Stakeholder Engagement in the UNC Nutrient Management Study

August 15, 2017

Kathleen Gray, Grant Parkins, Megan Rodgers and Victoria Triana

Contents

Introduction 2
Methods 2
Findings 3
Perceptions of "Good Water Quality" 3
Water Quality Concerns 4
Perspectives on the Value of Good Water Quality 4
Responsibility for Maintaining Good Water Quality 5
Role of Government 6
Equity 6
Nutrient Management Strategies 7
Success Stories 8
Failures 9
Information Needs Identified by Participants 9
Conclusions and Future Engagement Activities 10
References 12
Appendix A: Focus Group Topic Guide 13
Appendix B: Codebook 14

Introduction

During the 2016 legislative short session the North Carolina General Assembly approved a special provision in the annual budget bill that directed UNC-Chapel Hill to compile water quality data and evaluate nutrient management strategies in the context of Jordan and Falls Lakes. As part of this study, the UNC Institute for the Environment (UNC-IE) sought to understand how key interest groups in the Jordan Lake watershed viewed water quality in the watershed, what approaches they recommended for managing nutrients and additional information they desired to inform decision making, with an emphasis on information that could be gathered by scientific and policy researchers on the study team.

Involving stakeholders in environmental decision-making has been shown to improve the quality of resulting decisions and provide information that can shape environmental research (Beierle, 2002; Reed et al., 2008). Further, the participation of diverse stakeholders can increase the quality of environmental management plans (Brody, 2003). In several studies, focus groups have been used to better understand stakeholder perspectives associated with environmental management strategies (Gordon & Barton, 2015; Monaghan et al., 2016; Murti et al., 2016; Henrich, Holmes, & Prystajecky, 2015). This approach is well suited to discussion of attitudes and decision making, as group dynamics typically enable participants to compare and contrast their experiences, which can provide unique insights for researchers (Rossi, Lipsey & Freeman, 2004). When the focus of a study is to compare beliefs and attitudes of people of differing backgrounds, as is the case with this study, focus groups consisting of separate, homogenous groups have been shown to produce a greater depth of information (Knodel, 1993).

For these reasons, UNC-IE employed focus groups as a primary method of researching stakeholders' views about water quality and nutrient management in the Jordan Lake watershed. The ultimate goals of the research were to identify: (a) locally relevant perspectives that could inform scientific research and policy decisions related to nutrient management and (b) research needs expressed by stakeholders that potentially could be addressed by the UNC-Chapel Hill study team.

Methods

The stakeholder engagement research team conducted focus groups and one in-depth interview with stakeholders involved in nutrient management in Jordan Lake. Focus group participants included leaders and staff from local governments in the Triangle and Triad regions, realtors/developers in the Triad region, and environmental nonprofits from central North Carolina. The interview was conducted with staff of the NC Farm Bureau Federation. The focus groups and interview were conducted between April and June, 2017, with 61 people participating in focus groups and three people participating in the interview.

Researchers used a semi-structured topic guide to ensure consistency while enabling varied viewpoints to be expressed. (See topic guide in Appendix A.) The questions started with a general focus on perceptions of water quality in large bodies of water and then shifted to perceptions of water quality in the Jordan Lake watershed as well as specific questions about nutrient management strategies.

These conversations lasted up to 90 minutes and were audio-taped. The audiotapes were transcribed verbatim, and established methods for content analysis were applied (Miles, Huberman & Saldaña, 2013; Rubin & Rubin, 2012). Transcripts were coded for pre-established categories as well as emergent themes. (The codebook is included in Appendix B.) Each transcript was coded by at least two members of the research team, and any coding differences were reconciled. During the focus groups, notes also were taken on flip

charts, and these notes were referenced as needed during analysis. Despite the small sample size, analysis of transcripts indicated that saturation was reached with respect to key themes. Study procedures were approved by the Institutional Review Board at the University of North Carolina at Chapel Hill (IRB 17-0873).

Study participants included employed professionals whose work involved water resource and nutrient management issues from the following sectors: municipalities within the Jordan Lake watershed (including the Research Triangle area and the Triad), environmental nonprofits, the real estate and building industry, and farming and agriculture. In the focus groups, participants included representatives from: 10 local governments in the Triangle area, six local governments in the Triad area, 12 Triad area realty/building industry companies, and eight environmental nonprofit organizations. Among the environmental nonprofits, some focused on sub-watersheds which drain into Jordan Lake, while others focused on statewide, regional, or national environmental issues. As mentioned above, representatives from the North Carolina Farm Bureau Federation were interviewed as part of the study as well.

Varied methods were used to recruit participants including phone, email, and in-person communication as well as gatekeepers within target organizations. Of the 64 participants in the study, between 78% and 88% chose to provide demographic information. (Individual responses varied by question.) Among respondents, 66% were male, and 34% were female, and the average age was 50, with participant ages ranging from 27 to 71. Most respondents (91%) held bachelor's or higher level degrees, and most (91%) had 10 or more years of experience in their professions.

Findings

In this section, we present findings from the focus groups and interview, with particular attention to areas of agreement and disagreement among stakeholders and their identified information needs. In some cases, we present the information in participants' own words through direct quotation.

Perceptions of "Good Water Quality"

We began the focus groups and interview by asking participants to describe good water quality in a large body of water. Across all focus groups and the interview, participants asserted that good water quality meets water quality standards and provides healthy habitat for wildlife and plant growth. They consistently used phrases like "non-polluted", "clear" and water having "low turbidity". Likewise, participants in all four focus groups and the interview claimed that good quality water can be used for drinking, and three of the focus groups (Triangle local government, Triad realty/building industry, and environmental nonprofit) stated that good quality drinking water should not require excessive treatment. Participants in the two local government focus groups also described good water quality by what it lacks, specifically noting that good water quality means there are no "dead fish".

When the conversation focused on Jordan Lake, participants across all focus groups said that having good water quality in Jordan Lake meant that the water could be used for drinking. (This dimension was not mentioned in the agriculture interview.) Participants in both local government focus groups (Triangle and Triad) and the environmental nonprofit focus group also said that good water quality in Jordan Lake meant that it could be used for recreation, such as swimming and fishing. Additionally, participants in the environmental nonprofit focus group underscored the importance of good water quality for aquatic life and a healthy, sustainable ecosystem.

As these comments show, there was general agreement among participants across all focus groups and the agriculture interview about how to describe good water quality in Jordan Lake. Participants in all focus groups also acknowledged known impairments or other problems with water quality in Jordan Lake, including algal growth; and high levels of nutrients were mentioned as an indicator of poor water quality in Jordan Lake by participants in most groups. One participant in the Triangle local government focus group underscored the need for improved management practices to maintain the status quo, saying:

> *It seems like it's at an acceptable water quality now….but unless better watershed management is put in place for Jordan Lake, I could foresee that water quality declining rapidly in the future*.

Water Quality Concerns

In terms of specific concerns, participants in the two local government focus groups and the agriculture interview acknowledged odor and taste problems with drinking water drawn from Jordan Lake. In addition to taste and odor, participants in the environmental focus group mentioned other evidence of poor water quality in Jordan Lake including pH, sediment, trash, and industrial contamination. Participants in both the environmental and the Triangle local government focus groups indicated they had concerns about swimming in Jordan Lake. One participant from the Triangle local government focus group said *"Honestly, there's a couple times a year that I just don't want to get in it".* A participant in the environmental focus group mentioned advising people to shower immediately after swimming in the lake. It was also mentioned that rashes had been observed on children after they had been in the lake.

Conversely, although participants in the Triad local government focus group, the Triad realty/building industry focus group and the agriculture interview acknowledged several indicators of poor water quality, they did not believe that these impairments were causing serious problems. As evidence for these views, they cited impairment only in isolated areas of the lake and its continued use for recreation and drinking water. However, participants in both Triad focus groups (local government and realty/building industry) as well as the agriculture interview indicated that they had not directly experienced any problems with Jordan Lake's water quality, primarily because they rarely use the lake or its water. Participants in the Triad focus groups supported their assertion of good water quality in Jordan Lake and the Haw River sub-basin by referencing low turbidity, limited algae, and the use of this water for drinking and recreation. Further, participants in both of the Triad focus groups believed that their area was not significantly contributing to the water quality problems in Jordan Lake. For example, one participant in the Triad realty/building industry group said, "*The water that we contribute comes in just above the dam. It runs right over the dam in just three days. And so, essentially, nobody drinks that water".*

Perspectives on the Value of Good Water Quality

Focus group and interview discussion also touched on the *value* of good water quality in large bodies of water, and participants across all focus groups and the interview identified good water quality as important to recreation. Participants in all four focus groups described good water quality as a life sustaining resource that is important to a successful economy and to local industry. Participants in three of the focus groups (realty/building industry and both local government focus groups) used the words "invaluable" and "priceless" to describe the value of good water quality, while participants in two focus groups (realty/building industry and environmental nonprofit) and the agriculture interview emphasized the cultural and societal value of good water quality. A participant in the Triad local government group summed up these sentiments by saying:

We couldn't have textiles in this region. We couldn't have industry in this region. We couldn't have the population we have. We couldn't do much of anything that we do without good water quality.

Additionally, participants in the environmental nonprofit focus group noted that poor water quality actually could be detrimental to a community, because people depend on clean water for survival.

In discussing the value of good water quality in the specific context of Jordan Lake, participants in all focus groups and the interview recognized its importance. The phrases "intended use" and "intended purpose" were mentioned across groups, and participants in two focus groups (Triad local government and environmental nonprofit) and the agriculture interview asserted that good water quality should serve its intended use. These uses encompassed a range of activities from flood control to drinking water to recreational uses. Once again, participants in two focus groups (Triad local government and environmental nonprofit) and the agriculture interview mentioned the value of using the lake for recreation, while participants in both Triad focus groups and the agriculture interview cited the value in being able to use the lake for drinking water. Participants in both local government focus groups noted the importance of Jordan Lake for flood control and serving as a pollutant sink, helping control water quality downstream. Perhaps unsurprisingly, participants in the Triangle local government focus group listed the greatest number of ways that good water quality in Jordan Lake was valuable. In addition to the ways already mentioned, this group identified the lake's value in incorporating wastewater from upstream. They also recognized the high quality of life associated with having accessible parks and natural resources and called Jordan Lake an "engine" for health and economic vitality in the region. Interestingly, this issue was raised in the realty/building industry focus group as well, with one participant noting that although it is difficult to tease out the role of Jordan Lake on area development over time, one can assume it has played an important role, as both a recreational and drinking water resource.

Responsibility for Maintaining Good Water Quality

When asked about responsibility for maintaining good water quality, participants across all focus groups and the interview agreed that "everyone" is responsible, yet they also recognized that allocating that responsibility *equitably* is difficult. When attempting to assign responsibility, some participants (in both local government focus groups, the environmental focus group and the agriculture interview) distinguished between people who use the resource and those who contribute to the flow of the body of water. Specifically, participants in the Triad local government focus group noted that *users* should bear more of the burden, while participants in the Triangle local government and environmental nonprofit focus groups and the agriculture interview focused more on the responsibility of *contributors*.

Participants in all focus groups also specifically named the agricultural industry as a key responsible party. In addition, participants in three focus groups (Triangle local government, environmental nonprofit and realty/building industry) asserted that government agencies have a responsibility for enforcement and for educating residents about good water quality. Participants in the Triangle local government and realty/building industry focus groups further emphasized that residents may not be aware of water quality concerns and their role in contributing to good water quality.

Similarly, when discussion focused on Jordan Lake, participants across all focus groups and the interview agreed that the responsibility for good water quality and managing nutrients in Jordan Lake was a shared responsibility. As one participant in the realty/building industry focus group noted,

Jordan Lake is an important source of water…the effect it has upstream and downstream is important. It's not just a localized issue. We're all in this together.

A recurring aspect of the discussion of responsibility, which arose in all focus groups and the interview, was the expressed frustration that Jordan Lake was originally intended for flood control but was later designated as a drinking water source, resulting in a situation in which the lake was impaired even before it was built. One participant in the Triad realty/building industry focus group asked, "*How did it get built when there was such a powerful force as the [US Army Corps of Engineers] saying, 'Don't build it. You're gonna have problems'?*". Another participant, in the environmental nonprofit focus group, noted, "*Once Cary started drinking from it, it became all of our problem to keep it clean.*"

Role of Government

Participants across all focus groups and the interview also recognized the need for state and federal government agencies to play a greater role in maintaining good water quality in Jordan Lake. Participants in two groups (Triad realty/building industry and Triangle local government) identified state government oversight as necessary because of the large size of the watershed. A participant in the Triangle local government focus group noted a potential facilitative role for state government, saying "*Watershed boundaries don't respect political boundaries, and government has the unique ability to facilitate those inter-jurisdictional discussions and conversations that need to happen*". However, this participant felt that such facilitation might feel "heavy-handed" if led by federal agencies. Underscoring the opportunities for local government leadership, a participant in the environmental nonprofit focus group noted that local governments must be allowed "*to protect their own waters*".

In several groups (Triangle local government and environmental nonprofit) as well as the agriculture interview, participants mentioned the importance of and need for state government funding to address water quality issues in Jordan Lake. Participants in the agriculture interview also called for increased funding for research, particularly for programs to assist farmers in implementing best management practices, and one participant noted that "*Our folks don't like regulatory programs...I don't think anybody does*".

Other issues that arose in this discussion related to regulatory frameworks and the political nature of these issues. Specifically, participants in the Triangle local government and both Triad focus groups addressed the *chlorophyll a* standard, which certain areas of Jordan Lake have exceeded at times. They noted that the standard is the same for every water body in the state and expressed a belief that it should instead be tailored for each water body. A participant in the environmental nonprofit focus group noted that "*the 'polluter pays' principle…is the foundation of federal law*" but asserted that, in North Carolina, state politics have prevented those responsible for polluting Jordan Lake from being held accountable. Frustration with the political situation was further evidenced by comments such as the following:

> *It's important not to look at the experience of Jordan and say, oh, what this shows is that we can't approach things with the Clean Water Act lens, we can't approach things through rules, a nutrient management strategy lens. That isn't broken. What's broken is the political system in the state.*

Equity

Participants across all focus groups and the interview believed that the current system for achieving good water quality in Jordan Lake was unfair, though there was disagreement in the ways in which it was unfair. For example, participants in both local government focus groups and the realty/building industry group

identified agriculture and forestry as significant contributors of nutrients to Jordan Lake and noted that those land uses are not regulated at the same level as other land uses. Participants in the Triad focus groups also pointed to homeowners with septic tanks or those who fertilize their lawns as significant, unregulated contributors of nutrients in waterways. At the same time, participants in the agriculture interview noted that their sector is meeting nutrient goals and questioned whether a shrinking number of farmers should be asked to meet the same goals as larger land uses or point source polluters. Participants in both Triad focus groups and the agriculture interview expressed that they believed that the expectations for achieving good water quality in Jordan Lake were unreasonable. One participant in the Triad local government focus group supported this assertion by noting that the local government had met its phosphorous and nitrogen goals for 10 years, yet that there had been no concomitant reductions in Jordan Lake. Participants in the Triad local government focus group also wondered how others perceived their contributions to the Jordan Lake water quality problems; and across focus groups, participants expressed interest in better understanding the contributions of various sectors to nutrient-related pollution.

Participants in the Triad focus groups felt they were bearing a disproportionate financial burden for maintaining water quality. They also asserted that the Triangle region, and the City of Cary in particular, were not being asked to bear the same burden. One participant in the Triad local government focus group stated,

> *Cary is the predominant water user…they don't have to do anything for Jordan Lake, so the burden of responsibility falls on everybody upstream… and Cary doesn't have to deal with the problem.*

Further, these participants also questioned whether it was worth continuing to spend money to achieve better water quality in Jordan Lake, given that the lake is still impaired despite all of the money that has been spent to date. A participant in the Triad local government focus group expressed concern that the cost of nutrient management might prevent businesses from coming to the region, asking "*Why would somebody come to [our city] when they could go 12 miles away and not have to comply with these rules?*"

Though each stakeholder group had its own view of the ways in which the current system was unfair, participants across all focus groups and the interview agreed that achieving good water quality and managing nutrients in Jordan Lake was a significant financial burden. For example, one participant in the Triad local government focus group referenced its Capital Improvement Plan, which committed a $100 million investment for wastewater treatment. A participant in the agriculture interview mentioned concerns among farmers that the cost of meeting nutrient management goals could make farming unprofitable.

In terms of accountability, a participant in the environmental nonprofit focus group emphasized the need for state government to play a role in ensuring that the financial responsibility for achieving good water quality in Jordan Lake was shared *equitably* though not necessarily *equally*. Along similar lines, a participant in the Triad local government focus group recognized that compromise would require sacrifices from all participants, saying, "*My hope out of this is that…they bring all the members to the table, and they say, "Everyone's gonna come out here with some skin lost," and then when we all agree to that, then we can move forward*."

Nutrient Management Strategies

In discussing approaches to nutrient management in Jordan Lake, questions about baseline contamination and the need for tailored strategies arose as well as specific examples of management strategies, not all of which were deemed successful. Related to baseline contamination, participants in the

realty/building industry focus group and agriculture interview raised the issue of legacy contaminants, while participants in both Triad focus groups asserted their belief that the current water quality in Jordan Lake was the best that could be achieved. Further, they felt that the current baseline should inform future nutrient management goals.

Participants in several focus groups discussed the need to redefine what constitutes acceptable water quality in Jordan Lake. As noted above, some participants asserted that the *chlorophyll a* standard should be unique to each body of water, instead of having a statewide standard; the realty/building industry and both local government focus groups reiterated that point when discussing specific strategies. Along these lines, participants in the agriculture interview stated that each of the three sub-watersheds draining into Jordan Lake required a unique approach to achieving good water quality as a result of some sub-watersheds being highly developed while others are more rural.

Across all focus groups, participants identified policies and infrastructure that could address nutrient management problems. For instance, in both the Triangle local government and the environmental nonprofit focus groups, participants recommended that government incentives be provided for low-impact development. Participants in the Triangle local government focus group also noted that buffers were effective at mitigating flooding, improving water quality, and even increasing home values. Participants in this focus group recommended consideration of smaller scale treatment facilities, which could recycle water for use in food production, and suggested wastewater treatment facilities should allow treated wastewater to filter into the ground instead of discharging it to streams.

In the realty/building industry focus group, participants suggested bio-retention cells and constructed wetlands as potential strategies for improving water quality in Jordan Lake. One participant in this group also suggested restricting the amounts of nitrogen and phosphorous in residential fertilizers. This person stated that some states have implemented this approach but did not know whether research had shown positive effects on water quality as a result. At the same time, a participant in the Triad local government focus group stated, "*The expectation that we are gonna clean up Jordan Lake by retrofitting the cities is borderline absurd*." Participants in both Triad focus groups also emphasized the need for enhanced education and outreach about the Jordan Lake Rules, water quality problems in the lake, and potential solutions to those problems.

Success Stories

Several groups provided local examples of effective nutrient management strategies. For example, a participant in the Triangle local government focus group highlighted the City of Durham's efforts to improve water quality, noting that Durham is unique because it falls within the boundaries of both the Falls Lake and Jordan Lake watersheds. This participant also asserted that the City's experience provided evidence that enacting the Jordan Lake Rules would not impede growth, saying:

> *Durham has enacted all of the Jordan Lake nutrient management rules within our jurisdiction, as well as the Falls Lake nutrient management rules within our jurisdiction, and I would defy anyone to say that growth and development has been impeded in the City of Durham.*

A participant in the Triangle local government focus group noted that its development decisions, such as building the greenway system within the floodplain, resulted in fewer flooding problems, which directly impacts nutrient movement.

In another example, several participants in the Triad local government focus group highlighted the watershed restoration plan of Little Alamance Creek, which they noted had been impaired for 100 years. Though the plan has only been in effect since early 2016, one participant noted that "*it's a watershed restoration plan that all entities who are involved within that watershed…have taken ownership of it and are taking a holistic approach together at trying to restore the water quality in that watershed*." Referring to a website that was created to educate the public about the project, another participant noted that the project is changing the stigma long associated with the creek.

Failures

Underscoring concerns that current strategies cost too much and are ineffective, participants in the Triad focus groups provided several examples of what they viewed as failed nutrient management strategies. For instance, a participant in the realty/building industry focus group described a project in the City of High Point that utilized regional ponds and wetlands designed to trap nutrients but noted, "*There were periods through the year that [the ponds and wetlands] exported nutrients. It didn't trap nutrients; it exported nutrients*." Similarly, a participant in the Triad local government focus group described a project in his city as follows:

> *We retrofitted a big, municipal parking lot...we put in a huge bio-retention facility, pervious pavement, and some of these little tree boxes...and the combination of all three of those retrofits on this area cost us almost a million dollars; and we gained ten pounds of nitrogen removal—that's nothing—and we spent a million dollars doing it.*

A participant in the Triad local government focus group also pointed to the Neuse River as an example of failed nutrient management, saying: "*They've spent millions and millions and millions of dollars and yet the nutrients in the basin continue to rise, even though the point sources, they're down more than 50 percent*."

Information Needs Identified by Participants

Participants across all focus groups and the interview identified a need for scientifically based decision making in finding solutions to water quality problems in Jordan Lake. These participants also identified gaps in knowledge and additional information needed to better understand how to achieve and maintain good water quality in the lake. Specifically, participants in all focus groups wanted information about how much each land use is contributing to nutrient-related pollution in Jordan Lake.

Participants in several focus groups (realty/building industry and environmental nonprofits) and the agriculture interview wanted information on how much it would cost to achieve the desired improvements to Jordan Lake's water quality. Participants in the Triad local government and environmental nonprofit focus groups identified a need for improved technologies to reduce nutrient pollution, and participants in the realty/building industry and environmental nonprofit focus groups wanted to see improvements related to water quality sampling in the Jordan Lake watershed. Specifically, participants in the realty/building industry focus group called for easily accessible water quality data from upstream communities, while participants in the environmental nonprofit focus group identified a need for guidance on designing and implementing neighborhood, school, or citizen science programs that can produce high quality data.

Other questions about nutrient management in Jordan Lake that were raised by participants clustered in four categories: water quality parameters, costs, modeling of future impacts and organization roles. These questions are summarized below.

Water Quality Parameters

- How has water quality in Jordan Lake changed over the last 10 years, and what changes, if any, can be attributed to specific management strategies?
- What do we know about legacy nutrients: have they been measured, and how much are they contributing to water quality the problems in Jordan Lake?
- How would prohibiting either nitrogen or phosphorous in residential fertilizers affect water quality?
- Which crops are most efficient in the uptake of nitrogen?

Costs

- How much more does it cost to treat wastewater than to treat drinking water?
- What is the return-on-investment of financing buffers for farmers (versus other strategies)?
- How do the costs of 50-foot buffers compare to those associated with 100-foot buffers? Has a cost-benefit analysis been conducted?

Modeling Future Impacts

- How will climate variability affect nutrient management in Jordan Lake?
- How did the models that were used in developing the Jordan Lake Rules account for growth in Wake County? How is current modeling incorporating growth trends?

Roles and Responsibilities

- What is the responsibility of the US Army Corps of Engineers in terms of managing nutrient pollution in Jordan Lake?
- How will the knowledge gained through the UNC Nutrient Management Study be used by UNC researchers, state legislators, the EPA and other decision makers?

A number of these questions are being addressed by the UNC Nutrient Management Study, and for this reason, the research team appears well positioned to respond to some of these information needs.

Conclusions and Future Engagement Activities

The qualitative research described in this report represents the perspectives of several key stakeholder groups that are interested in nutrient management in Jordan Lake. Across focus groups (with Triangle and Triad area local governments and realty/building industry and environmental nonprofit professionals) as well as an interview with agriculture/farming industry representatives, participants **largely agreed on how to describe good water quality**, both in general and in Jordan Lake. Being suitable for use as drinking water was part of these descriptions, as were other uses (e.g., able to support aquatic life, recreation). Participants also all agreed that there were impairments or other water quality problems in Jordan Lake. Further, although they **agreed that achieving good water quality in Jordan Lake was a shared responsibility**, the stakeholder groups had varied ideas on what their potential contribution to shared management might be. On a related note, participants in each focus group and the agriculture interview **questioned the fairness of the current system for achieving good water quality in Jordan Lake**. Finally, they all agreed that government, particularly at the state level or higher, should play an integral role in maintaining water quality in Jordan Lake.

Despite general agreement on these foundational issues, participants held **divergent views on *current* water quality in Jordan Lake**. Although participants in all groups agreed there were impairments or other water quality problems in the lake, some participants (specifically, in the Triad area focus groups and the

agriculture interview) did not see these impairments as major problems. These participants pointed to impairments only in isolated areas of Jordan Lake and its continued use for drinking water and recreation as evidence of good water quality in Jordan Lake. Conversely, participants in the Triangle local government and environmental nonprofit focus groups identified several concerns about the water quality, including concerns about swimming in Jordan Lake.

There also were **differing views on who should be responsible for maintaining good water quality** in Jordan Lake. Participants in the Triad local government focus group indicated that water users should bear more of the burden, while participants in the Triangle local government focus group, along with participants in the environmental nonprofit group and the agriculture interview, indicated that more responsibility should fall on those contributing to impairments. Across all four focus groups, participants identified the agricultural industry as a key party responsible for maintaining good water quality. Further, both local government focus groups and the realty/building industry focus group noted that agriculture and forestry are not regulated at the same level as others. Conversely, participants in the agriculture interview stated that it is unfair to ask a shrinking number of farmers to meet the same goals as much larger land uses and point source polluters.

Interestingly, participants in all focus groups and the interview had **concerns about the high cost of achieving and maintaining good water quality in Jordan Lake**. Participants in the Triad focus groups expressed concern that they bore a disproportionate financial burden in comparison with some Triangle area stakeholders. Participants in the Triangle local government focus group worried about the rising future costs to the region if measures weren't put in place now to protect Jordan Lake's water. Additionally, participants in the environmental nonprofit focus group expressed frustration that federal laws based on the "polluter pays" principle were not being enforced in North Carolina.

The study also identified **information needs among the stakeholders**. All groups expressed interest in knowing more about how different land uses are contributing nutrients to Jordan Lake. Many participants also had questions about the cost of implementing measures that would achieve water quality goals in the Jordan Lake watershed. Several participants also had questions regarding water quality in the Jordan Lake watershed and what is known about how specific nutrient management strategies can reduce pollution.

As noted at the beginning of this report, one goal of the project was to identify locally relevant perspectives that could inform scientific research and policy decisions related to nutrient management. Toward that end, this report will be shared with the UNC research team and the team in the NC Department of Environmental Quality that is managing the formal stakeholder engagement process for nutrient management in Jordan Lake. Another goal was to identify research needs expressed by stakeholders that potentially could be addressed by the UNC research team. A number of the questions raised during the focus groups are already being explored by the UNC Nutrient Management Study team (e.g., dynamics of water movement in the lake, determining nutrient contributions by different areas and land uses, management strategies implemented in other geographic areas), highlighting opportunities for team members to engage with these stakeholders and other public audiences to share their results. Additionally, new questions that were raised during this research will be discussed with the study team, in an effort to develop research that is responsive to stakeholder needs in North Carolina.

References

Beierle, T.C. (2002). The quality of stakeholder-based decisions. *Risk Analysis*, 22, 739–749.

Brody, S.D. (2003). Measuring the effects of stakeholder participation on the quality of local plans based on the principles of collaborative ecosystem management. *Journal of Planning Education and Research*, 22, 407–419.

Gordon, J.S., & Barton, A.W. (2015). Stakeholder attitudes toward reforestation and management of bottomland hardwood forests in the Mississippi delta. *Journal of Forestry*, 113(3), 308-314.

Henrich, N., Holmes, B., & Prystajecky, N. (2015). Looking upstream: Findings from focus groups on public perceptions of source water quality in British Columbia, Canada. *PLoS ONE*.

Knodel, J. (1993). *The design and analysis of focus group studies: A practical approach. In Successful Focus Groups: Advancing the State of the Art* (Morga, D., ed.), Sage, London, pp. 3–19.

Miles, M.B., Huberman, A.M., & Saldaña, J. (2013). *Qualitative data analysis: A methods sourcebook.* 3 ed: SAGE Publications.

Monaghan, P., Hu, S., Hansen, G., Ott, E., Nealis, C., & Morera, M. (2016). Balancing the ecological function of residential stormwater ponds with homeowner landscaping practices. *Environmental Management*, 58, 843.

Murti, M., Yard, E., Kramer, R., Haselow, D., Mettler, M., McElvany, R., & Martin, C. (2016). Impact of the 2012 extreme drought conditions on private well owners in the United States, a qualitative analysis. *BMC Public Health*, 16.

Reed, M.S. (2008). Stakeholder participation for environmental management: A literature review. *Biol. Conserv*., 141, 2417–2431

Rossi , P.H. , Lipsey, M.W., & Freeman, H.E. *Evaluation: A systematic approach* (7th ed.). Thousand Oaks, CA: Sage, 2004.

Rubin, H.J., & Rubin, I.S. (2012). *Qualitative interviewing: The art of hearing data.* 3 ed: Sage Publications.

Appendix A: Focus Group Topic Guide

The following questions were used to guide discussion in all focus groups and in the interview.

For this focus group, we will define "large body of water" as any significant collection of water whether it be natural or manmade. This could include rivers, lakes, reservoirs, and oceans.

General Water Quality Questions

1. When you think of good water quality in a large body of water, what goes through your mind?
2. How would you describe the value of good water quality in a large body of water?
   Discussion prompts: Why is it important? To whom?
3. Who should be responsible for good water quality in a large body of water?

Jordan Lake Water Quality Questions

4. When you think of good water quality in Jordan Lake, specifically, what goes through your mind?
5. What problems, if any, do you perceive with Jordan Lake's water quality?
   Discussion prompts: Can you walk me through the last time you experienced a problem with water quality in Jordan Lake? What happened, and how were you involved?
6. How would you describe the value of good water quality in Jordan Lake?

Jordan Lake Nutrient Management Questions

7. Who should be responsible for managing nutrients in Jordan Lake?
   Discussion prompts: What role, if any, should government play in managing nutrients in Jordan Lake?
8. What are some strategies for managing nutrients in Jordan Lake?
   Discussion prompts: What are the costs of these strategies? What are the benefits?
9. What do you think we need to know to better understand how to manage nutrients in Jordan Lake?
10. Is there something you would like to talk about that we have not addressed?

Appendix B: Codebook

Research Questions

RQ 1. How do participants define and value good water quality in a large body of water? Who do they believe should be responsible for maintaining it?

RQ 2. How do participants define good water quality in Jordan Lake? Who do they believe should be responsible for maintaining it?

RQ 3. What potential nutrient management strategies do participants describe for Jordan Lake? What are the knowledge gaps associated with these strategies?

Code name	Sub-code name	2nd level sub-code	Definition	Example
WATER QUALITY (WQ)				
WQ	WQ-good		How participants describe good water quality in a large body of water. Includes positive and negative descriptions.	"…you don't see dead fish floating up."; "Good water quality supports the ecosystem that was original to that area."
		-intended use	Used when participants reference designated uses of a large body of water to describe water quality.	"[Water quality] depends on the intended purpose. If it's for drinking water, then that has a certain high-level value."
		-standards	Used when participants describe good water quality as meeting regulatory requirements and standards.	"…all the thresholds that are there for all different types of heavy metals, everything should be below those thresholds."
	WQ-value		How participants describe the value of good water quality in a large body of water.	"…water is crucial to maintaining healthy people all around the world."
		-priceless	Used when participants describe good water quality as invaluable.	"No matter what [water] is used for, I don't think a price can be put on it."
	WQ-responsible		Entities participants identify as being responsible for maintaining good water quality in large bodies of water.	"Anyone that uses the resource within a watershed, or even within a state boundary."
		-everyone	Used when participants identify "everyone" as a responsible entity.	"…everyone's responsible, there are no exemptions in terms of keeping [water] clean."
	WQ-cost		Costs associated with maintaining good water quality in large bodies of water.	"There's a high price, but the big question for me is what is that price?"

Code name	Sub-code name	2nd level sub-code	Definition	Example
WATER QUALITY-JORDAN LAKE (WQ-JL)				
WQ-JL	WQ-JL-good		How participants describe good water quality in Jordan Lake.	"I swim in it, I drink it."
		-intended use	Used when participants reference designated uses in Jordan Lake to describe water quality.	"…even though [drinking] was an unintended use of the water, it hasn't stopped them from using it."
	WQ-JL-value		How participants describe the value of good water quality in Jordan Lake.	"[Jordan Lake is] the future and the vitality of this region."
	WQ-JL-problem		Comments about perceived or actual problems with water quality in Jordan Lake.	"I've been told that it [Jordan Lake] was impaired before it was even finished filling up."; "…when Jordan Lake was established early on, they said it was gonna be polluted – and guess what? It is."
		-standards	Used when participants reference problems with Jordan Lake water quality standards.	"What's the appropriate target? I really don't think that 40 micrograms per liter of chlorophyll A is."
	WQ-JL-cost		Costs associated with treatment and maintenance of water quality in Jordan Lake.	"…in 20 years, when we can no longer swim in Jordan Lake or drink the water, it's going to cost 10, 20 times the amount to try to fix it as it would have been were we to put measures in place now."
	WQ-JL-equity		Comments about equity/inequity related to water quality in Jordan Lake.	"…you've got a region down there that's making use of [Jordan Lake] for their water source, but they're not the ones that are being asked to pay for it."
NUTRIENT MANAGEMENT (NM)				
NM	NM-responsible		Which entities participants identify as being responsible for managing nutrients in Jordan Lake.	"I think everybody upstream does have a certain level of responsibility to our downstream neighbors."
		-equity	Used when participants reference equity/inequity in managing nutrients in Jordan Lake.	"…all of us should be responsible for [nutrient management in Jordan Lake], but that's all of us, not just municipalities."; "the toughest part of this is that you have a lot of contribution coming from upstream and they have very little benefit coming back to them for complying with regulation."

Code name	Sub-code name	2nd level sub-code	Definition	Example
NUTRIENT MANAGEMENT (NM) - continued				
NM	NM-responsible	-govt	Comments about the role of government in maintaining good water quality in Jordan Lake.	"Watershed boundaries don't respect political boundaries, and government has the unique ability to facilitate those inter-jurisdictional discussions and conversations that need to happen."
	NM-strategy		Strategies that participants identify for managing nutrients in Jordan Lake.	"…nutrient trading has been looked at. It's certainly a tool."
	NM-cost		Costs associated with nutrient management strategies for Jordan Lake.	"What's accomplishable and at what cost? There's gotta be a reasonable level there somewhere and at what cost to our region is slight improvement?"
	NM-additional info		Comments about additional information needed to better understand how to effectively manage nutrients in Jordan Lake.	"How do you deal with that legacy sediment, that legacy phosphorus?"