River Basin
Nutrients and Dissolved Oxygen Modeling Plan

Introduction

The DWR Modeling and Assessment Branch has developed this Modeling Plan for the middle Cape Fear River Basin to outline the modeling goals, spatial extent, parameters of concern, and monitoring needs.

Goals of Modeling

There are several modeling goals that have been identified:

1. The DWR Point Source Branch has identified the need for modeling tools to assist with nutrient permitting in the Cape Fear River Basin. Support NPDES permitting for nutrients.
2. Provide information on conditions associated with algal bloom frequency and duration.
3. Provide additional information on existing impaired waters.
4. Provide additional information for public water supplies.
5. Potentially support numeric nutrient criteria, as described in the North Carolina Nutrient Criteria Development Plan (NCDP).

Spatial Extent of Modeling

As currently designed, the modeling will support permitting below Randleman and Jordan Lakes down to Lock and Dam #1. Tools exist for Jordan, Harris Lake, and Lower Cape Fear. Randleman Lake and Jordan Lake have permitting strategies already in place. The spatial extent is further defined in the bullets below as well as in Figure 1.

- Jordan Lake – boundary loading only
- Rocky River – from headwaters to confluence with Deep River
- Deep River – from below Randleman Lake to confluence with Cape Fear River
- Cape Fear – from confluence with Deep River down to lock and dam #1 (excluding Harris Lake watershed). Harris Lake watershed will be excluded from model development as there already is a model for Harris Lake. The flow gage and monitoring station on Buckhorn Creek will be used to develop loads from Harris Lake watershed for input to middle Cape Fear River model.
- Lower Cape Fear – excluded

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Division of Water Resources
Planning Section – Modeling & Assessment Branch (MAB)
Draft Monitoring Plan for Upper and Middle Cape Fear River Watersheds
March 2017

This document outlines the monitoring plan for the upper and middle Cape Fear River (CFR) watersheds to support model development. This data will be used to support the development of a watershed model for the upper Cape Fear watershed (Deep River and Rocky River watersheds) and a water quality and hydrodynamic model for the middle Cape Fear River watershed (from confluence of the Haw River and Deep River down to Lock and Dam #1). The two models are Soil and Water Assessment Tool (SWAT) and CE-QUAL-W2, respectively. An accompanying document titled "Cape Fear River Basin Nutrients and Dissolved Oxygen Modeling Plan" describes the purpose and goals for the model development.

The data to be collected will allow the DWR to develop the models to characterize water quality dynamics more accurately in the CFR basin. The goal here is to collect enough site specific information to reduce the uncertainties of estimating model parameters. This will increase confidence in model predictions and hopefully, avoid the need for additional modeling.

Please let the MAB staff know immediately if some aspect of the study will be difficult or impossible to obtain.

Duration: 24 months, starting ASAP to include 2 summer seasons (May-Oct)

1. New Monitoring Stations

The following section details requested monitoring for new locations in the Cape Fear, Rocky, and Deep River watersheds. It is anticipated that DWR will be responsible for this portion of the study. Seven of the locations described below were included in a 2016 grant award to DWR from NFWF.

Spatial coverage: Table1 lists the nine watersheds (also shown in Figure 1) and their monitoring locations. Note that the list does not include existing ambient and coalition stations in the watersheds. Existing stations should continue to be monitored according to their established schedule as that data will also be used for modeling purposes.

Frequency: The proposed nine locations should be monitored once per month. These locations are critical points in the watershed for model calibration and validation.

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Monitoring Partners

- DWR Intensive Survey
- DWR Regional Offices
- Monitoring Coalitions – UCF/MCF

Model Selection – Important Considerations

- Parameters of interest
- Data availability
- Modeler expertise
- Ability to represent impoundments
- EPA supported
- User interface

Existing Models - CPF Basin

Models	Developed Year	Domain	Target
1. Hydrodynamic			
3D EFDC-WQ	2009	LCFR	DO
3D EFDC-WASP	2007	Jordan Reservoir	Chlorophyll a
2D CE-QUAL-W2	2010	Harris Lake	Chlorophyll a
2. Eutrophication			
BATHTUB	2004	Roberson Creek	TP
WASP	2003	Jordan Lake	Chlorophyll a
CE-QUAL-W2	2010	Harris Lake	Chlorophyll a
3. River/Stream			
QUAL2e/QUAL2K	2008	CFR up to L&D1	DO
4. Hydrologic			
Cape Fear/Neuse Combined OASIS	2015	CFR up to L&D1	Water Balance
5. Watershed			
SWAT	2008	Northeast CFR	TN and TP
GWLF	2007	Jordan Lake Watershed	TN and TP
BASINS-HSPF	2004	Upper N Buffalo Creek	Fecal Coliform
SWAT	2004	Roberson Creek	TP
CRAP	2003	Northeast Creek	Fecal Coliform
BASINS-NPSM	2002	Little Troublesome Creek	Fecal Coliform
SWAT	2015	Rocky River Watershed	TN and TP
SWAT - TNC	2015	Middle Cape Fear	TN and TP
LSPC	2013	Jordan Lake Watershed	TN and TP

Parameters of Concern

Based on existing impairments, known concerns, permitting needs

- Nutrients (primarily nitrogen and phosphorus)
- Chlorophyll-a
- Dissolved Oxygen (DO)
- Turbidity – indirect
- Algal blooms - indirect
- Total Organic Carbon (TOC)
- Others as identified by NCDP/Scientific Advisory Council(?)

Supporting Studies

- Bathymetry study - DONE
- Rocky River special study – Summer 2016
- SOD/Nutrient Flux behind locks and dams – DONE
- Periphyton survey
- **Deep/Rocky Rivers monitoring gaps**
- **Middle Cape Fear monitoring gaps**

Estimated Draft Timeline

- 2018 - Confirm monitoring plan
  - Determine available resources / lab limitations
  - DWR meeting with monitoring partners May 1
- Intensive Monitoring
  - 2019-2020
- Model Development
  - 2020-2021

Summary

- Models will provide permitting tool to allow for future growth
- NCDP SAC work may add additional areas of focus
- May or may not result in reduction requirements/ nutrient management strategy
- Resource availability?
- Modeling resources in-house

Thank You!

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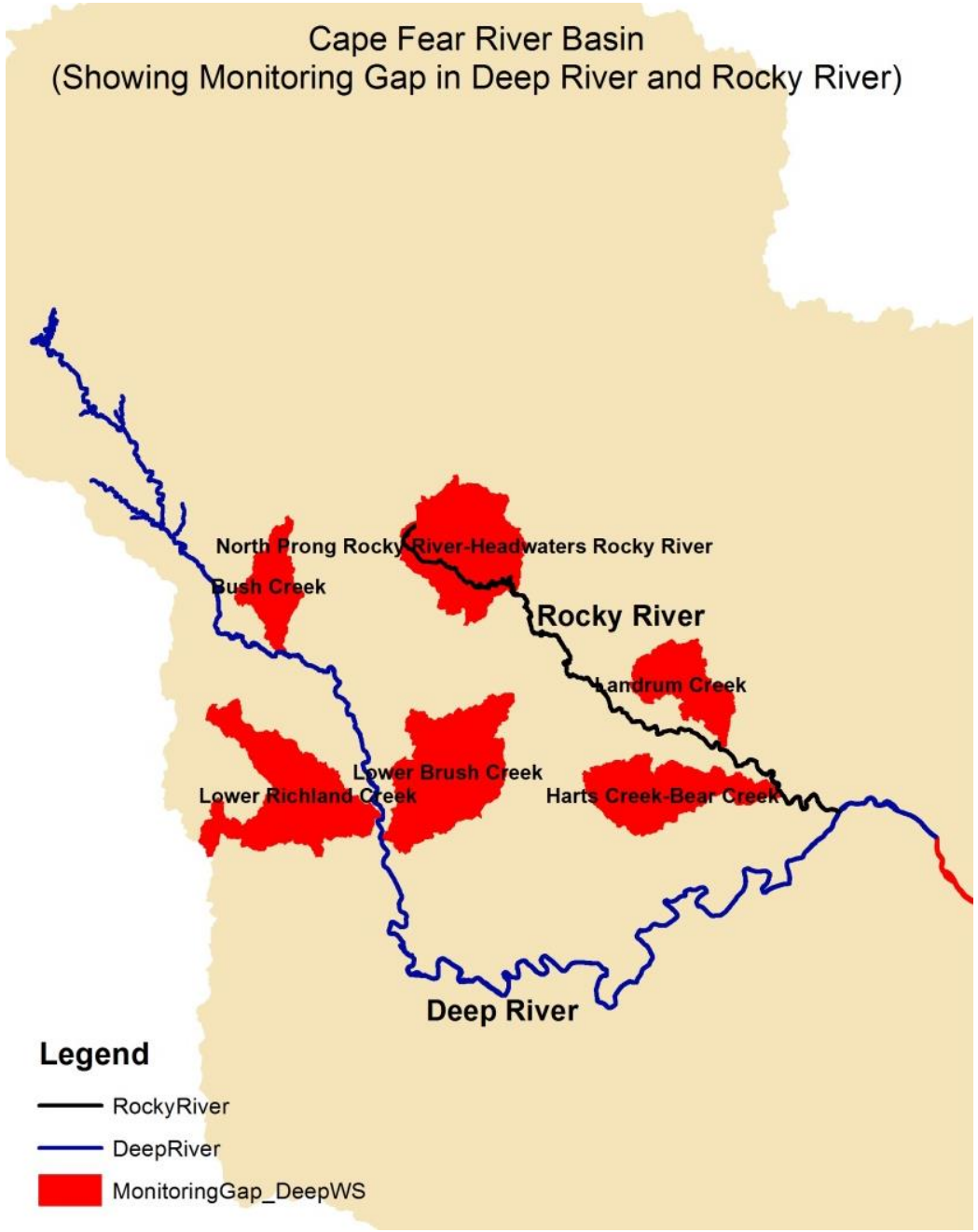
Monitoring Gaps
Deep and Rocky Rivers



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Monitoring Gaps
Middle Cape Fear

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9 Proposed Monitoring Sites

Coalition	Watershed	Receiving River	Station Location		Road Crossing	Model Use
			Longitude	Latitude		
Upper Cape Fear	Bush Creek	Deep River	-79.713	35.753	SR 2226:	SWAT
	Brush Creek	Deep River	-79.583	35.602	SR 22 and 42	SWAT
	Richland Creek	Deep River	-79.619	35.608	SR 2873	SWAT
	Headwaters Rocky River	Rocky River	-79.493	35.802	SR1362	SWAT
	Landrum Creek	Rocky River	-79.275	35.688	NC 902	SWAT
	Bear Creek	Rocky River	-79.212	35.635	SR 2156	SWAT
Middle Cape Fear	Gulf Creek	Cape Fear River	-79.027	35.566	SR 1916	CE-QUAL-W2
	Headwaters Locks Creek	Cape Fear River	-78.855	35.047	SR 1006	CE-QUAL-W2
	Carvers Creek	Cape Fear River	-78.404	34.453	NC 87	CE-QUAL-W2

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