



The North Carolina  
**FORUM**  
ON NUTRIENT  
OVER-ENRICHMENT

**Question & Answer Sessions Day 2**

**Durham, North Carolina May 29-30, 2012**

**TRANSCRIBED FROM AN AUDIO RECORDING**

**The North Carolina Forum on Nutrient Over-enrichment was conducted on May 29 and May 30, 2012, at the Sheraton Imperial Hotel & Convention Center, Durham, North Carolina, commencing at 8:30 a.m.**

**The following is a transcript with minor editing of the first question and answer session conducted on May 30<sup>th</sup>, including the following speakers: Deanna Osmond, David P. Genereux and Kathy DeBusk. Richard Whisnant is the MODERATOR.**

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**MODERATOR:** Deanna and David, if you could join us back up here so we can take some questions right now from our panel, which is looking refreshed this morning. Glad to see everyone back. For those who might not have been here yesterday, although I think most of you were, our panel-- distinguished panel is asking questions of our presenters, and if you want to raise a question, that's what these colored cards are in front of you. Just jot it down, note the speaker that you'd like to ask the question of and pass it toward the projector, and someone will pick them up. So I turn it over to the panel for questions.

**MS. JARRELL:** Okay, I'm going to ask the first question. My name is Jackie Jarrell. Good morning and thank you for your presentations. They were very interesting. One of the questions we have from the floor -- we've had several that are similar, so we're trying to group these questions together -- is dealing with the nitrogen loading in the river and what was really being estimated as what's coming from groundwater as opposed to surface water and how much can it actually be reduced, in your opinion.

**DR. GENEUREUX:** Question to me?

**MS. JARRELL:** Yes.

**DR. GENEUREUX:** How much can the nitrogen loading be reduced? I defer to Kathy, I think, or Deanna might --

**MS. JARRELL:** Oh, yeah. What is your opinion about -- with the -- with runoff best management practices and looking at surface water runoff compared to the groundwater that -- what practices would you recommend or what do you think we need to do to go forward in looking at the surface water as compared to the groundwater and the age of the groundwater and the nutrients that in the waters from the groundwater?

**DR. GENEUREUX:** Maybe I'll start, and I'm sure Deanna can say a lot more than me about best management practices. I mean the natural condition of the land, which is for most of that -- most of that rainfall to infiltrate. Of course, the coastal plain is not nearly in its natural condition. There are a variety of, you know, disturbances to the land surface, and that could increase overland flow during storms. Of course, overland flow is only during and right after storms. Groundwater flow is continuous. Tidal drains have already been mentioned by Deanna, and they're short-circuiting riparian zones, and opportunities for de-nitrification are not helping in any way.

**DR. OSMOND:** We have researches in our department that estimate that for nitrogen only about five percent of the nitrogen comes through overland flow. So that means that 95 percent of the nitrogen is going through the soil system into the shallow groundwater. And so the ability to effect change for nitrogen fertilizer or nitrogen from animal waste is going to come through practices that can remediate shallow groundwater nitrogen.

And so you have riparian buffers, but as Dave already alluded to, they don't work everywhere because of the flow paths of water into the rivers. You have wetland systems. You have reducing the nitrogen at the source, which is the whole attempt to do nitrogen management. And that's why we spend so much time talking about nitrogen management, but even there you can only cut around the edges. Having said that, I think our farmers have reduced their nitrogen application rates by probably 40 -- this is an estimate, 40 pounds per acre over the last 30 years. So you have to use all of these as a practice. In addition, you have soil types that drain well, that load more.

For instance, Contentnea Creek, this stream runs higher in nitrate and nitrogen, about five milligrams per liter. If you go lower in the coast, you'll find those streams generally running lower nitrate and nitrogen because the soils themselves are so wet that they have high de-nitrification potential. So I guess this is a really complex way to answer a difficult question. I know that people hate to hear this, but it really depends on the system that you're working with.

**MS. JARRELL:** And I have a follow-up question to that. How is -- how do we know what those rates -- how they're being reduced? I know that there's data that's being collected on these farms. But is the amount -- how is that data collected from these farms and measured? There's a lot, as you know, measurement that is done on point source. So how is that balanced?

**DR. OSMOND:** So one of the things I was talking about was multiple lines of evidence, and every year soil and water conservation districts in the different regulated watersheds and river basins collect what they believe are the best estimates for nitrogen application in their county for a given crop. I think those estimates are pretty good, and the reason I think they're pretty good is that we have done these very, very detailed watershed/basin scale surveys of agricultural practices.

It is probably the most complete data set in the United States relative to agricultural practices, and we have a very good understanding based on those surveys as to the nitrogen rates. Relative to the nitrogen rates that farmers tell us they were applying 20, 30 years ago and what we're seeing now, we think those rates have absolutely come down. And the rates are very similar to the county level data that are being given to us for the nitrogen loss estimation worksheet tool. But one of the problems with nitrogen use data is that people try and use the county level fertilizer data as representation of what farmers are using. And, unfortunately, in North Carolina, if you use county level data, you're going to misrepresent the amount of nitrogen because it's not just used in that county. It can be used all over the place, so you have to be really careful of the source that you're using.

But, again, these multiple lines of evidence reduce that nitrogen has -- nitrogen rates have been dropping. The other thing that I might mention for the Neuse, because we spent some time talking about that, is the farmers switched out of corn and they switched into cotton. Cotton takes about half the amount of nitrogen that corn does. So just by virtue of shifting crops they reduced their amount of nitrogen.

**CHAIRMAN SMITH:** I'll start with two questions for Dr. Genereux. The first question relates to phosphorus migration. Simulated studies have shown nitrogen mobility persistence discharges from groundwater to surface waters. Have you found similar studies on phosphorus migration from groundwater to surface water?

**DR. GENEREUX:** No. No, the chemistry is quite different and, no, I'm not aware of this type of information for phosphorus. In North Carolina in recent years we funded a couple of projects related to the remobilization of phosphorus from agricultural lands that have been reconverted back to their natural wetland state

There are a different set of issues where the mobility is more tied to the presence of oxides -- iron oxides and other coatings on grains and aquifers that may sorb the phosphorus to it, whereas nitrate is just much more mobile. So it's completely different chemistry.

**CHAIRMAN SMITH:** Does that mean then that the phosphorus we find in the streams is more likely to come from a source other than groundwater?

**DR. GENEREUX:** Does it mean that? Deanna probably can answer that question than I can, too.

**DR. OSMOND:** So when we think of phosphorus, it mostly moves across the soil surface and into the streams. For the project that I talked about, there's pretty good evidence from a couple of those studies that in many of these watersheds the majority of the phosphorus is actually coming from point sources or urban areas, and most of the nitrogen is coming from agricultural areas. Having said that; however, in Ohio, the project that I was talking about there, part of the soluble phosphorus is probably coming through the drain tiles. So the phosphorus is solubilizing. It's not interacting with the soil. It's going through big pores straight into the tile drains. Fortunately, in North Carolina we don't have lots of those tile drains, although they're adding more. And so, again, it's mostly surface contributions. If we can reduce erosion, we can typically reduce total phosphorus but not necessarily soluble phosphorus.

**CHAIRMAN SMITH:** Thank you. And then one other quick question to Dr. Genereux. How do you think that groundwater discharge ages from Piedmont and mountain streams would compare to coastal plain streams?

**DR. GENEREUX:** Oh, that's a great question. I wish I knew the answer to that. It's a very different -- a very different hydrogeology. The coastal plain in some sense is maybe the easiest place to do this, where we're looking at flow through largely granular materials, and in the Piedmont, fractured rock with thick clay saprolite developed over it, and probably some preferential flow paths through that saprolite. That's a great question. I mean, rather than -- I probably shouldn't just speculate, but I imagine -- I don't think the work has been done. I don't think there's been the kind of data collection that there has been in the coastal plain.

**MAYOR MOSS:** Good morning. I'm Darryl Moss. I'm the mayor of Creedmoor, and I can tell you I was really excited about this part of the presentation because this is a conversation about how we deal with storm water. We're having this real time in our community. I've got a question from the floor, but I do need to give just this kind of a context, if you will. We sit in the critical area of the Falls Lake watershed, 100 percent of our community. We just formed a storm water utility or we're in the process of forming a storm water utility just last week. So, again, all this stuff is real time for our community.

But the question came from the floor, and, again, it kind of -- this is the conversation that we're having in Creedmoor right now, very similar. So projects like in Washington, North Carolina, where they have pumped all of the downtown storm water to one large constructed wetland for treatment, might be the best option for some urban areas. Kathy, this question was for you, and just give us your thoughts on that.

**MS. DeBUSK:** It might be. Like I said, the variability is just so great between different watersheds and even within the small watersheds that I looked at. And so it -- I would just have to say that it certainly depends on where you are, what nutrient you're trying to control. And if you have the facilities and the land to do something like that, then it might be cheaper and more cost effective for you than somebody who does not.

**MAYOR MOSS:** Just a quick follow-up question. What is the ultimate fate of the nutrients that are removed through the use of the BMPs, land application, land filled?

**MS. DeBUSK:** That's a great question. In fact, there is very little research to tell us the answer to that simply because this is kind of a new thing. It's not very old. It's very hard to find BMPs that are reaching their end of life expectancy to actually figure out where the nutrients are going. And there have just now started studies to determine that. We are assuming a 30-year life span for most BMPs, but that may or not be accurate. And there have also been studies to test the soils, like within bio-retention or within four bays of wet ponds, to determine how polluted the sediments are. Do they need to be treated as hazardous waste? Do they need to be land filled? Can they be land applied? All of these are great questions, but, unfortunately, we don't have the answers quite yet.

**MAYOR MOSS:** Thank you.

**MR. McCALLIE:** Good morning. I'm Grady McCallie with the North Carolina Conservation Network. And this is a fascinating set of presentations. Kathy, good morning; I have a couple questions for you. One is: are you seeing much change in the cost of various BMPs? I'd imagine some will go up over time, some will come down.

**MS. DeBUSK:** I would say you're right. Certainly with fuel costs, if you were building BMPs that require either structures or media or something to be brought in from elsewhere, I would imagine that that would increase in your costs in those types, especially with construction, the cost of diesel fuel, et cetera. And so, again, I would -- I hate to keep saying that it's variable. It depends. It's the traditional engineering answer to everything, but I would say you're absolutely right in the fact that the costs will vary based upon market values and fuel costs.

**MR. McCALLIE:** And then the other question is -- I noticed on your slide that green roofs are way out at the end, and I wanted to ask for some BMPs. I imagine one way to slice BMPs is that some you pay a cost, you get a reduction and you have to maintain them. Other BMPs you pay a cost, but you get payback. For instance, with green roofs you may get energy savings over time. So with something like that, you may actually have a payback period and after that it's a net benefit. On your graph it would actually be all the way at the bottom left, I think, except that you have to get people through a period where they're putting out an outlay before they get to -- pass the payback period. How do you think about that in evaluating the collateral benefit to BMPs and how that affects their costs?

**MS. DeBUSK:** Great question. It was not at all considered in this study. We were simply looking at nutrient reduction. We have seen previous research that indicates green roofs could be problematic in terms of nitrogen reduction, and they have a little better track record with phosphorus. But in terms of nutrient reduction, we did not see them as beneficial or cost effective, but they give many, many services that are beneficial: energy savings, heat cost savings, et cetera. So we actually have kind of -- we've developed a little research niche in Bill Hunt's storm water team where we're looking at ecosystem services of storm water BMPs. And we're trying to put prices on these services. It's very, very difficult. How do you -- how do you quantify the benefits of habitat or esthetics? It's very difficult, but that is something that's kind of up and coming and something that can be considered when you're implementing those types of BMPs.

**MS. JARRELL:** Okay, I have another question, and it's for everyone. What -- based on your experience and data collection and looking at these different non-point source areas, what would you like to see in a strategy -- a monitoring strategy here in North Carolina as far as being able to collect different types of data, or what things do you think are missing from what we're doing now?

**DR. OSMOND:** I'll start with that. One of the things that I said is that you have to recognize what your objective is, and if in fact you're trying to show that these conservation practices work, and then what you need to do is have a paired watershed study.

There are some agricultural paired watershed studies being funded, but there could be more to look at different practices. And that's what I'd like to see, is a few more paired watershed studies in the different physiographic regions looking at different conservation practices. So that's -- for me as an agriculturist, that's kind of the gold standard.

**MS. DeBUSK:** I would say for urban stormwater -- unlike Dr. Osmond, we have quite a bit of data on specific practices. What we're missing and what is of most concern to many municipalities is what happens between that bio-retention soil and the stream or the lake where you're looking for that reduction to occur. And we don't know the answer to that. So we can do everything we can within the watershed, but we may not see the reduction we expect within the lake or the stream. So I think we certainly need to focus data collection efforts on the process of water and nutrients reaching the surface water to determine how that's interacting with the environment.

**DR. GENEUREUX:** One of the things I've been talking about with some colleagues in bio and ag engineering for a while is this -- something we'd love to have, which is kind of the hydro/agro observatory where we have long-term records and monitoring of fluxes for water and nutrients in a stable environment. And it's harder to get these data than you might think. For example, in the West Bear Creek area east of Goldsboro we've had essentially no cooperation from landowners at all until earlier this year. We found one gentleman whose son just graduated a few years back from NC State in bio and ag engineering and brought some ideas back to the farm that are making him a ton of money, and he's been a big help. We think he may have some warm feelings about NC State because of this.

And we visited last year an agricultural research station in the coastal plain. I won't say which one, but we were talking to the director about whether he had records of the nutrients applied to fields over the years. And we were told something about boxes of records being moved to a shed and getting moldy and not having room for them, and they were tossed. And that would have been really interesting and useful for us to know because we're trying to read the archive of what's happened from the groundwater. And, you know, you can do that. We're pretty good at that, but it would be a lot nicer if we could relate that to independent records of what had actually been applied at the land surface. So, you know, some sort of situation where we have records of what's applied, what are the fluxes of water and nutrients in and out of the hydrologic cycle is known very well, and the nutrient fluxes and applications and uses are known very well and those records are maintained and available and you can actually get onto the land to make measurements, that would be great to have.

**MS. JARRELL:** So it sounds like really to get that grassroots effort may be to work with the agricultural community, for example, to help them see the benefit and to be able to really get the information.

**DR. GENEUREUX:** Yeah, we're -- I'm sure what Deanna and others in bio and ag and soil science do is often seen as a benefit. It's easier for them to make the case of the benefit to the farmer. I think maybe we're viewed as a problem rather than a benefit, coming in, trying to read the history of contamination in their groundwater. I'm sure there are others -- probably others in the research community at NC State who have had better luck with this maybe because of the nature of what they're doing.

**MS. JARRELL:** Thank you.

**CHAIRMAN SMITH:** All right. This question relates to TMDLs, and I'll just put it out to all thereof you and you decide what you want do with it. And it begins with the premise that we all know that TMDLs look at the various sources -- point sources, urban non-point sources, agriculture and atmosphere. And the question is, have TMDLs been looked at to attempt to estimate how much total loading is from old groundwater and how that might affect what is required in the efforts to reduce total loading?

**DR. GENEREUX:** I'm sorry, could you say that last part again?

**CHAIRMAN SMITH:** To estimate -- looked at to estimate how much loading is from old groundwater and what impact that might have on the requirements of --imposed on other sources.

**DR. GENEREUX:** That's a good question. That's a good question. That's a hard number to get, and I guess it depends a little on what you mean by "old," because, really, as the data for nitrate versus age show, that there's really very little contamination --relatively little, you know, pre-1960s, even still in the 1960s. The worse situation -- I mean the younger the groundwater is, the worse it is. So, in that sense, really it's the recent history that's carrying the bulk of the load even though there's a memory that goes back farther. I mean think of that exponential curve I showed for the uniform aquifer with uniform thickness. You know if you integrate under that curve, probably -- I mean I don't know the numbers. Maybe a quarter of the total area is probably within the last 10 years, probably more. So it's -- there is a legacy that extends longer, but that memory fades the farther back you go. So it would be tough to apportion that quantitatively. I mean I showed a map on a stream bed, 75 meters of West Bear Creek.

There are a lot of meters of streams in the coastal plain and a lot of kilometers of streams, and what we were looking at there was probably about \$20,000 in dissolved gas analyses to get that information. So it's not the type of thing that's easy to just run around the coastal plain and do every year. Really, it's an ideal application for models and, you know, we really do understand, I think, the basic physics of it pretty well. And if you could extend this information from a few detailed field studies like what we have using models, it may be possible to do something like what the question suggests, which is, you know, apportion maybe by decade, or something like that, the loading. We haven't attempted that yet, but that's a possibility I think.

**DR. OSMOND:** Can I go at that question a little bit differently? As David suggested, it takes lots and lots of money to do that, and the modelers don't do it. So I think the thing that is more important when you have TMDLs, considering the kinds of conversations that Dr. Genereux had about lag time, is when you take -- have those TMDLs, you need to put the year that they're met much further out than the year that people are expecting those standards to be met by, 10 years, five years. I guess in the Neuse it was five years. It doesn't even make physical sense.

**DR. GENEREUX:** Not realistic.

**MAYOR MOSS:** This is a really basic question, but it's really important for me as we -- as I try to look at having conversations with stakeholders, and it's about the wider riparian buffers that most of you mentioned earlier. How would you respond -- just, you know, looking at wider buffers from, say, 50 to 100 feet, what do you think the real effect is?

**DR. OSMOND:** Not much.

**MAYOR MOSS:** Gotcha.

**DR. GENEREUX:** Five percent, right? You went from 50 to 100 feet.

**DR. OSMOND:** You know, it depends on the system, and it depends on the flow you're trying to control. In urban areas, riparian buffers get short-circuited a lot because you have changed the hydrology so much from mostly subsurface flow to surface flow. So, you know, in the urban areas you have a completely different system than you have in the ag area with riparian buffers. If you're looking at nitrate and nitrogen reduction, usually that occurs in a really fine-- fine line where the soils get wet.

It's really the soils that cause the de-nitrification that reduce the nitrogen, not the vegetation. If you're trying to control sediment and you've got a huge amount of sediment coming off, then you want a wider buffer as long as you can get sheet flow over that buffer. But if it's cutting through the buffer, 100 foot doesn't make any difference because it's going to cut through. Kathy keeps talking about "it depends". It doesn't matter whether you're an engineer or a scientist. When you're trying to solve a problem, it depends on the landscape that you're putting that practice in, whether it's an urban landscape or an agricultural landscape.

**DR. GENEREUX:** Let me just add one other thing about short-circuiting of buffers. It can happen over the land surface or maybe through tile drains, but also there's a fair amount of groundwater that just goes underneath it, depending on how you -- how deep you consider the buffer to be. I don't know what thickness you would ascribe to them, but there are certainly flow lines that just go right underneath, which would tend to be the older flow lines. They're deeper and perhaps maybe less contaminated, but there's short-circuiting both over and under.

**MR. McCALLIE:** Have you time for one more question?

**CHAIRMAN SMITH:** You've got three minutes, Grady.

**MR. McCALLIE:** Okay. One, I guess question about -- also about agriculture and groundwater. I think it was last year, 2011, a National Academy of Sciences study about nitrogen cycles noted that, unexpectedly, legumes and I think for us this would be soybeans -- because they fix nitrogen, although not much fertilizer is applied to the fields because they fix nitrogen, they actually act as though in some ways you're applying fertilizer because you have all these concentrated nitrogen fixers. Is that something you've seen evidence of in North Carolina and in the groundwater contribution in North Carolina?

**DR. OSMOND:** So in my slide set I actually had that point, and then I took it out. Depending on -- so these are colleges that work at worldwide scales. Depending on who you talk to, they're estimating that 50 percent of all reactive nitrogen is coming from legumes. It used to be we didn't have many. And what we've seen in the coastal plain is we have had a huge shift into soybeans, and from a nitrogen fertilizer perspective and nitrate leaching, it reduces nitrogen leaching. But from total reactive nitrogen, I mean that's a massive amount of nitrogen that's going in. And so from a groundwater perspective, your nitrate and nitrogen concentrations are going to be lower under legumes. But, still, when you're looking at the global nitrogen cycle, you've got as much reactive nitrogen coming from legumes. So it depends on whether you're looking at air, water or just the total amount of nitrogen.

**MR. McCALLIE:** So in terms of impacts to the estuary, what does that mean?

**DR. OSMOND:** It should be lower because, typically, the groundwater nitrate and nitrogen concentration that's measured under soybeans is lower than under commercial fertilizer. But, again, it depends on whether you're talking about cotton or corn.

**MODERATOR:** Will everyone please join me in thanking these speakers and the panel. [APPLAUSE]

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[END OF Q&A SESSION 1]

**The following is a transcript with minor editing of the second question and answer session conducted on May 30<sup>th</sup>, including the following speakers: John Hall, Michael E. Richardson, and Clifton F. Bell.**

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**MODERATOR:** Thank you, Clifton. I'm not sure I've ever heard anyone from Virginia say we should be proud of North Carolina. So that's a great first. Further, John and Michael, if you could join us up here for the panel questions.

**MR. McCALLIE:** Good morning. This is a question for Michael, and the question is, would it be helpful to have -- I imagine that there must be some sort of a drinking water standard for cyanotoxins that will be on its way. Would it be helpful to have a water quality standard for cyanotoxins and is that appropriate?

**MR. RICHARDSON:** What a specific -- I mean it's hard to answer that, you know, in exactness until we know exactly what we're treating and then work backwards. Is there a problem? If so, then yes, there has to be some kind of things that we have to look for. But we've got to know is there a problem. And we're taking steps to look at those things and see, as I said. You know, these toxins have just shown up. They may be there. They may be so minute that they're not there, but we know that they have created issues if untreated. So I think we have to back into it a little bit.

**MAYOR MOSS:** Michael, this question is for you as well. Have you assessed the incremental treatment cost due to over-enrichment? And if you have or have-not, are you aware of others who have developed similar numbers?

**MR. RICHARDSON:** I have not developed those as far as over-enrichment, and I'm not aware of any right now. I think we've been focused, once again, on the end product and what it takes to satisfy the needs of the customers on a regular basis. Once again, this is something we kind of-- in my way of looking at it, we're kind of backing into it and trying to associate how this over-enrichment problem -- is that the really the cause of this thing? It was spoken to earlier. It's kind of all over the place in some respects. So just focusing in on one side of it is not going to totally be the answer. But we do need to know what's kind of causing the problems, and before we can totally fix the problem we've got to know these things. So I guess that's the best I can say.

**MS. JARRELL:** Mike, I think that your presentation at least pointed out to me that the water treatment or the receiving end is another stakeholder that may be has not considered or included as much as maybe some of the others. And so I think that that's good learning for today; that we need to be sure that we're considering all the stakeholders in what we're looking at. A couple of questions. One is that some toxicologists have suggested that taste and odor should not be considered in looking at water quality standards since they're not health based. Do you have any opinions or thoughts on that?

**MR. RICHARDSON:** Well, I think the taste and odor itself is not, but, once again, it is a big factor in whether you drink the water or whether you don't. If it doesn't look good or if it doesn't taste good or if it doesn't smell good, you're not going to consume it. And, once again, the confidence in the water purveyor is lessened when it's not as aesthetically pleasing and it's presumed to be bad. There again, we're just opening the door on these toxins that seem to be deriving from some of the algal problems that do -- you know, as I said, it's -- geosmin and the MIB are usually the ones associated with taste and odors, and these are not harmful. But there are some others that are riding along with it, so there's some new frontier out there that we need to investigate. It's hard to say that we need to look at that, but obviously there's an issue. We're just now opening the door on it.

**MS. JARRELL:** And as a follow-up, have you noticed if the changes in the water have been significant over a short period of time or over a longer period of time in your experience?

**MR. RICHARDSON:** Over the last 30 years of treating water, you know, the last few years I've seen an increase in algal blooms in our area for the lower Cape Fear as over the previous, you know, 17 or 18 years. They were spotty before, but just in the last few years. I don't know what's attributing to that, whether it's the drought, whether it's climate change or whether it's over-enrichment, what's happening, but something has definitely shifted and causing these problems. So is it cyclic in nature? That's another one. I don't know, but it seems to be an issue that is arising each year that we do have to deal with.

**MS. JARRELL:** Thank you.

**CHAIRMAN SMITH:** Mr. Richardson, a follow-up of sorts on that, and this is three questions but they're all related. Do you have a regular monitoring program for cyanobacteria toxins or is it bloom related? If so, is it post treatment, that is, your monitoring, and what toxins are you testing for?

**MR. RICHARDSON:** We do not have regular monitoring for that. It's cropped up in the last few years-- we do look at algal situations. As I mentioned earlier, for us, we realized that we have some of the latest and greatest tools to handle these things, so we're kind of after the fact looking at these problems. It may be we are changing. We're going towards looking at the future of what's our best avenue of monitoring pre-event, especially in the spring and summer, and seeing if we can begin to figure out what's happening, some database that we're putting in because it's been one of the things that's after the fact.

And the toxins -- you know, just now the new UCMR that's coming out in the three that I mentioned were on there, we're looking for -- we'll be getting data as we start this year in monitoring those. There will be some new information, so we'll probably be continuing to monitor that once we comply with the regulation.

**MR. McCALLIE:** This is a question for John Hall. I was curious. You mentioned that canopy cover seems to be the most important factor for streams. We've had discussions in the past about statewide buffers or buffers on additional watersheds. That tends to be incredibly politically controversial. From your presentation, it sounds as though -- we've often talked about that as protecting downstream waters by intercepting nutrients, but it sounds from your presentation as though in the right places buffers can be very important because they provide that canopy. What is your feeling about buffers, mandated buffers, basically, as a way of getting proactive protection?

**MR. HALL:** Well, I think the entire concept of buffers is in general, you know, a good area to explore for stream restoration. What we were finding in the nutrient issues, in particular, you have to look at buffers in two different ways. What are the benefits in the immediate area of the stream and then what are the downstream benefits, because you can have, as you know, multiple --nitrogen might be more important downstream in a saline area, and phosphorus might be more important to driving in the coastal plain area.

But what we were finding time after time was that -- at least with regard to algal growth on rocks in smaller streams, medium size streams, that the moment the canopy was removed the algal growth took off. I mean this really shouldn't be a shock to anybody and if you've got a big tree on your front lawn and you're trying to grow grass and it's looking a little thin, cut the tree down. You'll grow plenty of grass and you didn't even need to add too much nutrients to do that.

So what we're finding is there are situations where the canopy restoration, and that's a form of buffer, could be extremely effective in returning the stream to its more natural state.

So I'm certainly a fan of that type of effort as opposed to if you thought you needed to get down to 20 or 10 micrograms of phosphorus in an area where the background phosphorus might be 50. Really, you can't get there with that solution, so the solution that might work out well is canopy restoration. So I like to see all of those things on the table when you're looking at your nutrient solutions for an area.

**MAYOR MOSS:** Mr. Hall, this question is for you as well. What is a good alternative for North Carolina to pursue if it chooses not to adopt the numeric nutrient criteria recommended by EPA?

**MR. HALL:** Well, the alternative you should pursue is the one that you -- in my view, is the one that you have been pursuing, the basin planning and strategy approach where you look at the individual needs of different basins. You target key lakes, key estuarine areas for a primary protection up front. That's the scientific and cost effective way to go about the problem. That approach is allowed within the federal regime. EPA was originally, and has been pushing, nutrient criteria for years because a lot of states weren't taking any action in moving forward on protecting their different areas.

North Carolina, quite frankly, in my view is fairly unique. You have had a long-standing program where you have looked at the specifics of different areas, and it's led you to come up with different solutions for different areas. There's nothing in the Clean Water Act that says that is anything other than acceptable, so I would say stick with what you've been doing. Keep showing progress and if you need to adopt, oh, say indicator pollutants -- you have a chlorophyll-a level, for example, that you apply in lakes that you don't want to go above. You've got a similar level for your estuaries. You know, come up with the environmental indicators that are the responses to nutrients and other things. Use those and then generate the right nutrient control from that. But don't think that you're going to have single phosphorus or a single nitrogen number that's going to work. I mean all I've ever seen that happens from doing that is controversy, and then people don't make progress, and that is not a good thing.

**MS. JARRELL:** Okay, these questions are for Clifton. In talking about cost effectiveness, would your conclusion regarding storm water BMPs change for combined sewer systems if you can avoid significant investments in gray infrastructure?

**MR. BELL:** Well, I assume that question is referring to the use of low-impact development practices to reduce wet weather events or overflows. And I think the cost per pound of that is probably going to be probably a little better than for storm water simply because you're talking about wastewater as opposed to storm. Storm water is even though the concentration of nutrients is elevated over natural water, you're dealing with a very dilute substance as opposed to manure or wastewater. So I would think the same practice as applied to a CSO overflow that's going to have higher nutrient concentration would be a little better. But when you're talking about orders of magnitude, higher concentrations, I think it's still going to be all the way to the right of that curve in terms of being among the most expensive ways to reduce nutrients.

**MS. JARRELL:** Is there also, though, the added benefit of reducing greenhouse gas emissions because you're planting trees?

**MR. BELL:** Yeah, anything -- anything where you're planting trees and you've got a big enough footprint that it makes a difference would in fact have that benefit, yes.

**MS. JARRELL:** Okay. And one other question related to cost. On the point source costs that you were showing in your presentation, did that include the biosolids disposal costs?

**MR. BELL:** Yes, it did.

**MS. JARRELL:** Okay.

**CHAIRMAN SMITH:** This one goes to Mr. Hall and this is, in a sense, a follow-up to what you were just talking about regarding what should North Carolina do and how should we proceed. And I'll paraphrase this question since its writer, like everybody else in the room, has strong opinions, and I'll put it this way. Is it correct that you're not saying that nutrient enrichment has no adverse effect on stream ecosystems? Is it correct that you're not saying that?

**MR. HALL:** Oh, I'm certainly not saying that.

**CHAIRMAN SMITH:** But that your recommendation is for a solution, for a plan going forward is focused on site specific applications?

**MR. HALL:** That's correct. I mean, I think if you break the situation up into pieces, there are different stream circumstances that you can regulate via nutrient control and other ones that are going to be extraordinarily difficult to regulate via nutrient control. And those, as I mentioned, in particular involve where on small streams you've taken the canopy down.

Again, what -- and I didn't bring the slides with me, but there was a little quote at the bottom of one of the slides, and it was from Walter Dodds, who was one of the leading researchers who was looking at periphyton growth in small streams. And after many years of believing that you were going to be able to regulate periphyton growth effectively via nutrient control, he put out a paper that said, "You know, periphyton can grow to really impressive levels in nutrient poor waters." Hmm. Well, we need to rethink. If we need to control that end point and we want to regulate that end point, how are we going to do it? Not that you should ignore it, but what's the way to get to the ecological improvement that you're trying to get to? In some cases, it's just not nutrient regulation. You can't get there from here. Other situations it is. You just have to look at them case by case.

**MR. McCALLIE:** So this is also for Mr. Hall. I wanted to circle back to the question of proactive protections. So in North Carolina, as in many states, we've got outstanding natural resource waters or high quality waters. Those have sediment measures with them, and then you've also talked a lot about what we do if the water isn't meeting its uses or if it's impaired. But what about just regular fishable, swimmable waters? What is the appropriate way to think about management measures to keep them clean?

**MR. HALL:** That's an anti-degradation question, and it's a good one. For those kind of waters that are not currently impaired, the idea is not, shall we say, to conduct the experiment to figure out just how much more can I keep loading it before it all turns green and then I have to try to undo what I've caused. Baseline monitoring programs are what I would normally recommend in that situation where you get early indicators of changes in algal growth or other relevant nutrient-related impact indicators, such that the agencies that control the situation can decide when they have to install or when you have to make progress on maintaining existing loads.

I think, quite frankly, most of the storm water program requirements that are going to be coming in over time are going to keep those loads either where they are now or lower. And then it seems -- though I understand the effectiveness of the ag BMP programs is sometimes up and down, and I understand how that can go. But that nutrient management should keep things in a positive direction or, in other words, the load should not just keep rising until we've run into a problem. But the only way to ensure that is with a monitoring program.

You've got to keep an eye on what your current levels are and where things are moving to so that you can make intelligent decisions as to what the next round of regulatory requirements need to be to preserve that water quality, because you don't want things to turn pea green and then fix them after the fact. That's just not a good idea.

**MAYOR MOSS:** This next question could be for any or all of you. Has anyone looked at the cost of land protection relative to other structural BMPs and point source initiatives?

**MR. BELL:** I can take a shot at that. I think that probably the closest thing -- the closest slide I would have had to that would be riparian buffer/forestation slide. And in terms of a cost per pound on converting, say, an agricultural land use to a forested state is extremely cost effective. It's probably one of the easiest ways to generate a lot of pounds with one project. So in terms of land preservation, which I think how the question was phrased, from a regulatory standpoint, if there was no net change from your baseline, I don't know that there would be any credit given for that reduction. I think there would need to be a conversion.

**MR. HALL:** I suppose that was almost a softball question on the Tar-Pamlico. I mean that, in essence, is why the regional approach on the Tar-Pamlico was developed, because when we looked at some of the elevated costs for nutrient reduction -- and it wasn't just wastewater. We knew storm water requirements were going to be coming down in the future. That looking at some of the cost-effective alternatives, whether it's buffers, other BMPs, why would anybody would build extensive storm water reductions with the type of dollar numbers you're looking at per pound as opposed to, what, spend twenty cents on the dollar and putting twice as many other more effective BMPs?

I mean, really, in the end you're trying to get to a particular outcome. If you can find those other options available, it's just a cheaper way of getting from Point A to Point B. And that, I think, does need to be an essential part of the state program when you see these types of high-dollar numbers coming in on the storm waterside.

**MS. JARRELL:** Okay. I have another question for Clifton. Based on what we've learned about legacy nitrogen in groundwater, how does that affect the cost effectiveness of agricultural practices?

**MR. BELL:** Well, I suppose you're hoping that it will eventually, if you're reducing at the land surface and you're reducing the shallow groundwater concentration that you will eventually see that benefit. I think one of the implications of those long lag times, when we're talking about considering our options, is certainly to emphasize the need for patience.

But, also, one of the things the regulated community is going to be looking for is reasonable compliance schedules for doing things. And I think, you know, an implication of those long lag times is even if we have a very reasonable implementation schedule, we will still be done long before the non-point source problem is fixed. So you can feel comfortable giving us that implementation schedule.

**CHAIRMAN SMITH:** I've got a couple of questions here that, in one sense, are related. The first one -- both of them deal with how to go about being proactive, and I'll put it to all of you. But the first one is focused on lakes, and it asks whether or not a nutrient -- a numeric nutrient criterion would be effective or preferable for lakes as opposed to streams since it seems that we've been reactive to lake management rather than proactive. And then the second one is more general, and it is what approach is best for states that want to be proactive in addressing these various environmental indicators and, in particular, addressing nutrient over-enrichment?

**MR. HALL:** Let me give a quick shot at the lake response. Lakes are far more uniform in their response to nutrients. With that said, they're not completely uniform. The way to structure lake criteria is similar if you're going to do it. And I'm generally, I don't say, a fan of lake criteria, but shall we say they have far greater utility and can start you off in the right direction than having nothing and certainly compared to streams. If you wanted to do lake criteria, you set them as a range. You pick your chlorophyll-a targets that you think are relevant to the lakes that you want, and then you set a range of phosphorus and/or nitrogen, whichever you think is going to be controlling-- a range of potential control for the phosphorus, because the lake is going to vary.

Lakes will vary, and one lake may require a much lower phosphorus number than another. And if you build your criteria in with the flexibility that it already has a range, then just as a nuance point to the Clean Water Act, if you build in the range, you don't have to develop a site specific water quality criteria and get EPA approval to use something in that range. That allows you to bring some science to bear to determine where within the range you want to be. And if you want to have a driver for that, you can tell people that they need to be on the lower end of the range if the science does not get produced to show where in the range you could be. I mean you could do that as a forcing function if you want to, but I think that approach on lakes would be workable and wouldn't lead to inappropriate solutions being dictated from a single number approach.

**MR. BELL:** And if I could address the part of the question about being proactive, the threshold rules were one of the things that led to this forum. And having worked with a regulated community a bit on this issue, one thing I learned is that the issue with the threshold rules was not the concept of using a response variable to detect problems that are coming and addressing them proactively. There was a lot of support for that concept, but the issue was mandating or prescribing what the management response to that is, which was another part of the threshold rules. If we have meaningful response variables that are linked to designated uses, you know, it's very appropriate to use those to look at trends and to determine where you need to make proactive steps. But you need those meaningful response variables.

**MR. RICHARDSON:** As far as the drinking water aspect, once again, we've been the end user. We kind of lag behind, but being proactive helps us to begin to be part of the solution, not part of the problem and how it affects us, what goes on with it, you know, being able to do feedback as far as the criteria. I don't know that the connection is always there, but we need to be providing information and sitting at the table so that we can be part of that and offer up information, how it, you know, goes in with our program as far as meeting the regulations and other regulations that we have to meet on the drinking water side.

**MR. McCALLIE:** This is a question for the whole panel but keying off Mr. Bell and your presentation about the different costs of the different approaches to nutrient control. It's a question about trading. Trading can be used to sort of let folks self-select which are going to be the cheapest approaches. I often tend to be concerned about the potential for hot spots and the potential for sort of mismatching accounting so that the reductions aren't actual, real reductions but people are buying -- they're getting -- some people are buying credit that they're going to use where it's supposed to be real reduction, but they're buying it from somebody who hasn't actually kept careful track or we don't actually know it's a reduction. Dealing with those issues imposes a transaction cost.

So I mention your general thoughts about the applicability of trading, but also, in particular, how large a market does it need to be? How large an amount of nutrient reductions do you need to be going for before trading is actually viable once you've got the transaction costs considered?

**MR. BELL:** Yeah, in addition to transaction costs, there are things like delivery ratios, and some states use retirement ratios that all start eat into that credit that you tend to get.

I think you can get some kind of sense of that from the cost per pound of these -- of these. So typically, by the time you've paid your transaction cost, you've taken into account a non-point source ratio to account for the greater accountability, that you probably you're looking at having to buy at least two pounds for every pound you need, and delivery ratios can make that worse.

You know, that's the problem with your guideline right there. If there's at least a factor of two or so in the cost per pound that you can pay that and still make -- it still makes sense to do. I don't know how to otherwise address the part about how big the market has to be. I would think you can certainly see trading programs where it's kind of a farm by farm kind of approach. And even a very small market, there might be a developer somewhere that wanted to get a few pounds out of one site as long as the framework allowed you to do that.

**MR. HALL:** I'm not so sure size of the market is really the driver. It really comes down to the incremental cost. When you're looking at wastewater facilities, the threshold I've always suggested to the clients is don't even think about trading until you have basic nutrient removal in and you've tuned it up and you're getting close to "do I need to add methanol?" The methanol addition threshold is a place where I'll say a lot of bizarre things happen. You know, you're bringing in -- you're trucking something in that had to be manufactured somewhere else that's got a high cost associated with it and little things under the Clean Water Act like anti-backsliding and things like that that apply to permits. This is almost like once you start this train; you're not going to stop it.

So when you're looking at that high cost switch, where you're going to move over to something that really will jump things up and you may have to continue it in perpetuity, that's the point at where I recommend that the clients look at the alternative solutions. Now, I do have to say at least on the storm water side it is a little bit different. Some of these BMP costs can be enormously high per pound, and it just seems to make far more sense to have flexibility on whether or not I'm doing a more detailed MS4 program or picking selected technologies or BMPs in agricultural areas. With that said, if you're going to pick BMPs, they really need to be ones that, if you will, operate themselves, have a high reliability. One of the ones that we used in the Tar-Pamlico, I thought to considerable success, for nitrogen reduction were little check dams in these streams. You know, you want to de-nitrify water going through a system? Slow it down. Everybody is draining their fields. They're draining them into ditches. Put check dams in the ditches. And the reports back that we got were that these were extremely cost effective. Of course, you needed to make sure they didn't get completely silted in and things like that. You had to pay a little bit of attention to it, but do simplified ones that get you some prompt bang for the buck, not these things that require a lot of attention.

And, as you said, somebody is showing you something on paper and says, "Here's the nutrient reduction." Oh, really? Is that a paper exercise or is that a real exercise? Because you need to trade for real reductions, not -- not calculated predictions.

**MODERATOR.** We're about out of time. If there's one more quick question, we can entertain that or break now.

**MS. JARRELL:** I have just one. It's a question about fertilizers. Are slow-release fertilizers or fertilizer reformulations a cost effective option for lawns.

**MR. BELL:** Yes. They will prevent a lot of your fertilizer from being lost early on in a rain event that they're beneficial. Urban nutrient management is an interesting issue as to how you cost it, though, given that that actually; doing a soil test is very cheap. Actually doing a public relations campaign to get people to do urban nutrient management and wondering how many people are going to respond to that can drive that cost up, though.

**MS. JARRELL:** Thank you.

**MODERATOR:** Join me in thanking our speakers. [APPLAUSE]

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[END OF Q&A SESSION 2]

**The following is a transcript with minor editing of the third question and answer session conducted on May 30<sup>th</sup>, including the following speakers: Mary Jo Kealy, Bill Holman, and Jeffery Hughes.**

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**MODERATOR:** Mary Jo and Bill, if you will join us back up here; we'll subject you to our panel.

**MAYOR MOSS:** Sometimes it's better to be lucky than good. I guess it would be lucky that it's my turn to go first with the question this time. Bill, this will be for you. This is actually a comment and a question. I'll ask the question second, but I do want to thank you tremendously for the great marketing slide that you put up about Creedmoor. Your collaborative water management slide was a slide of Falls Lake. It was mainly in red. There was one blue stream. That's Beaver Dam Creek. That's Creedmoor. It means we're doing something right. I feel good about that, but the thing I wanted to just tell you is that that is a great example of collaboration. That was a \$2.1 million grant from the Clean Water Management Trust Fund, plus \$150,000 from the City of Raleigh they invested in Creedmoor. They actually saw the value of helping us help them. So, to me, that's a great example of the collaboration that you talked about.

But this is the question. What proactive approaches make sense for protecting North Carolina waters from nutrient pollution as opposed to waiting until something obviously bad happens? Specifically, are there any rules that the EMC could adopt?

**DR. HOLMAN:** A great question. We spent a lot of time today talking about the well-known and thought-over nutrient sensitive waters, the Neuse, the Tar-Pamlico, the Randleman. But there are other waters out there, and we all know about them. I mean I've changed jobs four times, and High Rock Lake has still been in this kind of pending nutrient sensitive --I mean it is nutrient sensitive. It just hasn't been classified as such. Jeff -- I think Jeff Morris has left, but we all know Lake Rhodhiss has had nutrient issues, and Lake Raleigh has had them. I think there have been some improvements there, but there's a lot of growth in the Charlotte metro area. There could be some challenges there.

I think one thing the EMC could do is just sort of put the word out there. Sooner or later we got to deal with these nutrient sensitive waters in other parts of the state and invite the people in that region to get started. I'm a former regulator. I believe regulations have a place, but there's no reason for folks in some of these watersheds not to start getting together, start sharing information. You put them on notice you care about those waters. The state may play a future role, but give them a chance to, you know, come up with some ideas, share information, move to the site specific approaches. So that would be one thing I'd throw out.

How to deal with this sort of bigger question of how do we respond to EPA and numeric nutrient criteria and so on, I don't have really a great answer for that. The EMC and other agencies in the past have created these kinds of more structured processes. We heard yesterday about Florida, their technical advisory committee that advised the state on their program.

I think there's some great talent in our universities but also in our environmental consulting firms and our citizens and stakeholders that it wouldn't hurt to explore that. I think we do have to make a choice between are we going to sort of stick with our site-specific watershed by watershed approach or are we going to, you know, look at a different strategy? There are pros and cons to each.

**MR. McCALLIE:** Jeff, I was thinking about your slide where you're talking about bundling, and in some ways a great example of a program at the state level of bundled money and then spent it in a bundled way was the Clean Water Management Trust Fund with projects all over the state. A couple thoughts about that. One is that it points -- there was pressure to spend some of that money on things that actually weren't particularly useful projects, and then in -- just in the last year it's been focused -- the focus of ideological attack so that the current draft budget has it down to eleven and a half million non-recurring.

So a question, when you're thinking about constructing a source of bundled money, what do you do to avoid having it being diverted to other purposes and, two, avoid having it be cut for ideological reasons down the line?

**MR. HUGHES:** Well, the first question about how do you keep it pure, you know, I thought a lot over the years. And, you know, North Carolina has the Clean Water Management Trust Fund. Another program historically that has done a lot of water and wastewater improvements are the funds administered by the Rural Center -- Rural Economic Development Center. And, you know, we've worked in other states that have had similar efforts, but I think North Carolina is well known for the Clean Water Management Trust Fund being really unique in that it's pooled together in an organized way. I honestly think that it is -- it's going to be political in some way -- form or fashion, but I have seen states where they don't pool it that way. There are many states and you can kind of look across to Kentucky, for example, where there were years where they were spending the same amount in gross of state funds, state collected from us. But their approach was line item earmarks.

And this is -- if you want to talk about politics, whatever kind of politics went into -- and I know not when Bill was there -- the Clean Water Management Trust Fund, start to a place where you just are picking project by project and moving funding. I guess a little bit of a pragmatic answer is I think you can have good criteria, and I think over the years the criteria for the Clean Water Management Trust Fund and the Rural Center, they've been perfected and modified. So I think that gets you down the way. But I also think having a little bit of transactions costs and a little bit of politics is not necessarily a bad thing. You're weighing that, again, with, I think, the large significant advantages of the bundling.

Now, for some, that whole idea of taking my money at the state level and then giving it back to me is anathema, especially for the large urban areas that might feel like they could do it cheaper. The question is just are these public goods where we're all in it together, or are these very private goods where each individual or each city should go it alone. And it's, in a large way, an economic debate.

**MR. McCALLIE:** I wonder if Bill wants to comment on that.

**DR. HOLMAN:** The Clean Water Management Trust Fund was actually a bipartisan creation, and it goes back to the fish kills in the Neuse. Remember, we had the fish kills in the Neuse River in the summer and fall of 1995. Fortuitously, New Bern was represented by a guy named John Nichols, Republican chairman of the house who started out his career as a legislator being pretty hostile to the environment. But when a lot of his constituents were raising Cain about dead fish washing upon their docks, he had a conversion. And in part, the reaction -- the Clear Water Management Trust Fund came from a reaction to the regulations that the EMC proposed because when the governor said to the EMC, "I want the river cleaned up," the only tools the EMC had available were regulatory tools.

So I think the legislature quite wisely recognized a year later that we needed regulatory tools but we also needed non-regulatory tools. We needed incentives, and so we were fortunate. Also, the state budget was much healthier in those days, too. But I'd like to think that that could happen again. We have some new legislators. Many of them are ideological, but I found sometimes ideological people can change when something happens in their own community and their constituents say, "This is unacceptable. Fix it." And so I hope that will happen again.

**MS. JARRELL:** As we know and what we've just been talking about, DENR's resources have been more limited, and that makes it much more difficult to do much of the work that needs to be done. And we do have resources -- we have a lot of other resources available to us. How do you think that relationship should continue going forward to help us optimize looking at these different areas of the state and looking at the different water bodies and making the evaluations as we've been going forward and doing, but how can we continue to do that together?

**DR. HOLMAN:** I think there's some great examples out there that need to grow. I mean the Catawba Water Management Group is in part organized because of response to FERC relicensing, but it's not only water utilities. It's Duke Energy in North and South Carolina, so it's local governments and Duke Energy that share the Catawba water resource. And they're not just meeting and sharing information, but they're taxing themselves in contributing to a common pot. They're, you know, buying some monitoring data. They're doing a 50-year water supply plan. That's a very exciting initiative, and I think over the four or five years the organization has been up and going the members have found value in it and, therefore, have continued to invest.

There's also the Upper Neuse River Basin Association. It's, you know, stepped up. It's increased its dues, and I think it's trying to provide a common meeting ground for its members to share data. They've hired Cardno Entrix to help them with monitoring. Forest Westall is out there somewhere giving them some advice. You know, I'm a real advocate. I think we need more watershed-based organization, but I also think we -- they also need to start straddling the quality/quantity issues, and I think there are resources there. I mean, sure, it costs money, but there are efficiencies when people pool their resources by common models, engage their citizens and start developing watershed-based approaches.

I really admire the work the state does, but I know when I was working for the state we could only do one hard thing at a time. It could be air or water, too. It couldn't be like an air thing and a water thing. There's just too much going on in North Carolina now for the state to be trying to solve every problem. So I think the state is going to have to rely more on -- it's going to take more sophistication at the regional level, but the state is going to have to rely more on the local knowledge that people have. And sometimes the state is still going to have to push. The state is going to have to say, "Hey, if you don't do something, you're going to run out of water," or, "If you don't do something, the uses in this reservoir are not going to be met." The state has to provide that disquieting or unsettling information, but I do think a lot of the solutions could be more regionally based in the future. And it gets closer to the people that are benefitting from those services. They're the ones helping pay for it.

**MR. HUGHES:** Again, I'm focused a lot at the local government level, and I think there are a lot of resources. There's probably, I think the last time we checked the numbers, maybe \$2 billion collected in water and sewer fees a year in North Carolina. So, you know, even the cost side is quite high, the revenue side is quite high. I do think folks like Mayor Moss are seeing that a lot of small communities are feeling they're at their capacity for their citizens to pay -- to pay more. So I think that's a real challenge.

I have noticed that the folks -- just anecdotal level, the folks that are saying what they sell is a very narrow product. They sell wastewater treatment or they sell -- even narrower, they sell sewer.

Their citizens are having harder and harder time understanding why those -- when I flush the toilet, it seems just like I flushed the toilet last year, but I'm paying a lot more. I think a lot of little governments are going this way. You have to sell something different than what you deal with flushing the toilet. What you're selling is a quality of life. You're selling environmental improvement. So I think the ability to at least raise revenues at the local level is going to require as much PR as anything. It doesn't work when you're selling regulatory compliance. I mean it may have to, but I honestly think I was a utility director at times, and I know how -- how somewhat comforting it is today it's not me, it's them.

The problem is that long-term I'm not sure it always does the best interest blaming the next level of regulator because then people aren't really that excited about paying for regulation, but they seem to be fairly excited about paying for a body of water that their nine-year-old can swim in. So, anyway, that's just a little soap boxing. But, you know, that's kind of where I think it is. I think any way you look at the numbers, though, moving forward, I think we're just -- we've already started to see where the resources are coming from. Again, it's probably not good news for folks like Mayor Moss, but the revenues and resources are generated at the local level versus the state and the federal level --I have people remembering the good old days in the 1970s when they would pay for 75 percent of a wastewater treatment plant. You know, I don't see those coming forward. I think you're going to have to tap in to that local level revenue, and it's a pretty deep pool, but it's somewhat uneven and it's going to require a lot of courageous mayors out there.

**MS. JARRELL:** Do you think North Carolina needs a flush tax?

**MR. HUGHES:** I don't think we need or could really sell a flush tax at the state level. I don't think we have a culture -- the Chesapeake Bay is an iconic body of water and I think that came across the other day. So I don't think it's a state level, and there's been state level proposals. I mean my personal opinion is that that would be a little bit of a tough sell convincing someone in Cullowhee that, you know, they should be contributing to a project that might be done in Cary. Nothing personal. But I think that statewide culture might not-- might not be there quite as strong here. But I definitely think at the revenueshed or at the multi-county level there's a lot more we could do.

I'm really encouraged to see -- I mean it's taken -- again, Charlotte and Mecklenburg County have somewhat of an example of this, but, you know, we have had storm water utilities in North Carolina for the last 15 years. As far as I know, this is the first kind of large-scale regional storm water utility. We still have relatively few local governments that do storm water and wastewater and water in an integrated way. So there's a lot of ways to pool things without going statewide, although if somebody wants to -- I know we have a lot of advocates in the room. If somebody wants to sell a statewide fee, I'm happy to calculate how much you raise, but I think it's going to be a little bit harder sell.

**MS. JARRELL:** Thank you.

**CHAIRMAN SMITH:** We'll get Mary Jo to do the benefit cost.

**DR. KEALY:** Well, I do want to say that just as we heard yesterday and then we were talking a little bit more today that part of the problem is the need to show that what we'd like to do is effective, that we will in fact provide these benefits. I do think that we've got the vehicles, and we were talking about one of them today, to learn from the public what they're willing to pay for that benefit. But you have to kind of have some chance of delivering on that benefit. So the -- the information, though, from the public on what they would pay if you could deliver that benefit does motivate you to say, "Well, let's see if we can." You know, let's see if the science would support it and then go out and implement. But if the public weren't willing to pay it, you kind of step back and say, "Well, maybe we're pursuing the wrong environmental objective." We've got so many environmental objectives out there. Are we pursuing the right one?

But I think with respect to quality we're seeing over and over again that this is something that people relate to. They have -- in your own state and in your own local region and in the nation as a whole for some of these major resources, like the Chesapeake Bay, we have an identify and feel a responsibility and feel -- as a rule, I think we're finding that we do feel people do want to maintain and improve this attribute that we call part of our quality of life. But we can't be throwing money away. We can't deliver and we don't know what we're doing. Don't waste those resources on something that doesn't effect change.

**CHAIRMAN SMITH:** I think Mr. Hughes may have just answered this question, but I'll put it out anyway and see if anybody has anything they want to add to it. How could the state create a sustainable source for funding water infrastructure projects in North Carolina?

**MR. HUGHES:** You know, I think a lot -- Bill and Richard have both been involved in looking for the infamous dedicated revenue source for these things. And I think there's -- we have a couple studies. DENR did a study a few years ago in an informal kind of workgroup. There are some options. They're fairly limited. I think that part of the solution -- certainly a flat fee would be one approach. There's -- there are states that do water extraction fees, you know, based on the amount of water. Again, not particularly popular with large urban utilities in the states where they have tried to implement those things. But there are -- there are options to do.

I think the key is diversification. You know, if you can get a pool funds at the state level that can be matched with -- there's a lot of psychology involved in this, and I think having even -- you know, a lot of the projects Clean Water Management Trust Fund supported, it was leveraged. I mean they used a little bit of state funds matched with local funds. So I think getting one of these statewide revenue sources to fund all our problems is probably unrealistic. Getting something that could generate \$50 to \$200 million I think is feasible for a state with the kind of economic output that North Carolina has. But you are going to -- you are going to have public -- they might come to face you at EMC, and you are going to have public hearings with folks raising their arms. And they did -- you know, they did in Maryland. They did -- anywhere where I found a sizeable environmental revenue -- environmental finance system there's been some outcry, although it's usually less than you would predict if it's sold properly and if people see benefit. So I know that's a little vague, but I have the answer. I'm just holding it.

**DR. HOLMAN:** I'll just agree with Jeff. I think in the short run there's not going to be a state [inaudible] water, and I chaired the State Water Infrastructure Commission. Water is not high priority for the state right now. It is the high priority in some regions, though. So I'm more optimistic that the Catawba Water Management Group -- they're doing this 50-year water supply plan. They're going to come up with some options. Then how do they pay for them? I mean then -- there will be a plan laid out, a case made to the public and the utilities, "here's where we need to invest, how we are going to finance it." There may be more sharing there. You know, same in the Upper Neuse: "Here are the most cost effective things for us to do, here's where it makes sense for units to go on their own, here's where it makes sense for us to share; you know, let's figure some payment mechanisms like the Upper Neuse Clean Water Initiative." So I think -- and was it Doug from TetraTech yesterday talking about the South Florida Water Management District? Even with their budget cut, they're still investing about \$50 million a year in payment for watershed services. A lot of it driven by water supply and flood issues, but I think that the models are out there to look at structures more to the regional or watershed-based level. And I think you can -- you can make a greater connection to the people paying the fee for the benefits they're getting.

**MR. McCALLIE:** This is a question for Dr. Kealy. This morning the presentation by Dr. Genereux about groundwater -- nitrogen in groundwater was in some ways shocking to see the way in which we can take out a debt -- environmental debt that we're going to be paying for decades.

I'm curious, in willingness to pay studies, do you find when -- there are different ways to tell the story about Dr. Genereux's information, but that's one. When you find the public gets information that's kind of startling like that, do people's willingness to pay change based on the depth of information they have about an environmental problem and their relationship or their action to it?

**DR. KEALY:** The value is context specific. So if you change the context or people's understanding of it, their value will respond. Having said that, most of us don't understand groundwater, period. But in our survey we said, "Look, you're not going to see this improvement tomorrow. It could take 20 years, it could take longer." So it really is buying into the long term, you know. We would expect a different answer if we said we could give it to them tomorrow. We would have expected probably higher values sooner rather than later. So I think the important thing, if you're using this sort of information to help them form policy, you have to recognize that the story you tell people is what they're going to value. And you can't take that number for that story and apply it to something else without making some adjustments, I imagine.

**MODERATOR:** One last question. I think we have time.

**MAYOR MOSS:** Okay. I'm struggling getting this straight in my head, so bear with me just for a moment. I'm trying to kind of balance out this notion of your project boundary thought, bundling in economic development. And my question is going to be, do you see any potential for not only cross-boundary collaboration but even cross-agency collaboration within the state of North Carolina to really get the biggest bang for our buck? Let me give you my example, NC 50. Granville County is a member of the Capital Area MPO. They determined that our transportation needs are much --are being more influenced by what's happening in Raleigh than north of us. There's a very dangerous slide from my perspective in the NC 50 corridor study. From 540 to the south side of Falls Lake, developable land is 75 percent built out. The north side of Falls Lake to the River, 25 percent developable land available. From my perspective, that is a very dangerous slide from a water quality standpoint for Granville County because if I'm my neighbors in Raleigh, I don't ever want to see another house built in southern Granville County. All that said we're trying to drive economic development. Do you see any possibilities of creating a win-win scenario where good things happen for everybody? It's kind of a crazy question, I know.

**DR. HOLMAN:** I'll take a stab at it because it may be crazy, but I think -- if you're the mayor of Creedmoor or the mayor of Oxford or the mayor of Stem, you're elected to advocate for your community and try to make your community a better place, just as the mayor of Durham or the mayor of Raleigh is. But I think particularly with the changes the legislature's made in our annexation laws, it's -- you know, our path for growth is we're just going to spread out. A city is going to grow by spreading because they can annex. You know, you can't really do that anymore. So I think one of the challenges for a small town like Creedmoor or a larger city like Durham is we got to make places where people want to live. And, storm water utilities and I think, honestly, the public doesn't care much about storm water, but they do care about flooding. They care about greening the city. They care about recreational opportunities, connecting to nature, those sorts of things.

So I think a part of the story here is to sort of see this as an opportunity to, yes, you have to reduce pollution going into Falls Lake or pick your other water body, depending on where you are in the state. But, you know, can you use this as an opportunity to make your community, you know, a great place to live and attract the economic development? And, you know, that NC 50 I'm sure is a very challenging issue -- a regional issue because it cuts right through Falls Lake, but I think -- I personally think the folks in Raleigh are going to be much more willing to entertain options if they believe their neighbors in Granville County really are committed to water quality.

So I think the collaboration you all are building in the Upper Neuse River Basin Association and these other efforts will pay off in the long term because part of it is developing a trust between communities that -- yes, you're there to advocate for your community, but you're aware of these other regional issues. I think it's very important in the Triangle for folks to get along in the Falls and Jordan Lake areas because there are so many other things the communities need to do together. They need to do water supply planning together. They need to do regional transportation planning together. They need to do regional air quality planning together. If you start fighting and squabbling over water quality -- you can say, "Oh, we're going to work together," and these other things, but, in fact, it doesn't work that way. You know, things splinter apart. So I really admire the work that the local officials have done in this region and have taken some heat. I mean regionalism sounds good, but you know, Mayor Moss, in your own community you don't get reelected on being a great regional citizen. You get reelected on looking out for our own constituents. I hope we can find ways to build that collaboration and support each other in striking that balance on these regional issues.

**DR. KEALY:** May I respond to that? One implementation mechanism that we designed for the City of Damascus, Oregon, that was told that it had to accept growth from their current 10,000 to 60,000 people -- meanwhile, they're a lovely rural community. They've got bluffs. They've got sensitive areas. They've got clean water quality right now. And what we designed for them was actually a market for ecosystem services. We endowed landowners that were holding the high priority lands that you want to preserve with an asset and then a choice. Either you can sell your credits and preserve the area or you can develop the area, sell to developers. And, meanwhile, developers, including the city itself for its public facilities, would need to buy credits in order to develop. And we set up the system so that you have the incentive to develop the less ecologically desirable area and preserve for everyone, for the entire community, the more desirable areas. So it's one way to implement your dream.

**DR. HOLMAN:** Next Friday, June 8th, there will be some Duke and UNC researchers presenting some of their work on payment for watershed services and another revenue shed talk. The Triangle J Council of Governments is hosting us from 10:00 to 12:00 at their offices. Actually, just kind of across the street. And a final coming attraction in the fall, the Nicholas Institute and other partners are planning a conference on the Clean Water Act, the role of states. Numeric nutrient standards will probably be one of the issues we try to drill into. I think most of you know this year is the 40<sup>th</sup> anniversary of the Clean Water Act. It's had some great successes but also some areas we're falling short on. So we're looking at hosting this at Duke Gardens on September 18th and 19th. We'll work with EMC and others to get the word out, but you're all invited.

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[END OF Q&A SESSION 3]