Programs and Institutions Addressing Nutrient Reduction in Jordan Lake

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Introduction

Jordan Lake provides multiple valuable services for those living in the North Carolina Triangle region. The lake is a source of recreation through activities such as camping, hiking, swimming, Bald Eagle watching, boating, and fishing. Additionally, Jordan Lake provides clean drinking water for residents of Apex, Cary, North Chatham County and Morrisville, and multiple other communities hold allocation rights including Chapel Hill (OWASA), Durham, and Raleigh. Despite the fact that Jordan Lake is a rich source of benefits for many in the region, there is a longstanding history of water quality concerns that communities in the watershed are still struggling to address.

In the spring of 2018, a group of students at UNC-Chapel Hill undertook a semester-long capstone project to look at Jordan Lake watershed nutrient management issues. Specifically, this capstone project looked to address the following key questions:

- Who are the entities currently working on nutrient management in the watershed?
- What types of programs are being implemented?
- To what extent is the One Water approach occurring within the watershed?
- Where are there opportunities for collaboration, expansion, and improvement?
- Why has managing the health of the Jordan Lake watershed been entwined with conflict and difficulty?

This report summarizes key findings related to those capstone questions by providing:

- A history of Jordan Lake and associated nutrient management efforts
- An overview of the One Water approach and how it relates to the Jordan Lake watershed
- Details on the methodology of curating a list of programs/institutions and an associated mapping element
- An analysis of the watershed with recommendations for future involvement of institutions and program within the Jordan Lake watershed
Section 1: Background on Jordan Lake Nutrient Issues

History

In 1945, a major tropical storm and hurricane hit the Cape Fear River Basin, flooding the city of Fayetteville. Water levels reached 70 feet and the city incurred $2 million in damages, equivalent to a value of $26 million today ("Jordan Lake rules timeline"). In response to this major flooding event, the Army Corps of Engineers, a federal agency that is concerned with the management and engineering of the nation’s waterways, directed a study of water resource needs in the area. The Army Corps of Engineers developed a plan to dam the Haw River, which would create the Jordan Lake reservoir ("Jordan Lake rules timeline"). About twenty years later, in 1963, the plans were ratified by the United States Congress. In 1970, the project began excavation and twelve years later, the lake was completed ("Jordan Lake rules timeline"). Today, Jordan Lake is located in Chatham and Durham counties, and is fed by the Haw River, Little Creek, Morgan Creek, and New Hope Creek.

Jordan Lake Rules

Jordan Lake was declared nutrient sensitive in the same year that it was impounded. Initially, the Upper New Hope arm was non-compliant for Chlorophyll A concentrations in 2002. In 2006, the Haw River arm and the rest of the lake were declared non-compliant for Chlorophyll A as well ("Jordan Lake rules timeline"). Exceeding federal Chlorophyll A quality standards is an indicator for nutrient overloading. When nutrients like nitrogen and phosphorus pollute a waterbody, it promotes the growth of algae. Too much algae leads to decreased oxygen in the water, which harms the ecosystem and the organisms that live there. Additionally, certain types of algae can release toxins and result in poorly tasting water. Therefore, the presence of algae causes a decrease in water quality that makes the water more difficult and costly to treat to drinking water standards.
As a result of Jordan Lake being declared impaired, the Jordan Lake Rules were created by the North Carolina Environmental Management Commission to protect and improve the water quality in the lake. These rules went into effective in 2009 and involved a culmination of extensive meetings, public hearings and negotiations between residents, environmental groups, local and state governmental agencies and other stakeholders in the watershed (“Background”). Addressed in the rules are:

1. Stormwater -- New Development
2. Stormwater -- Existing Development
3. Options for Offsetting Nutrient Loads
4. Riparian Buffers
5. Watershed Discharge
6. Agriculture Discharge
7. Fertilizer Management

Counties subject to the rules include Alamance, Caswell, Chatham, Durham, Guilford, Orange, Rockingham, and Wake. Municipalities include Alamance, Apex, Burlington, Carrboro, Cary, Chapel Hill, Durham, Elon, Gibsonville, Graham, Green Level, Greensboro, Haw River, Kernersville, Mebane, Morrisville, Oak Ridge, Ossipee, Pittsboro, Pleasant Garden, Reidsville, Sedalia, Stokesdale, Summerfield, Swepsonville, and Whitsett (“Contacts”).
Although there have been numerous delays in the implementation of many of the Jordan Lake rules, some of them have been successfully implemented. Within wastewater rules, phosphorus discharge limits have remained in effect since 2010. The buffer protection rule has remained in effect since 2011, as well. Additionally, although the agriculture compliance deadline was delayed, the community is still working towards a collective reduction goal. (“Jordan Lake Nutrient Strategy Key Points”).

With respect to the delays in implementation of the Jordan Lake rules, since 2011, a total of 8 session laws have been enacted which have delayed and/or modified rule requirements, including calling for further studies. For example, wastewater nitrogen discharge reductions have been delayed until 2019. Local government implementation deadlines for new development stormwater rules have been legislatively delayed beginning in 2012, and the agriculture compliance deadline was delayed from 2015 to 2019 (“Jordan Lake Nutrient Strategy Key Points”).
**Nutrient Study**

During the 2016 legislative session, under House Bill 1030, the Jordan Lake rules were put on hold for three years and UNC Chapel Hill was tasked with conducting a six year nutrient study of Jordan and Falls Lakes, which was then delegated to the NC Policy Collaboratory. The ultimate purpose is to develop recommendations that will be considered further in the rulemaking process by March 2019. In the first year, some of the UNC research team focused on identifying streams of revenue, building relationships with the different municipalities, and providing stakeholders a platform to talk about their attitudes towards the rules.

Currently in its second year, the study is now focusing on strategy and recommendations. This capstone and report specifically provide insight on where nutrient management programs are being implemented and what roles they play in the Jordan Lake watershed.

**How Conflict Inhibits Collaboration in the Watershed**

When making recommendations, it is important to understand the current climate and complexities in the watershed that has lead to the challenge of managing water quality in Jordan Lake. Prior to its creation, the plan to impound the lake was challenged by many environmental groups. Their primary concern was water quality. A lawsuit was filed in 1971, twelve years before the lake’s completion, on behalf of these environmental groups ("Introduction"). The original 1971 Environmental Impact Statement for the creation of Jordan Lake noted a “primary concern [on] the possible eutrophic trendancy of the lake...” and that “the main concern expressed for [Jordan] Lake is over the aspect of algae growth.” Algal blooms and eutrophication in the lake resulted in the classifications of impairment and ultimately set in motion the creation of the Jordan Lake Rules. At the time when the lake was being created, scientists and engineers from all three major universities in North Carolina’s Research Triangle area agreed jointly, “if we looked for the absolute worst place to build a dam in North Carolina, we would not do much better than this site” (Vesilind 1997). Thus, nutrient concerns in Jordan Lake have been around longer than the lake itself.

Also predating the lake is the relationship between farmers and their land ("Introduction"). Much of the land that the lake now covers was previously farmland. During the process to create the lake, farmers and government representatives negotiated the purchase of farmland. This has led to frustration and resistance to collaborative nutrient management in Jordan Lake for some members of the agriculture community.

There are many different counties and municipalities that are implicated in the rules. Each one of these communities has a unique set of concerns with respect to the rules. Discrepancies in the perceived connections to Jordan Lake between upstream municipalities and downstream municipalities are an example of why it is hard to collaborate on nutrient management in the watershed. Upstream communities ultimately contribute excess nutrients Jordan Lake but do not rely on the lake for water supply.
withdrawals or recreation. Conversely, downstream communities do not contribute as much excess nutrients to Jordan Lake but instead rely on the lake for water supply withdrawals and recreation.

Managing sources of nonpoint source pollution is essential to nutrient reduction strategies. Nonpoint source pollution is discharge that derives from diffuse sources, like runoff from streets or farmland. As a result, regulation of nonpoint source pollution is much more difficult. Many band-aid solutions have been tried instead, to little effect. In 2013, a $1.4 million program called SolarBees was implemented in Jordan Lake. This program used small aeration devices powered by solar panels that were designed to restore oxygen to the water and prevent algae growth. In May 2016, North Carolina decided to terminate the program as no improvements were found. Scientists had advised that the failure of the SolarBees was imminent and that focusing on the Rules is the best way to see nutrient improvement. Discrepancies between what scientists and engineers recommend, and what governments find politically feasible and are willing to spend money on, have consistently hindered effective nutrient management strategies in Jordan Lake.

Section 2: Client Background and Objective

In 1959, the Triangle J Council of Governments (TJCOG) was established to serve as an intergovernmental organization for local elected officials to work proactively on regional issues to sustain and improve the quality of life for citizens in central North Carolina. In 2017, TJCOG established the Jordan Lake One Water Association (JLOWA) as a collaborative entity aiming to achieve “integrated water resource management” throughout the Jordan Lake watershed (“Jordan Lake One Water”). JLOWA is in the early stages of its creation, but as an organization, it seeks to include stakeholders from Raleigh to Greensboro including local governments, conservation groups, universities, water utilities, agricultural entities, and private industries. Together, they strive for water quality improvements in order to gain social, economic, and environmental benefits throughout the entire watershed (“Jordan Lake One Water”).

One of the underlying principles of JLOWA is the One Water approach. The One Water approach takes into account all forms of water use, which include drinking water, wastewater, and stormwater, and values all together as one entity. By thinking on a larger and more comprehensive scale, the One Water approach aims to achieve a multipronged goal of providing economic, societal, and environmental improvements. This approach builds upon the concepts of partnership and inclusion which is reiterated by JLOWA’s involvement with various stakeholders across the entire Jordan Lake watershed.

The One Water approach encompasses six arenas for action to improve water quality. Figure 3 below outlines these arenas and what they each entail:
This capstone project conducted research with the One Water approach as a guiding principle to identify strengths and weaknesses in nutrient management efforts within the Jordan Lake watershed. While the U.S. Water Alliance One Water approach was a starting point for the capstone project, amendments and additions were made in a few of the arenas. To account for some of the institutions and programs found, it was determined that wastewater treatment plants, cost-share programs and restoration programs were to be
classified under the **Reliable and Resilient Water Utilities** arena. Programs like Adopt-A-Stream, Stormwater SMART, restoration programs, and multi-governmental advisory boards were classified under **Thriving Cities**. The **Competitive Business and Industry** arena focused on incorporating water strategy at a corporate level and facilitating upstream and downstream partnerships. This included the Green Infrastructure Center, Nutrient Scientific Advisory Board and the NCDOT’s Highway Stormwater Program (HSP). The **Sustainable Agricultural Systems** arena included on-farm strategies focused on water consumption and nutrient management, such as the South Buffalo Creek Wetland and the Agricultural Cost Share Program. The **Social and Economic Inclusion** arena focused on building community resilience and capacity in water planning and governance. During the classification process, it was determined that educational endeavors aimed towards citizen action and environmental stewardship would also be placed in this arena. Examples of these educational and citizen-based action programs included the Haw River Learning Celebration, Clean-Up-A-Thon, and the Soil and Water Conservation District.

Lastly, the **Healthy Waterways** arena seeks the maximization of natural infrastructure to foster healthy ecosystems while also providing monitoring and watershed restoration. The majority of the programs compiled in this capstone fit into this arena.

As a client, JLOWA was interested in a catalog of One Water case studies and an inventory of the programs and efforts currently taking place within the watershed. In addition to a catalogue, JLOWA also wanted a comprehensive website to house all of this information. Because these are not research-based goals, this capstone focused instead on the collection of data and analyses to facilitate future policy decisions by giving JLOWA another perspective on nutrient management practices occurring within the Jordan Lake watershed. With an inventory of current institutions and programs taking place within the watershed, it will be easier for JLOWA to discern trends in policies and programs where certain institutions may work together towards a similar goal. Connecting existing programs in the watershed to the One Water arenas provides additional insight into the types of programs that are most prevalent and where improvements may be made. This capstone project will support JLOWA by providing tools and analysis to further their efforts to foster effective nutrient management within the Jordan Lake watershed.
Section 3: Development of Research Process

The Jordan Lake watershed has a multitude of players that affect the water quality in the region. These players can be hard to identify as they include local governments, businesses, environmental organizations, and farms (both arable and pastoral).

In order to construct an overview of nutrient management efforts in the Jordan Lake watershed, this capstone undertook a research process focused on various institutions that targeted water quality in the watershed and the impact that these institutions have in the area. Definitions of an institution, program, and impact were established to help streamline the process and standardize the data.

Definitions

Institution: Any public, private, or non-profit organization that has a vested interest in, contributes to, or mitigates pollution in the Upper New Hope, Lower New Hope, or Haw sub-watersheds. An institution is not necessarily limited to organizations that are exclusively found in the Jordan Lake watershed.

Program: A present/ongoing strategy or initiative implemented by an institution with the goal of improving water quality in the Jordan Lake Watershed. The goals of these programs can include helping reduce nitrogen and phosphorus levels in the water, educating those located in or near the watershed, providing specialized services for communication among institutions in the watershed, or providing other necessary services to improving the water quality in the region.

Impact: The success of the various institutions and/or programs implemented by each institution in the Jordan Lake watershed. Factors included in evaluating impact are cost, nitrogen and phosphorus reduction, number of individuals educated, and the use of institutions own metrics for initiative success. Additionally, through the One Water Approach arenas, each institution and/or program is categorized providing an overview of the impact that they have in the Jordan Lake watershed.

Overview of Methodology

To identify institutions, programs, and impacts in the Jordan Lake watershed, a two-step research process was put in place. The first step in the research process was gathering information from online sources. Institutions were categorized by subwatershed (Haw, Upper New Hope, Lower New Hope) to take into account the various regions that interact with Jordan Lake.

When tracking institutions, different informational components were recorded for each. These components included: geographic coordinates, type of institution, description,
website, contact information, and location in regard to subwatershed. Once institutions were found, any specific programs implemented by these institutions were identified, located, and recorded.

After the initial identification process of institutions and their respective programs, an interview and questionnaire step was applied. This next step in the research process allowed for the explanation and evaluation of the impact that these institutions and/or programs have in the Jordan Lake watershed.

**Informal Interview and Questionnaire Process**

Two questionnaires (one for government entities and one for nonprofit or private entities) were created and sent via email to the institutions with the aim of getting a more in-depth sense of the role that these institutions play in the watershed. Additionally, these questionnaires served to gather information and better understand the relationships between the institutions and programs examined.

The surveys (see Figures 4 and 5) were limited to six or seven questions in order to bolster the response rate while also not compromising on losing necessary information. The questions were centered around identifying costs, quantitative and qualitative impacts, strengths and weaknesses, incentivizing participation, and related institutions or programs associated with the institution. Each of these questions were generated with consideration for the information that would be of interest to JLOWA. Costs and quantitative impacts could be useful information to JLOWA because these factors allow JLOWA to weigh the costs and benefits of the institutions using quantitative data. Information about qualitative impacts can be useful for JLOWA from a policy standpoint on water quality research. The impacts of individual initiatives can sometimes be difficult to measure quantitatively. Thus, the qualitative impacts may also be used to provide insight on the water quality in the Jordan Lake watershed from a non-numerical viewpoint. Reported strengths and weaknesses of programs and institutions can allow JLOWA to look for patterns in the watershed and identify common problems that these organizations face. Gathering information about incentivizing participation is valuable for JLOWA and showcases the which incentives operate effectively as motivators and which do not. Identifying related institutions not only allows JLOWA to make connections within the watershed, but also assists in the research process.

While there were many advantages of using informal interviews to conduct the second step of the research process, it is also important to note the limitations that this approach had. Since the data was collected using questionnaires, there was a response bias present when collecting information. The data gathered was limited by what the institutions chose to represent about themselves. Although the surveys garnered a response rate of 50%, it was seen that only organizations with a degree of investment in the watershed and who had a cohesive system for dealing with water quality in Jordan Lake typically offered information. Another limitation of this process was the inconsistencies in reporting. Many institutions chose to answer certain questions and not others, and the metrics for measuring cost and
impact varied drastically. Institutions had different perceptions of their own impact. These issues could have been minimized by condensing the questionnaire further and posing more specific questions. This presents the risk of not collecting enough information. Despite these limitations, the questionnaires were very useful in directing the research process. Delving into the role of individual institutions and the relationships that institutions have to each other, the information gathered gave a more holistic understanding of the forces at play within the watershed.

The last step in the research process categorized each institution and program along with their impact into the different One Water Approach arenas. This procedure allowed for the relationship of each institution in the Jordan Lake watershed to be categorized. This step contributes towards the analysis of the watershed highlighting strengths and weakness of the impacts that the different institutions and initiatives have had.

**Government Questionnaire**
1. What is the upfront cost associated with this program?
2. What are the annual costs associated with this program?
3. How do you quantify the impact of this program?
4. What is the reduction of nitrogen/phosphorus (in pounds, %, etc.) as a result of this program?
5. Where has this program been most and least successful?
6. What additional non-nutrient benefits arise from this initiative? (i.e. social, economic)
7. How do you incentivize participation? (tax breaks, fines, subsidies, etc.)

**Nonprofit Questionnaire**
1. What type of programs do you conduct?
2. What is the sum of your annual donations, grant funding, and other sources of income?
3. How many volunteers and/or employees do you have (if applicable)?
4. How much of your funding is spent on programs impacting the Jordan Lake watershed?
5. How would you quantify your impact? What metrics does your organization use? Does your organization have a positive impact outside water quality?
6. In what areas has the organization been most and least successful?
7. How are you incentivizing participation in your program?
Section 4: Data Analysis

Analysis of Static Maps

Figure 6: Impact and Cost of UNC Nutrient Reduction Programs

The University of North Carolina at Chapel Hill is an example of an institution that promotes nutrient reduction utilizing techniques such as pond retrofits. As seen in Figure 6, UNC-Chapel Hill is home to three major nutrient reduction programs located at Battle Grove, the Outdoor Education Center, and the NC 54 Park and Ride lot. These programs contribute to UNC-Chapel Hill’s mandatory nutrient reduction requirements for the Jordan Rules.

The programs that UNC-Chapel Hill implemented for nutrient reduction are expensive, each costing hundreds of thousands of dollars. From a pure nutrient reduction standpoint,
Battle Grove has been the most efficient program spending approximately $5,000 per pound of nutrient reduction. The program located at the Outdoor Education Center spends a little more than $6,000 per pound of nutrient reduction while the program located at the NC 54 Park and Ride lot spends just under $7,000 per pound of nutrient reduction. As a result, while still costing $431,383, the techniques used for the nutrient reduction program at the Battle Grove seem to be the most efficient and future programs should consider modeling their project after this retrofit.

This map does raise some interesting questions, however. Why does the Outdoor Education Center have a comparable nitrogen reduction to Battle Grove yet have significantly less phosphorus reduction? Moving down on the map, figure 6 points to a similar phosphorus reduction between the Outdoor Education Center and the NC 54 Park and Ride lot, but the NC 54 Park and Ride lot is less than half as efficient at reducing nitrogen. While there is a positive correlation among the cost of the program and the overall nutrient reduction, there is a lack of consistency in the type of nutrient being reduced. This is an example of why nutrient management in the Jordan Lake watershed is so difficult. Large amounts of money can be spent for nutrient reduction programs but sometimes these programs are only successful at targeting a certain nutrient and are less efficient at reducing others.

It is important to look outside the quantitative nutrient reduction data as well when evaluating the impact of programs. The program located at Battle Grove does more than just reduce nitrogen and phosphorus, it also reintroduces native species which increases biodiversity as well as provides aesthetic appeal and can be used for recreation. These are also factors to consider in a cost versus impact analysis as it promotes the general well-being of the environment.

The map shown in Figure 6 is an example of how different programs can be compared when both the cost and impact of related programs are gathered. A similar model may be used in the future as the cost and impacts for other programs are gathered by JLOWA. With future models, others can do analyses to compare the strengths and weakness of nutrient reduction along with the cost that these programs accrue.
The “One Water Arenas of Selected Programs” map showcases how the programs fit into the One Water approach. While certain programs encompass several different One Water arenas, some represent just one or two. Overall, the Competitive Business and Industry arena had one of the lowest representation rates with only three programs falling under this classification. Conversely, the majority of the provided programs were categorized under Healthy Waterways. The Reliable and Resilient Utilities arena also had strong representation, and these programs were more widely distributed across the Jordan Lake watershed compared to other arenas. Most of the programs within the Social and Economic Inclusion arena are concentrated around the lake in the Upper and Lower New Hope Watersheds. Many of these institutions include an educational component. Though these educational programs are useful to inform people in the lake’s immediate vicinity, this arena would operate more effectively if it were more evenly distributed throughout the watershed. Four programs fall into the Sustainable Agriculture Systems arena, and only one of these is upstream from the lake. This is indicative of an arena where lake management could use improvement; most of the agricultural runoff that flows into the lake comes from upstream in the Haw River subwatershed, and this runoff is unmonitored. A diverse range of programs make up the Thriving Cities arena, and the distribution of these programs is even throughout the watershed.
Analysis of Institutions Contributing to Water Quality in Jordan Lake Map

Figure 9: Institutions Contributing to Water Quality in the Jordan Lake Subwatersheds

Figure 9 displays each subwatershed of Jordan Lake. Each of the 50 Institutions are marked at their geographic locations and identified in the key. Though not all institutions have been identified, it can be inferred that there is an uneven distribution of institutions located in each watershed.
Graph 1 shows the number of institutions cataloged within each subwatershed. The Upper New Hope subwatershed had the most institutions (17) followed by the Haw subwatershed (13) and the Lower New Hope subwatershed (8).

The size of the watershed, in terms of the number of municipalities under the Jordan Lake Rules, was measured to help analyze the expected amount of impact on the lake from each subwatershed. Graph 2 displays the number of municipalities participating under the Jordan Lake Rules; nineteen in the Haw, three in the Upper New Hope, and one in the Lower New Hope subwatershed. Two municipalities affected by the Jordan Lake Rules (Cary and Morrisville) are located outside of all three of the subwatersheds and were labeled as “other”.

When comparing the amount of institutions in each subwatershed to the amount of municipalities in each, there proves to be an uneven distribution. Graph 3 displays this ratio. Using this spatial information, we can locate regions where improvement may be able to occur. For example, the Haw subwatershed has the lowest institution-to-municipality ratio, so there may be more room for more collaboration and project establishment within this subwatershed. Not to mention, the sheer size of the Haw subwatershed allows for the greatest contribution of water to the lake, and the amount of institutions focused on its water contribution should reflect that.

Graph 1: Shows number of Institutions in each subwatershed. Haw (13), Upper New Hope (17), and Lower New Hope (8).

Graph 2: Shows number of municipalities regulated by the Jordan Lake Rules in each subwatershed of Jordan Lake. Haw (19), Upper New Hope (3), Lower New Hope (1), Other (2).

Graph 3: Shows ratio of Institutions/municipalities for each subwatershed of Jordan Lake. Haw (0.68), Upper New Hope (5.67), Lower New Hope (8.00).
Analysis of Program Cost Map

The “Cost of Various Programs” map shows the cost of various programs in the watershed. Costs are displayed by the size of the circle on the map; the larger the circle, the larger the costs. Of the 43 programs at which this capstone looked, only 8 were included in this map because these represent the programs that responded to this cost question in the survey process.

Clean Jordan Lake and the Army Corps of Engineers Visitors Center cost between $0-$100,000; Haw River Assembly, UNC NC 54 Park and Ride Retrofit, and Apex Stormwater Utility and Engineering Department cost between $100,001-$200,000; UNC Outdoor Education Pond Retrofit cost between $300,000-$400,000; and UNC Battle Grove Stormwater Regenerative Band cost between $400,000-$500,000.
Stormwater Regenerative Band and Willowbrook Park Stream Restoration cost more than $400,000.

Looking at the map, it appears that the further the program is away from the lake, the more it costs. It is important to note that although this is a trend, it does not constitute a correlation and causation relationship. Clean Jordan Lake and the Army Corps of Engineers are located right on Jordan Lake in the map and have the smallest circles, while the Willowbrook Park Stream Restoration in Burlington is the program that is furthest away and is represented by the largest circle.

For municipalities under the rules, Apex Stormwater Utility and Engineering department spent less money on its program than Burlington’s Willowbrook Park Stream Restoration. Apex’s costs represent the ongoing costs for its department, whereas Burlington’s cost represents a one-time cost for designing and building a stream restoration.

Non-profits in the watershed, such as Clean Jordan Lake and the Haw River Assembly, have some of the least expensive costs. Clean Jordan Lake has no paid employees and relies on volunteers and donations, its costs are less expensive than that of the Haw River Assembly, a program that does have paid employees.
Section 5: Areas for Collaboration, Recommendations, and Conclusion

Areas for Collaboration

In this large and fragmented watershed, there are a wide variety of types of institutions and programs. Cataloged in this report, there are institutions ranging from small scale clean-ups, to industrial wastewater treatment facilities, to private enterprises. Currently, most institutions in this watershed work independently and discretely. This makes it difficult for institutions to share information and contacts and help each other in reaching their goals.

This report looks at areas where these institutions can work together to tackle obstacles in their watersheds. These maps may help to pair projects from institutions that are in close proximity. Also, areas where institutions are lacking on the maps could be areas of focus as well. These maps can also help to pair similar institutions together such as educational groups, non-profits, etc. Some specific examples have been outlined and posted on the capstone website located here.

Recommendations

JLOWA has the potential to be the leader in the nutrient movement for the Jordan Lake watershed. One of the main issues that we have seen in the watershed surrounding Jordan Lake is the lack of collaboration between the different institutions that have implemented programs in the region. Although it may be difficult, this issue is possible to fix. Using the website platform that this capstone has already created, JLOWA can continue to add to the site and inventory of programs as more programs are implemented within the watershed. Institutions may self-report their programs and the impact that they have on the watershed either through the capstone website (Programs and Institutions page) or another platform of JLOWA’s choosing. Furthermore, JLOWA can create a framework for collaboration. This framework could include but is not limited to:

1. Continuing to add and update the current programs occurring in the watershed through the website and spreadsheet platform created by this Capstone
2. Establishing quarterly check-ins and/or updates from existing institutions that are reported on the platform
3. Hosting an annual convention (similar to UNC’s Clean-Tech Summit) with representatives from the different institutions in the watershed
4. Providing a way for nonprofits and local municipalities to communicate and collaborate on current programs

Furthermore, JLOWA could take steps to increase collaboration and communication between institutions by creating a system of standardized metrics. Some metrics, such as nitrogen and phosphorus reductions, are already widely accepted standards of measuring quantitatively the impact in water quality. Many of the institutions contacted during this study were able to report these metrics, and this continuity facilitated comparison.
Many of these institutions; however, collect qualitative data which can be difficult to measure. These institutions do not have quantitative metrics, but instead, provided the social and educational benefits they yield. To overcome this issue, JLOWA could create categorical metrics to measure impact of these programs. This could take the form of developing standards of measurement specific to a type of institution or program. For example, the impact of educational programs could be measured through the number of volunteers or number of visitors reached. By establishing these metrics, it will be easier to discern and compare the impacts of programs working in the watershed moving forward.

Conclusion

Nutrient management of Jordan Lake is always going to be an area that needs to be continuously worked on and improved, and JLOWA is an organization that has been adding a fresh perspective on how to manage the lake with its One Water approach. This capstone report provides a good starting point for how to enrich collaboratory efforts in the watershed. As previously mentioned, the data collected for this capstone was contingent upon informal interviews and survey responses. Even with a low response rate, maps and an inventory were still created, but there is still much to be done with filling in the gaps from the programs and initiatives that did not respond. Using the methodology as a framework, gathering those missing responses and filling in the maps will help further clarify what is going on in the watershed, and where there are opportunities for collaboration, creation of new programs, cost sharing, cost effectiveness, etc. The map allows the data to come to life, so if JLOWA decides that there is a certain metric that it wants to track, transferring it into a map form allows new analysis of the watershed.

This capstone drew its own conclusions from the maps created and the subsequent analysis, but for someone at JLOWA, there might be other valuable trends that not covered in this report. In this way, different views of the watershed are created, allowing for a variety of solutions. With JLOWA as a function of TJCOG, it is an entity in the watershed that has authority and resources to act on nutrient management. Jordan Lake nutrient management may seem like an insurmountable problem, but the options for moving forward are available and waiting to be implemented.

*To explore the products created by the capstone class, visit our inventory website at*

https://jordanlakecapstone.wixsite.com/inventory
Sources


