NC NUTRIENT SCIENTIFIC ADVISORY BOARD MEETING SUMMARY

MARCH 5, 2021 / 9:30 AM – 12:00 PM
REMOTE WEB MEETING

ATTENDEES

Members / Advisors
Charles Brown – Cary
Michael Burchell – NCSU
Morgan DeWit – Chatham County
Alisha Goldstein – Chapel Hill
Sally Hoyt – UNC
Bill Hunt - NCSU
Brian Jacobson - AECOM
Josh Johnson – AWCK
Eric Kulz - Cary
J.V. Loperfido – Durham
Grady McCallie – NC Conservation Network
Andy McDaniel - DOT
Deanna Osmond - NCSU
David Phlegar – Greensboro
Haywood Phthisic – LNBA
Peter Raabe – American Rivers
Allison Schwarz Weakley - Chapel Hill
Forrest Westall – UNRBA
Sandra Wilbur – Durham
Kristine Williams - Greensboro

DEQ Staff
Corey Anen - DEMLR
Patrick Beggs - DWR
Trish D'Arconte - DWR
Nora Deamer - DWR
Rich Gannon - DWR
John Huisman - DWR
Karen Higgins – DWR

TJCOG Staff
Maya Cough-Schulze
Jenny Halsey – Facilitator

Guests
Brooke Bauman
Natasha Bell
Steven Berkowitz
Claire Bradley
Anne Coan - NC Farm Bureau Federation
Nancy Daly - Wake County
Vic D'Amato – Tetra Tech
Jacob Dorman - Stormwater Solutions
Amy Farinelli
Taylor Fitzgerald
Nathan Hall – UNC CH
Joey Hester – DACS - DSWC
Charles Humphrey - ECU
Guy Iverson - ECU
Todd Kennedy
Keith Larick - NC Farm Bureau Federation
Alix Matos - Brown and Caldwell
Dan McLawyorn - Raleigh
Michael Orbon – Wake County
Don O'Toole
Mandy Pitz
Sushama Pradhan - NCDHHS
Jay Sauber
Rick Savage – Carolina Wetlands
Astrid Schnetzer - NCSU
Jamie Smedsmo – UNC CH
Emily Sutton – Haw Riverkeeper
Hope Thompson
Matthew Van De Bogert
Steve Wall – NC Policy Collaboratory
Michelle Woolfolk - Durham

AGENDA TOPICS

1. Approve December 2020 Meeting Summary
2. Estimating the Influence of Onsite Wastewater Treatment Systems on Nutrient Loading - Guy Iverson - East Carolina University College of Health and Human Performance
3. Cyanotoxin Presence and Year-Round Dynamics in Falls Lake - Astrid Schnetzer - NCSU Marine, Earth, and Atmospheric Sciences
4. Defining the Balance Between Cyanobacterial N2 Fixation and Denitrification in Falls Lake - Nathan Hall - UNC-CH Institute of Marine Sciences
5. Update: Neuse/Tar-Pamlico New Development Stormwater Model Program - Trish D'Arconte - DWR
6. JLOW Update - JLOW Advisory Comm members
7. NSAB Updates

Meeting Materials and the NSAB Charter are available online: www.deq.nc.gov/nps

MEETING SUMMARY

Jenny Halsey (TJCOG) opened the meeting with introductions and a review of the agenda.

The December 4, 2020 meeting summary was approved.

Estimating the Influence of Onsite Wastewater Treatment Systems on Nutrient Loading

Presenter: Guy Iverson - East Carolina University College of Health and Human Performance
Slides can be found online.

- How much do septic systems contribute nutrients to Falls Lake?
- Is septic system density a good indicator? Some studies show TN, chloride increasing as density increases at a watershed scale.
- Usually if leachfield is working you don't see much ammonium or organic N. Instream these can indicate system failure or leaking.
- Several Collaboratory studies compared sewer and septic watersheds; found higher TDN, phosphate and chloride in septic watersheds.
- Goal: Identify watersheds impacted by septic and identify potential sites for denitrifying instream bioreactors to attenuate nutrients stemming from onsite septic system
- Studies of attenuation ongoing
- Future plans include calculating mass load reductions and attenuation factors, not just concentrations.
- Contact Guy Iverson at iversong18@ecu.edu

Questions/Comments/Discussion: A live question and answer period was held after the presentation, some questions and responses were handled simultaneously in the video chat, and some were addressed later by email. The following is a compilation.

Can you clarify instream **nutrient processing** #s versus edge of property #s.

- The 97% TDN and 99% PO4-P attenuation factor includes all the in-stream processing of nutrients after discharging to the stream and migrating towards watershed outlets. The edge of property values are 75% TDN and 94% PO4-P.
- Percentages by themselves can be deceiving – it depends on influent concentration. What would be more representative would be to show the range of concentrations we're seeing.

Are you measuring TOC with the instream **bioreactors**? If you're putting all these woodchips in the bottom of a creek

- We have DOC. It fluctuates in terms of releasing the DOC; there's certainly potential. We used a range of sizes in my dissertation. We want to monitor this.

How large are **bioreactors**? Are they positioned so they impact flows; what kind of streams are we talking about?

- Usually put in unnamed tributaries; borderline whether blue line; would dry out in summer. Shouldn't have a big impact on overall flow. Creates a lot of storage in storms.

Have you studied WQ parameters beyond nutrients that might be affected by **bioreactor**?

- Some E coli, fecal indicator bacteria, but mostly just chemistry

Sounds like you're putting these **bioreactors** in ephemeral channels. If that is not the case, what do USACE and EPA think – presumably you'd need a permit.

- We did one install in a blue line stream and needed a permit. Clarification: for current project, just identifying sites not installing.

Are the **bioreactors** believed to perform better in aerobic or anoxic conditions?

- It depends on what the dominant nitrogen species is. If nitrate is the dominant species, anoxic conditions would be preferred so that the bioreactor can facilitate environmental conditions necessary for denitrification. Alternative designs may have to be considered in watersheds with more complex nitrogen speciation (e.g., roughly equal distribution of ammonium, nitrate, and organic nitrogen).

Do you have a sense or will you be looking to get one for **characteristics of the outlier systems** that may drive the high numbers?

- Yes – there are some interesting outliers that we are seeing in the studied watersheds. We're looking at land use differences, impervious surfaces, presence and condition of buffers, isotope data, etc. to better understand the outliers.

Will there be an effort to **normalize the data** for topography, impervious surface, and extent of stream buffers at the streams' edges?

- Yes – that's some of the next steps in the future work is to consider differences in watershed characteristics to see if these variables provide additional insights on the concentrations (and mass exports) that we are observing.

In-stream **bioreactors**/wetlands have long been a problem to implement (regulatory and for high-flows). Should consider ways to move these "off-line" through diversions that would handle base-flow and allow stormflow to bypass. The problem however is large loads can be passed through during storms.

- I think the considerations for flow bypass during storms depends on the nature of the watershed. There is potential to design these bioreactors to increase residence time of runoff during higher storm events, such that they could retain or reduce peak flow in receiving waters downgradient. However, you're not seeing much "bang for your buck" regarding attenuation of nutrient transport during storm conditions. I think caution is warranted during the design phase depending on characteristics of the watershed. A bypass is certainly needed to prevent flooding in residential watersheds. In areas where stormwater is channeled via pipe or ditch infrastructure, check dams or flashboards can be helpful to increase residence time before spilling into existing infrastructure, but elevation of these must be considered to prevent flooding in lower stream reaches, especially in residential watersheds. Another consideration is the stream gradient along the length of the bioreactor itself. Steeper gradients might also cause issues in residential watersheds. Upper reaches of the bioreactor might not be able to remain saturated year-around without use of flow control structures to retain water. These structures can help to ensure that the bioreactor remains saturated and reduce rate of carbon media decay. However, this may not be possible in streams with steep gradients without substantial alterations to the flow regime and possibly flooding lowland areas by damming water. There is definitely a low to unpack here and I am definitely interested in some follow-up conversations to discuss further. Thank you for your comment. Happy to discuss with you further.

Cyanotoxin Presence and Year-Round Dynamics in Falls Lake

Presenter: Astrid Schnetzer - NCSU Marine, Earth, and Atmospheric Sciences

Cyanotoxin types:

- microcystin (MCY)
- anatoxin (ANA),
- saxitoxins (STX)
- cylindrospermopsin (CYL)
- beta-Methylamino-L-alanine (BMAA)

Cyanotoxin Health Concerns

Hepatotoxin, Cytotoxins, Endotoxin, Neurotoxin & Dermatoxin

Toxin	Short term health effects	Long term health effects
Microcystins	Gastrointestinal, liver inflammation, and hemorrhage and liver failure leading to death, pneumona, dermatitis	Tumor promoter, liver failure leading to death
Nodularins	Similar to Microcystins	Similar to Microcystins
Saxitoxins	Tingling, burning, numbness, drowsiness, incoherent speech, respiratory paralysis leading to death	Unknown
Anatoxins	Tingling, burning, numbness, drowsiness, incoherent speech, respiratory paralysis leading to death	Cardiac arrhythmia leading to death
Cylindrospermopsin	Gastrointestinal, liver inflammation and hemorrhage, pneumonia, dermatitis	Malaise, anorexia, liver failure leading to death
BMAA		Potential link to neurodege-nerative diseases

Sampling both intracellular and dissolved toxins helps detect toxins during or after a bloom.

Solid Phase Adsorption Toxin Tracking (SPATT) is a simple and sensitive in situ (monitoring) method using the passive adsorption of biotoxins onto porous synthetic resin filled sachets (SPATT bags) and their subsequent extraction and analysis. Bags are used to assess how much toxins accumulate. This method helps detect over time rather than just at a single point, so we don't miss blooms. SPATT has a low detection limit; both fresh and marine application; low detection limits; multiple toxin detection; and is easy to deploy and recover. It is semi-quantitative and does not have a direct link to regulatory limits.

Cyanotoxins are removed from Falls Lake at the drinking water plant; recreational use more of a concern; data show it to be in an acceptable zone; but not sampling when the bloom happens.

There could be concerns with chronic exposure to toxins.

As for food web accumulation, there is a study that showed clams exceeded regulatory threshold for consumption even though surrounding lake waters had low levels.

Pandemic hindered event sampling during bloom.

Future steps:

- 3rd year of observations for monthly, seasonal and interannual trends.
- Molecular analyses to identify cyanobacterial population dynamics and connectivity across the lake and over time.
- Relationship between cyanobacterial community structure and toxin dynamics.
- Relationship between populations, toxins and environmental conditions (physicochemical and hydrological conditions).

Follow up questions: aschnet@ncsu.edu

Questions and Discussion:

Drinking water systems with conventional filtration don't have organic removal treatment in place at all times – only when there's geosmin issues due to taste and odor complaint. Are these algal blooms causing microcystin happening at the same time as these systems are online?

- In Jordan Lake, they were using these systems continually, so there wasn't an issue.
- This may be a good conversation to have.
- Maybe there is a correlation with geosmin.

A question for drinking water is whether the toxins are showing up at the same time as carbon is being used for taste and odor due to geosmin. Traditionally they don't have organic removal treatment all the time, mostly it is particulate. So it is not focuesd on organics. But, in the summer with potential algal blooms they will use Geosmin, and it is expensive.

If the same water crosses the SPATTs more than once due to flow regime, would you expect more toxics to accumulate in the bags?

- Lab is looking at degradation rates – how long toxins stay in water. Dissolved toxins stay a long time. Still studying fractions of intercellular and dissolved.

Why is cylindrospermopsin absent during warm season?

- From Jordan Lake and Chowan samples, it seems anatoxin and mycrocystin seem to be present at the same time; not quite sure of the intricacies yet. This is the longest we have been able to measure in the same place at so many stations. Appreciative of this opportunity.

How long are these different toxins persistent in the system – are they there until flushed downstream?

- They generally stay around until taken up by food webs, except dissolved forms. There is a need for a chemist to look at this and we are partnering with another NCSU group to look at molecules that stay around longer.

Defining the Balance Between Cyanobacterial N2 Fixation and Denitrification in Falls Lake

Presenter: Nathan Hall - UNC-CH Institute of Marine Sciences

Slides can be found online.

Understanding N2 fixation of Falls Lake is a good idea

1. N2 fixation can represent an important pathway of new N inputs- enhanced fertility and associated problems of eutrophication
2. N2 fixing cyanobacteria are scum and/ or toxin producers

3. Balance of N2 fixation and denitrification often determines nutrient limitation-can inform more effective nutrient control strategies
4. Can help constrain other parts of the N budget that are difficult to measure such as denitrification

Study Objectives

1. Estimate lake-wide rates of N2 fixation to determine its importance relative to other N sources
2. Explore correlates of N2 fixation to uncover stimulatory factors
3. Construct a N mass balance for the lake that includes N2 fixation to calculate a lake-wide estimate for denitrification

Conclusions

1. N2 fixation appears to be a small N source, ~2% of stream loads
2. Denitrification estimates are variable, but denitrification is significant, 10-40% of stream loads

Continuing Work

1. Increase sampling stations to capture longitudinal patchiness
2. Use nutrient addition experiments to test nutrient limitation status and ability to "turn on" N2 fixation
3. Continue comparisons of denitrification estimates vs direct measurements

Future work:

- Challenge: Bursts of activity can cause huge increases in N in short periods of time - can be hard to capture. Next year, will do more stations and not worry about the depth gradient, to see if missing patches spatially.
- Assess dataset of N fixing cyanobacteria – if patterns might drive nutrient limitations
- Work with Mike (Piehler?) on site-specific chla standard for Falls Lake for UNRBA – at level where zooplankton can('t?) control phytoplankton.
- Consider EPA National Lakes Assessment dataset compared to Greensboro College dataset – see if this approach works for our area/Falls

Some notes during presentation:

- Some of the toxins Astrid mentioned are produced by nitrogen-fixing cyanobacteria
- Depth of N fixation at 6 stations: slightly higher at surface
- A lot of cyanobacteria are not nitrogen fixers
- Seems like N fixation is a very small part of the budget
- Denitrification rates by mass balance: Lots of variability. Exported more than it imported in 2016. Source could be N fixation?
- N fixation doesn't appear to be an important source to the lake, despite having a large source of N fixing biomass

Questions and Discussion:

Is it reasonable to think that the fixation is so low partly because there is a lot of N inflow through streams, or is it about ratios?

- It's not uncommon to see a lot of N fixing biomass but low rates in a waterbody. It's possible supply meets algae needs so no N fixation.

If management can lower N entering lake, what impacts might that have?

- Would lowering N entering lake just increase N fixation – always a concern – literature suggests it never gets made up 100%

In your mass balances, is atmospheric deposition much higher than N fixation?

- Yes, 5x higher than N fixation

UNRBA looked at chla from 2014-2018 and it seemed pretty consistent.

> Consistent chla levels would be consistent with ability for N fixation, but I don't know that this is happening

Neuse/Tar-Pamlico New Development Stormwater Model Program

Presenter: Trish D'Arconte, NC Division of Water Resources Nonpoint Source Planning Unit

The amended Neuse and Tar-Pamlico New Development Stormwater Rules (.0711 and .0731 respectively), effective April 1, 2020, and require DWR staff to develop a new Model Program in consultation with local governments for Commission approval. This Model Program was developed in collaboration with the local governments and provides guidance and information templates to assist local governments in development of their own Local Programs to implement the new Rules. By local government request, it provides an example for integrating local NPDES Municipal Separate Storm Sewer System plans with their Neuse or Tar-Pamlico Stormwater programs.

[updated April 29, 2021] Trish presented at the March EMC and WQC meetings. The EMC approved the Model Program. The following is available online:

Presentation
Attachment A – Neuse and Tar-Pamlico Local Program Development Guide
Attachment B – Neuse and Tar-Pamlico Model Stormwater Ordinance for New Development
Attachment C – Neuse and Tar-Pamlico Model Stormwater Management Template

JLOW Update - Jordan Lake One Water

Presenter: Patrick Beggs – DWR, and members of the JLOW Advisory Committee

[updated April 29, 2021] Six JLOW workgroups have submitted their reports to the Advisory Committee which has incorporated the work into a Draft JLOW Plan. The draft plan is currently with the workgrup members for review and comment. Four identical meetings designed to orient participants to the draft have been scheduled. Please sign up for one of the meetings at the TJCOG JLOW website: www.tjcog.org/jlow.

NSAB Roundtable Updates / final comments:

- NSAB will not meet on Good Friday in April.
- Bill Hunt will present research updates and new work in May.
- Thank you to Steve Wall of the NC Policy Collaboratory for organizing today's presentations!
- Forrest Westall: A joint UNRBA/Collaboratory 2021 Falls Lake Nutrient Management Study Research Symposium is scheduled for May 19, 2021. Details: Wednesday, May 19, 2021 / 10:00am – 3:00pm / Virtual delivery / The Upper Neuse River Basin Association (UNRBA) is collaborating with the UNC Institute for the Environment to provide the 2021 Falls Lake Nutrient Management Strategy and Research Symposium. The purpose of this year's symposium is to inform stakeholders of recent research that has been funded by the NC Policy Collaboratory and UNRBA's efforts to re-examine the Falls Nutrient Management Strategy. The symposium will be held virtually and will feature updates from researchers from UNC, NC State, and East Carolina University, as well as the UNRBA. / Details for joining the symposium virtually will be provided several days before the event. Check back later for the symposium agenda. / The symposium is free, but registration is required. Register here. / Questions about the symposium can be directed to Grant Parkins, Watershed Education Coordinator with the UNC Institute for the Environment: parkins@unc.edu
- Peter Raabe: Congratulations to UNRBA getting the IAIA to this point – it is a new way to think about nutrient management, specifically stormwater from new development.
- Rich Gannon: Trish D'Arconte has done a huge amount of work on the NTP new development model program materials. Please look at the work using the links in the section above. John Huisman has also done a lot of work on the existing development for Falls Lake program which was approved in January. Stem is the only local programs outside this effort.

The NSAB will meet May 7, 2021.