

Perceptions of Water Scarcity in the Triangle

Jennifer Fitts, Kevin Fritze, Shuai Shao, Angela Vasconcellos, Elise Vergnano, Emily Vuxton

ABSTRACT

This pilot survey was conducted during the spring of 2010 at the request of the Nicholas Institute for Environmental Policy Solutions at Duke University. The purpose of the survey was to gauge the awareness and perceptions of local elected officials and water managers about water scarcity in the Triangle region of North Carolina. A web-based survey elicited 104 responses, one-fifth of which identified themselves as elected officials, another one-fifth as water managers, and the remainder as staff. The responses indicate that there is widespread awareness of water scarcity issues among the respondent groups, but there are differing opinions between state and local levels about the immediacy of water scarcity concerns. There are also significantly different, and conflicting, opinions over who has and who should have control over water quality, supply, and allocation decisions between the state and local levels. Finally, there is a widespread belief that decision makers at both levels have the tools needed to address scarcity concerns in the future.

Table of Contents

Introduction	3
Literature Review	3
Methods	5
Study region and time line.....	5
Survey Design.....	6
Focus Group	6
Pretesting.....	6
Survey Implementation.....	7
Results and Discussion.....	8
Demographics of Respondents.....	8
Awareness and Perceptions of Water Issues in Triangle.....	8
Mechanisms Used for Water Allocation and Management	12
Perceptions of local and state roles and responsibilities.....	14
Conclusion.....	16
Appendix A: Respondent Solicitation Email.....	18
Appendix B: Survey Instrument	19
Appendix C: Question Responses	24
Appendix D: Statistical Analysis	38

Table of Figures

Figure 1: Triangle Region of North Carolina	5
Figure 2: Major sources of water supply	8
Figure 3: Water supply data sources	9
Figure 4: Familiarity with efforts/projects to increase water supply for the Triangle	9
Figure 5: Importance of additional water sources for the Triangle	10
Figure 6: Perceptions of water scarcity	11
Figure 7: Topics of concern when making water allocation decisions	12
Figure 8: Mechanisms used to manage water allocation decisions	13
Figure 9: Preparedness to manage water allocation decisions over the next 20 years.....	14
Figure 10: Perceptions of which level of government should be responsible for water supply, quality, and allocation decisions.	15
Figure 11: Perceptions of which level of government are currently and should be responsible for all types of water decisions.	16

Introduction.....

Residents of the Triangle region of North Carolina in 2007 and 2008 can attest to the scarce nature of the all-important resource, water. Wake, Orange, Durham, and Chatham counties have exacerbated the issue by neglecting to work together toward better water management practices and have instead found themselves competing for over-stressed supplies. State officials recognized potential water supply problems back in 2001 when they issued the *State Water Supply Plan*, stating, “North Carolina is beginning to experience some problems in areas where somewhat limited natural availability of water is coupled with high demand or competition among water users.”¹

At a conference in 2007 entitled “The Future of Water in North Carolina: Strategies for Sustaining Clean and Abundant Water,” Duke University’s Nicholas Institute for Environmental Policy Solutions organized a group of government officials, industry representatives, and other interested parties to develop strategies for advancing more efficient water policy. Many of these recommendations relied on elected officials and water managers to more effectively value and allocate this resource.²

Several years have passed since those recommendations were made, but water scarcity is still a prominent issue in the area. Jordan Lake, for example, has long been a source of drinking water for Durham, Cary, Apex, Holly Springs, Morrisville and the counties of Chatham, Orange, and Wake. In 2010, the allocation policy was completely overhauled and municipalities and counties had to apply for a portion of the water supply. Because demand is so high and supply so low, a new project is being developed so that the Little River becomes a reservoir to meet the growing needs of Raleigh, Garner, Knightdale, Wake Forest, and other cities and towns.³

In response to this growing concern, the Nicholas Institute requested a pilot survey of elected officials and water managers in the Triangle to uncover the awareness and perceptions of local and state governments regarding water scarcity. The goals were to shed light on possible tensions between local and state governments, to evaluate any disconnect between the state’s growing population and water supply planning, and to evaluate the state’s ability to manage the problem. The results of the survey were intended to produce data that could be used to develop policies to help the Triangle and the state as a whole to use this resource more efficiently.⁴ These goals were addressed through perception-themed questions, asking respondents about the current and ideal water management responsibilities as well as current management practices.

Literature Review

In recent years, water allocation has been a growing concern around the country and several surveys have been conducted to explore the issue. While none had precisely the research questions in which the Nicholas Institute was interested, they provided valuable information on survey structure as well as successful or unsuccessful attributes of water-themed surveys.

¹ NC Division of Water Quality (2001). *North Carolina State Water Supply Plan*, p. ES-1.
http://www.ncwater.org/Reports_and_Publications/swsp/swsp_jan2001/swsp_j01.php

² Holman, Bill, Leslie Kleczak, and Eben Polk (2007). *The Future of Water in North Carolina: Strategies for Sustaining Clean and Abundant Water*. Conference Report.

³ City of Raleigh. *The Little River Reservoir Project*. <http://www.littleriverreservoir.com/Index.html>

⁴ Interview with Amy Pickle, Nicholas Institute for Environmental Policy Solutions. Feb 2, 2010. Durham, NC.

Prince George County in Virginia sought information on citizens' perceptions related to water resources in early 2009. Via a mixed-mode (phone and web-based) survey, the Planning Department surveyed "community organization representatives, business and institutional representatives, and other interested individuals."⁵ The sampling technique for this survey was not random, but the department did try to contact the greatest number of interested parties possible by using a variety of survey methods and attempting to make contact at different times of the day. The survey asked questions related to drinking water, wastewater, and stormwater.

Implementation of this survey encountered problems due to the accuracy of information on their original contact list. For example, some email addresses or phone numbers listed were incorrect and many more were unlisted. Despite these inconveniences, the Prince George Planning Department did draw some conclusions regarding the water concerns of those surveyed. More than half of those surveyed cited water quality/safety as their biggest concern. A similar number admitted to drinking bottled water. Many respondents did conserve water (more than 90%) but about a third wanted to learn how to conserve more. The survey concluded, "half of participants believe the main purpose of better management should be to protect and maintain the natural environment... One quarter believe the main purpose is to conserve a valuable and scarce resource for a growing population."⁶ While this survey did not target elected officials, it did provide some interesting insight into the public's perceptions of water management and its connection to population growth.

At the same time, several organizations and governmental departments in Alabama created a survey on "public opinion concerning policy issues related to the management, conservation and enhancement of Alabama's water resources" and administered it via phone to a random sample of 2,148 households. Two-thirds of people believed that there would be a water problem within the next decade, most importantly water shortages and water pollution. To counteract these concerns, 35% of respondents supported stronger conservation practices, especially those with higher water use rates.⁷

A similar survey was conducted in 2005 by Luisa Castro and the College of Tropical Agriculture and Human Resources at University of Hawai'i at Manoa. Two of the main objectives of this study were to gauge public perception about water issues and to "benchmark water conservation behavior." The 37-question survey was mailed to a random selection of 322 households listed in the Hawai'i phonebooks. With 163 responses, analysts could consider the sample representative of the population. The survey indicated that a) drinking water was the primary water-related concern for Hawai'i residents and b) people were fairly evenly split on whether they considered water quantity a problem (46% said their area "probably" or "definitely" had enough water while another 46% responded "probably not" or "no").⁸ Like the more recent survey in Alabama,

⁵ Prince George's County Planning Department (2009). *Water Use/Resources Survey Results*.

http://www.pgplanning.org/Projects/Ongoing_Plans_and_Projects/Special_Projects/Water_Resources/Survey/Survey_Results.htm

⁶ Ibid.

⁷ Center for Governmental Services (2009). *Survey of Opinions of Alabama Citizens Related to Water Resources and Water Policy and Law*. Auburn University.

http://www.nrmdi.auburn.edu/water/documents/ExecSum_SurveyofOpinionsofAlabamaCitizensRelatedtoWater.pdf

⁸ Castro, Luisa (2005). *Water Issues in Hawaii: A Survey of Public Attitudes*. University of Hawai'i at Manoa. www.ctahr.hawaii.edu/oc/freepubs/pdf/WI-2.pdf

elected officials were not the target of this survey. However, creating a baseline for public perception is important in water management and policy.

To our knowledge, the results of only one survey have been published that aim to uncover the same type of information sought by the Nicholas Institute. In October and November of 2008, New Hampshire's Department of Environmental Services (DES) administered a survey "to gauge [local decision-makers'] concerns and priorities with respect to water resources" to create a more comprehensive water resources plan.⁹

New Hampshire DES survey posed questions regarding drinking water, wastewater, water quality, recreation, and development issues. Less than a third of respondents considered water supply or wastewater a problem in their area. Still, many were in favor of various initiatives to help conserve water, and over half agreed that it would be worthwhile to incur added costs to preserve water resources.¹⁰ The respondents and the topic of this survey are very similar to the Nicholas Institute sponsored survey. The Nicholas Institute had the added goal of contrasting responses from officials and staff at different levels of government.

The surveys and reports regarding water issues around the country over the past decade served as a starting point for this survey. None of them were made with exactly the same intention as the survey in this study, but the collection of methods and results served as a guide.

Methods

Study region and time line

The purpose of this study was to uncover the awareness and perceptions of local and state governments regarding water scarcity in the Triangle. Figure 1 below shows the Triangle region of North Carolina. Within this region the counties of Durham, Orange, and Wake were the primary target of the survey, and are highlighted in green. The study targeted local and state elected officials and local water managers.

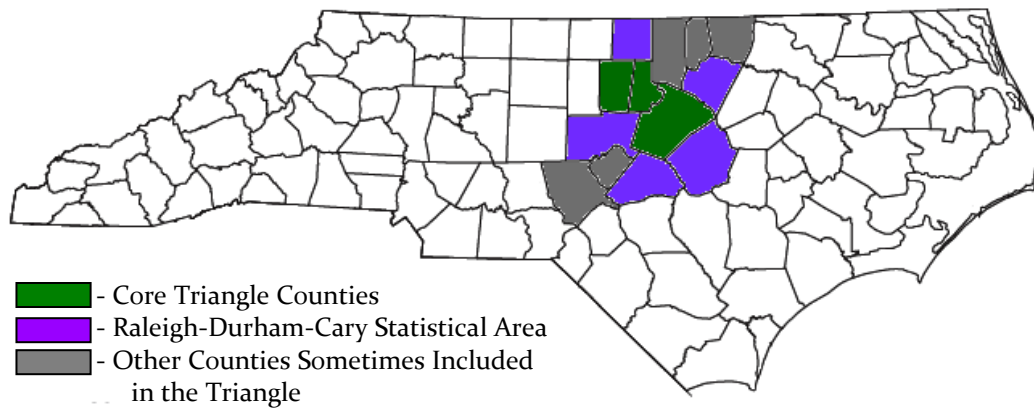


Figure 1: Triangle Region of North Carolina¹¹

⁹ N.H. Department of Environmental Services (2009). *Summary Report of Statewide Policy Maker Survey on Water Issues*. http://des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/interpretive_report.pdf

¹⁰ Ibid.

¹¹ Wikimedia 2010, Triangle, http://commons.wikimedia.org/wiki/File:Research_triangle.PNG

Survey design began in February 2010. A focus group was held on February 26 followed by expert review and peer review pretesting during early March. The survey was conducted from March 23 to April 7.

Survey Design

Three primary research questions guided the development of the survey instrument. They were:

1. What is the awareness of water scarcity issues in the Triangle?
2. What mechanisms are in place to deal with water scarcity issues?
3. What are the perceptions of state and local responsibilities in dealing with water scarcity?

A major goal was to make the survey quick to complete to encourage responses. Toward this end close-ended questions were used as much as possible with a few open-ended questions included where appropriate. The final survey questionnaire included 18 questions, which can be separated into four sections: 1) demographic questions; 2) basic knowledge of water supply and allocation in the Triangle; 3) perception and awareness of water scarcity issues; 4) responsibility of water management between local and state governments. To avoid confusion the definitions of key concepts such as water supply, water allocation, water quality, and water shortage were included at the beginning of the survey.

Focus Group

A focus group was held on February 26 at the Doris Duke Center in the Sarah P. Duke Gardens in Durham, NC. Since the target population for the survey was small, focus group participants with similar levels of knowledge about water issues were sought from other populations. Staff members at Duke Gardens were chosen because the Gardens must manage water as part of their daily operations. The director of administrative operations, Paul Kartcheske, facilitated the meeting by providing a room and recruiting participants. A total of seven staff members, including Paul, participated in the focus group.

Draft questionnaires were distributed to the participants and feedback was sought on each question in order. This approach was chosen so the participants knew what was in the survey so they could help identify important items that were left out as well as any redundancies. Some questions were given particular emphasis by the moderator when feedback was needed on particular design elements or wording. In addition the focus group provided very useful unanticipated feedback.

Based on feedback from the focus group several major changes were made to the questionnaire. The focus group included a discussion of how the mechanisms used to make long-term planning decisions may differ from mechanisms used to implement short-term allocation decisions. To accommodate this the mechanism question was divided into two questions. Additional key concepts were described at the beginning of the survey and several demographic questions were added to allow for more depth in the analysis of responses. Many questions were reformatted from open-ended to close-ended to improve clarity and shorten response times.

Pretesting

Expert review and peer pretesting were conducted after the focus group to prepare the survey for implementation. The Nicholas Institute reviewed the survey after the focus group and the survey

was then designed in Qualtrics. The survey was then presented to classmates during a formal class session for feedback. Finally, 12 student and recent graduate reviewers took the survey through the web and provided feedback that led to important changes. The questionnaire layout was adjusted to make it more user friendly, additional answer options were included, and technical problems were addressed.

Survey Implementation

Survey responses were solicited via email. Respondents were directed to a survey administered via Qualtrics, an online survey interface that facilitates dissemination and collects responses. Email addresses were obtained from the North Carolina Department of Environment and Natural Resources Division of Water Quality website¹² and the Triangle J Council of Governments (TJCOG) directory. TJCOG is an organization providing technical assistance to municipal and county governments in the Triangle J region of North Carolina (comprising of Chatham, Durham, Johnston, Lee, Moore, Orange and Wake counties). Emails were sent directly to these recipients from one of the group member's email accounts, with each recipient included in a blind carbon copy (BCC). A follow-up email was sent a week later. The text of the email is included in appendix A.

The same email was sent once to individuals on four different listservs. One of these listservs was administered by TJCOG and includes approximately 127 water managers and elected officials in the Triangle J region. The other three listservs are administered by the School of Government at the University of North Carolina at Chapel Hill. These were the 'nwateroperators' listserv composed of water operators, the 'stormwater' listserv composed of individuals and operators who manage stormwater, and the 'nwater' listserv composed of water managers.

Error Structure

Emails were sent directly to 220 water managers and staff and 123 elected officials, as well as an unknown number of listserv subscribers. Only 20 emails did not arrive successfully due to invalid addresses. This represents only 5% of recipients and is likely an insignificant source of error.

There were some technical difficulties in administering the survey. The initial link provided by Qualtrics did not open correctly for some recipients, possibly due to state computer restrictions. A follow-up email was sent with an updated link, but it is possible that some individuals received the first broken link and decided not to complete our survey at all, even though they received a follow-up email with another link provided. This could have contributed to some of the non-response.

In total 115 respondents completed the survey, 104 of which worked on water issues in the target counties. It is impossible to calculate a response rate because the number of unique listserv recipients is unknown. Given the use of multiple listservs and the thorough canvassing of publicly available contact lists it is likely that almost all members of the target population received the survey.

¹² NC Division of Water Quality (2010), DWQ Contact Directory, <<http://portal.ncdenr.org/web/wq/contacts>>

Results and Discussion

Demographics of Respondents

All responses were analyzed despite some respondents skipping some questions. Percentages were calculated for all responses based on the total number of responses per question. A total of 104 responses were received from the target counties and are included in the analysis below. To facilitate comparison respondents were split into four subgroups: elected officials, managers and staff, state, and local respondents.

53% of respondents work at the state level, 5% work at the county level, and 43% work at the city (municipal) level. Of those working at the city (municipal) level, 20% are from Durham County, 22% from Orange County, and 59% from Wake County. 21% are elected officials, 20% managers, and 56% are in staff-level positions. All elected officials were from local government agencies. 53% of respondents have been in their position for 5 years or more. 54% of respondents have a graduate degree or higher and 51% have a background in science.

Awareness and Perceptions of Water Issues in Triangle

The following section attempts to identify levels of awareness of respondents about current water issues in the Triangle. County and local level respondents were asked to list the major source(s) of water supply for their municipality. 38 out of 52 possible respondents chose to answer, translating to a 73% response rate for this question. Responses were coded and are shown in the graph below (Figure 2). Most respondents listed Falls Lake as a major source of water supply for their municipality.

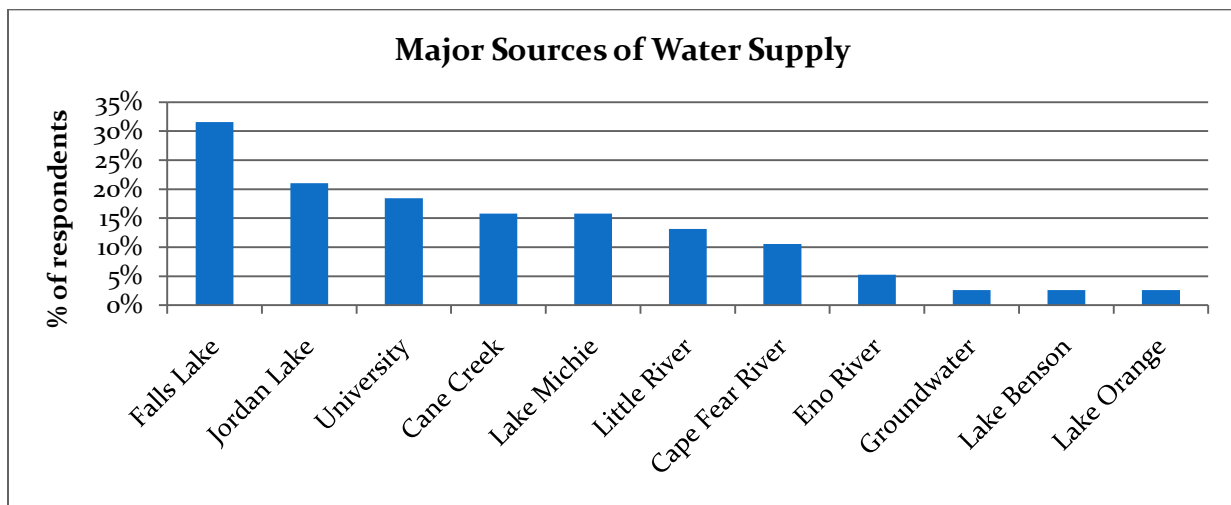


Figure 2: Major sources of water supply

When asked where their agency obtained data to make water supply and allocation decisions most respondents listed state and city/municipal data sources while only 15% were not aware of where the data came from. This indicates that awareness of water data sources is fairly high (Figure 3).

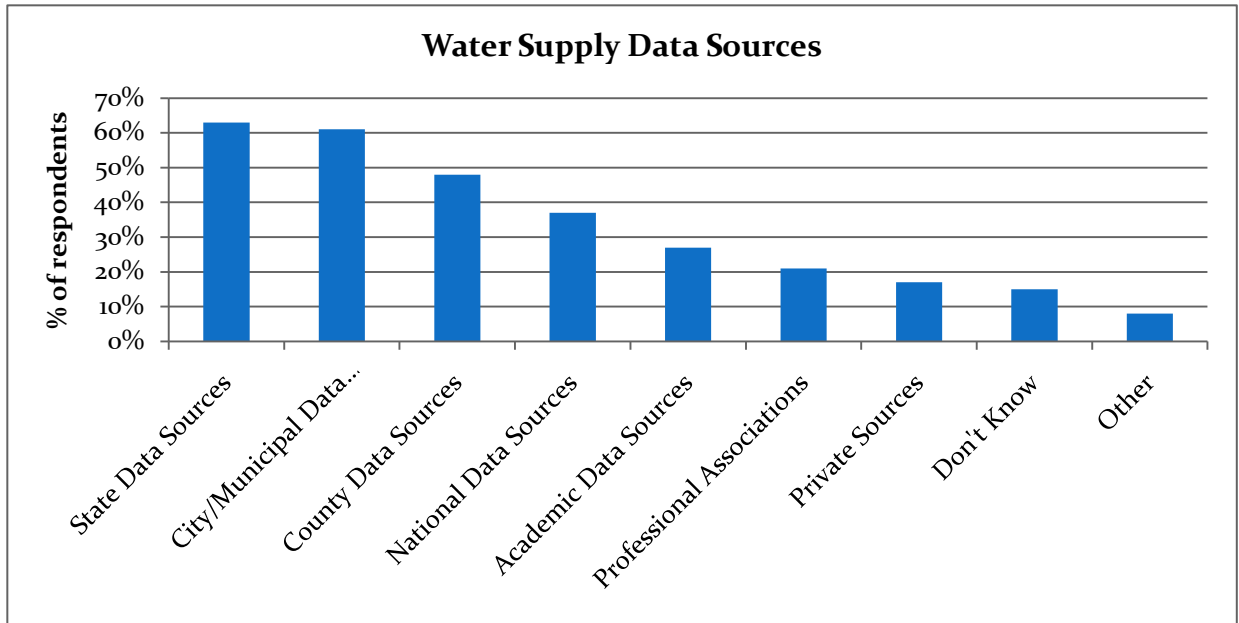


Figure 3: Water supply data sources

In addition to asking about their water supply and water data sources, respondents were asked about their familiarity with current projects to increase water supply in the Triangle. Overall, respondents were mostly familiar with Raleigh and Durham’s discussion of responsibilities for Falls Lake water quality and least familiar with the effort to increase allocation from Jordan Lake (Figure 4).

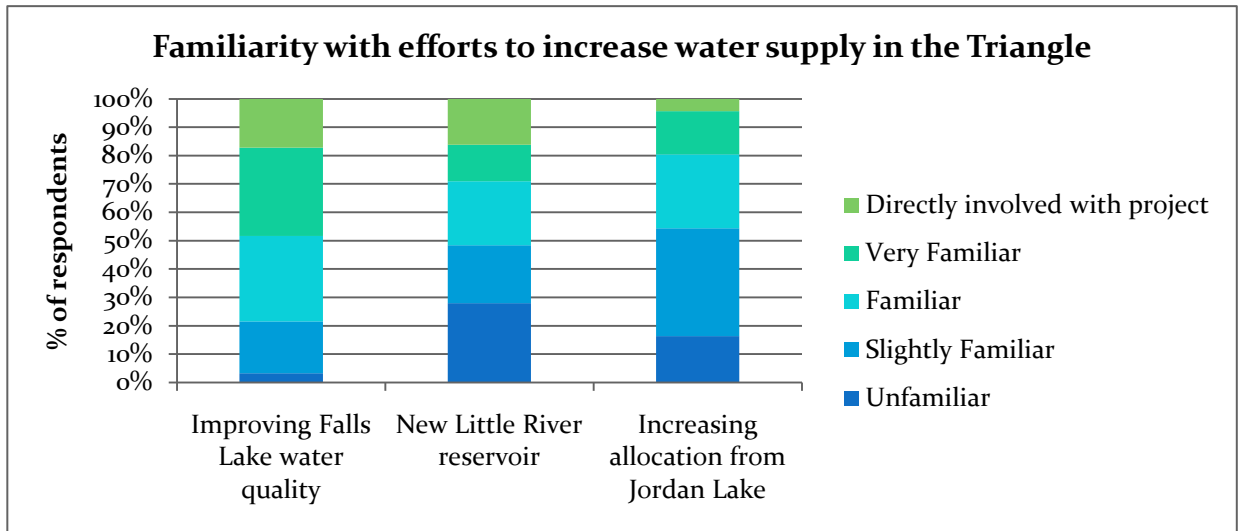


Figure 4: Familiarity with efforts/projects to increase water supply for the Triangle

Next, respondents were asked about the importance of additional sources of water for the Triangle. Elected officials, managers, and staff all indicated that water conservation was the most important while groundwater, new reservoirs and reallocation of reservoirs were of the least importance. However, in general most sources were considered to be very important (Figure 5).

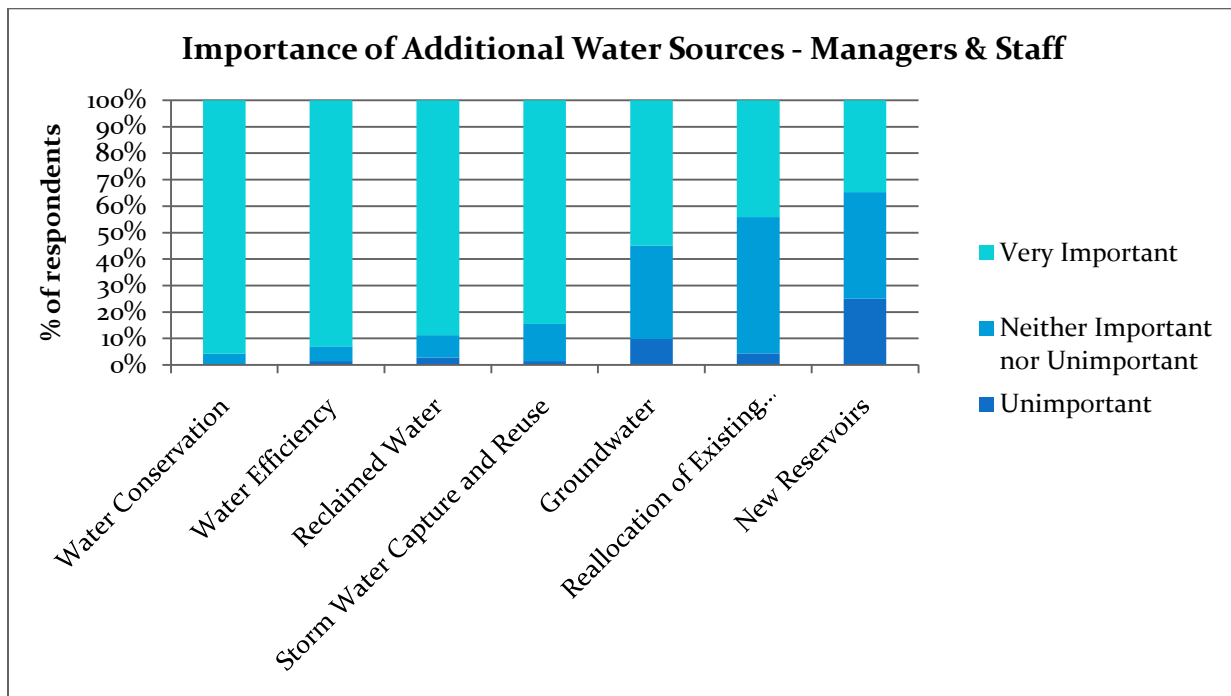
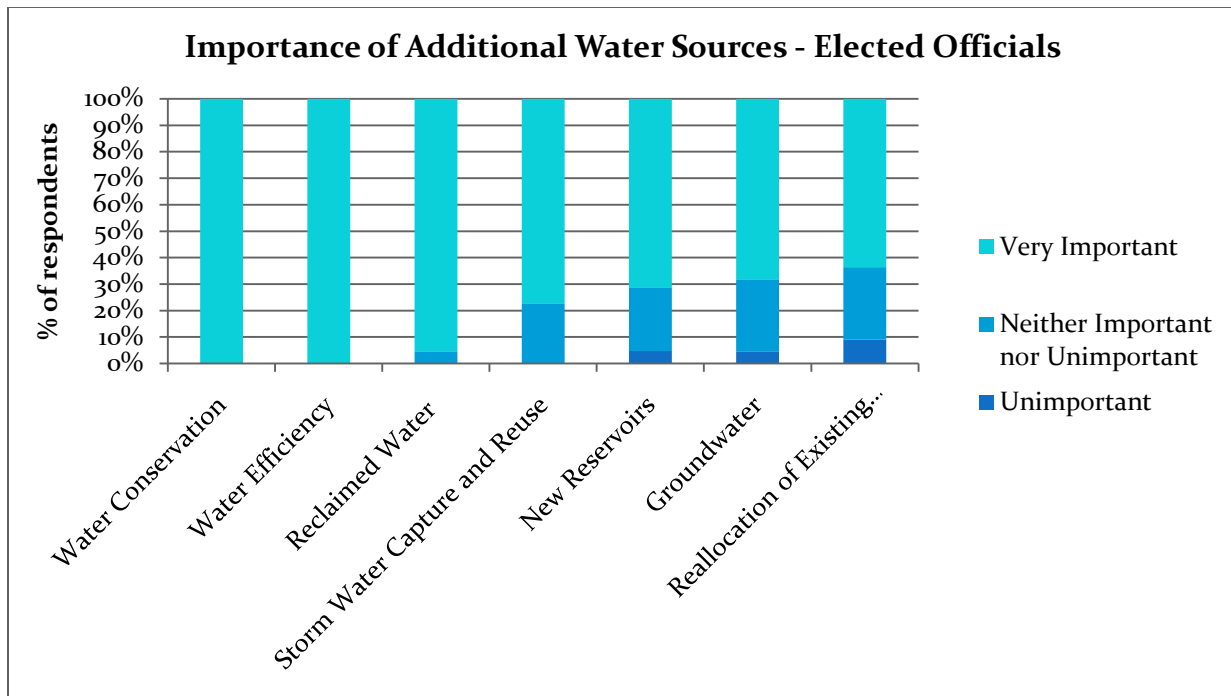


Figure 5: Importance of additional water sources for the Triangle. Sorted by level of importance.

Respondents were asked if they believed that the Triangle would face a water shortage (Figure 6). The majority of both elected officials (76%) and managers and staff (55%) believe the Triangle will face a water shortage in the future while a smaller percentage believes that the Triangle is currently facing a water shortage.

Opinions of the imminence of water scarcity varied considerably. 17% of local respondents believe water scarcity is an issue now, compared to 43% of state respondents. The differences in

state and local responses were found to be statistically significant at the 5% level, while the differences between elected officials and managers and staff were not statistically significant (see appendix D for statistical analysis). The similarities between the elected officials and the local subgroups are likely because all of the elected officials were from local agencies. When asked which counties in the Triangle (Durham, Orange, and Wake) were at risk, respondents indicated that all counties were at risk.

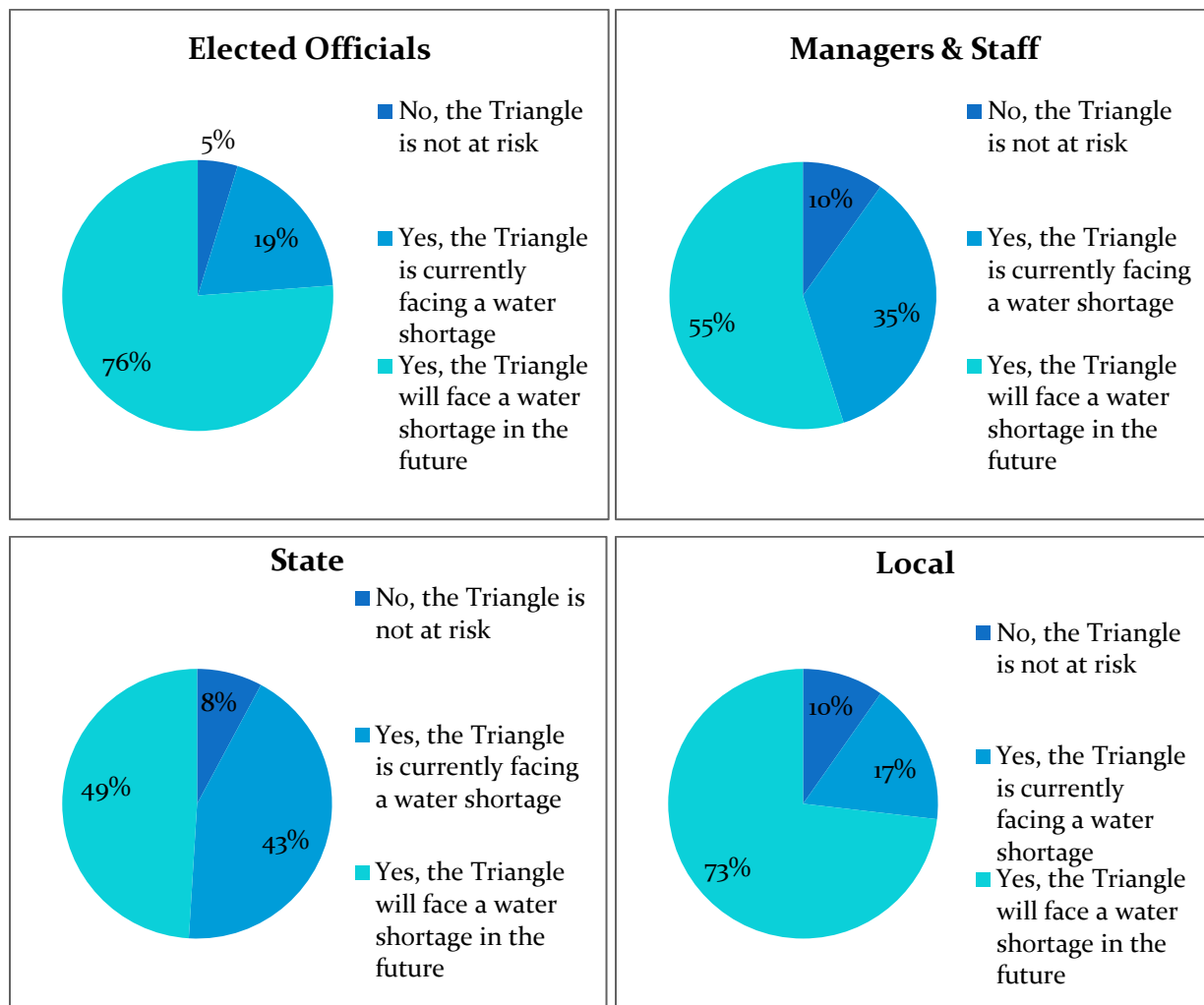


Figure 6: Perceptions of water scarcity

Respondents were asked about various issues that may affect water allocation decisions. Figure 7 shows the level of concern for each issue sorted by level of concern. Top issues for state respondents were water quality (88%), maintaining in-stream flows (73%), supply levels (53%) and population growth (51%). Top issues for local respondents were water quality (86%), supply levels (83%), population growth (86%), and budget (69%).

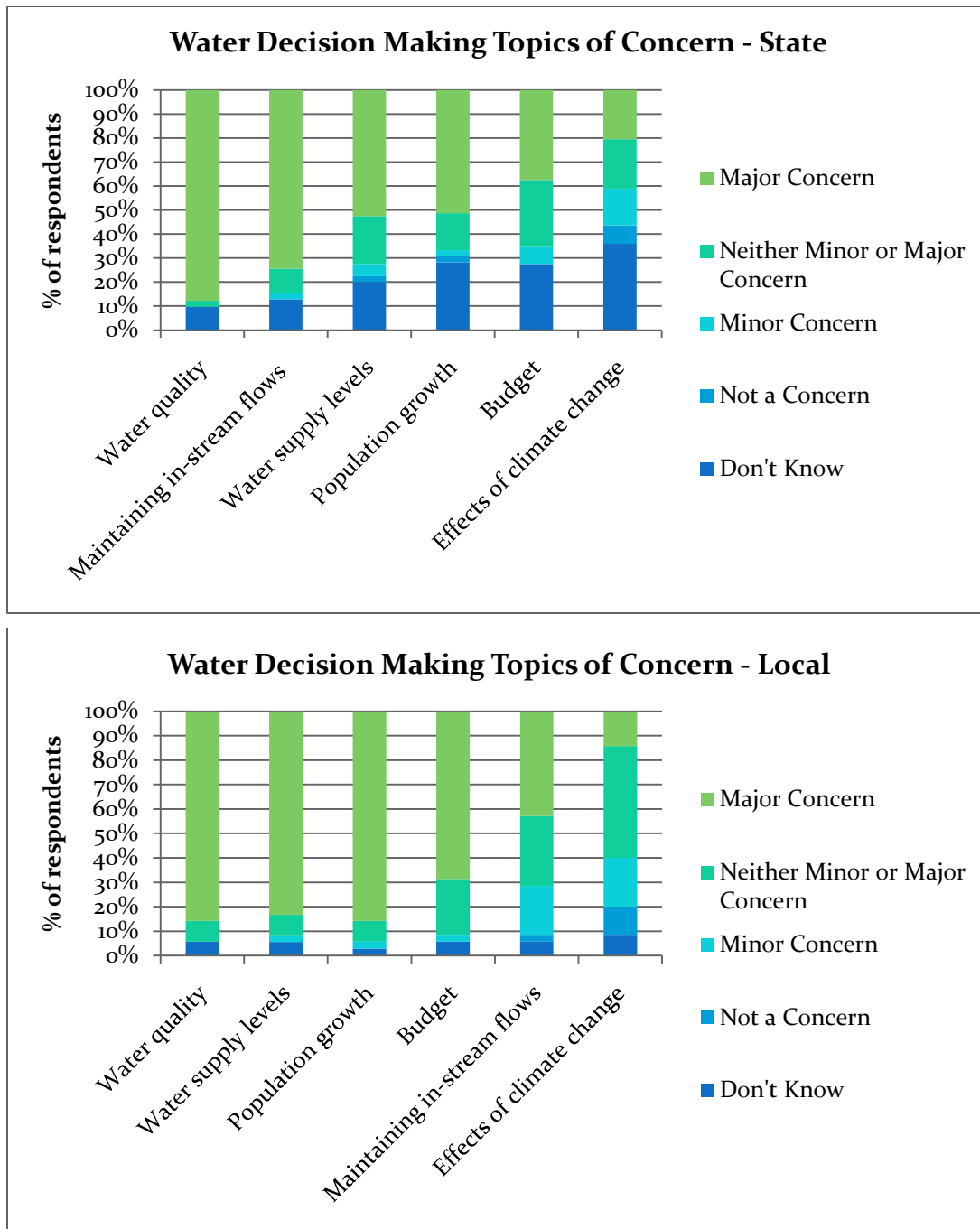


Figure 7: Topics of concern when making water allocation decisions. Sorted by level of concern.

Mechanisms Used for Water Allocation and Management

To address the research question regarding mechanisms currently in place to deal with future water allocation and management respondents were asked to indicate which mechanisms were currently available to manage water allocation decisions. Most respondents were unaware of which mechanisms were used. This result indicates that many agencies either do not have these mechanisms in place, or the respondents do not work in positions dealing specifically with water management. Local respondents appear to be more familiar with mechanisms used for water

allocation as 75% of state respondents did not know the mechanisms used to manage water allocation compared to 42% of local respondents. State respondents who identified specific mechanisms indicated user-based allocation. Local respondents chose user-based allocation followed by marginal cost pricing, social planning, and finally water markets.

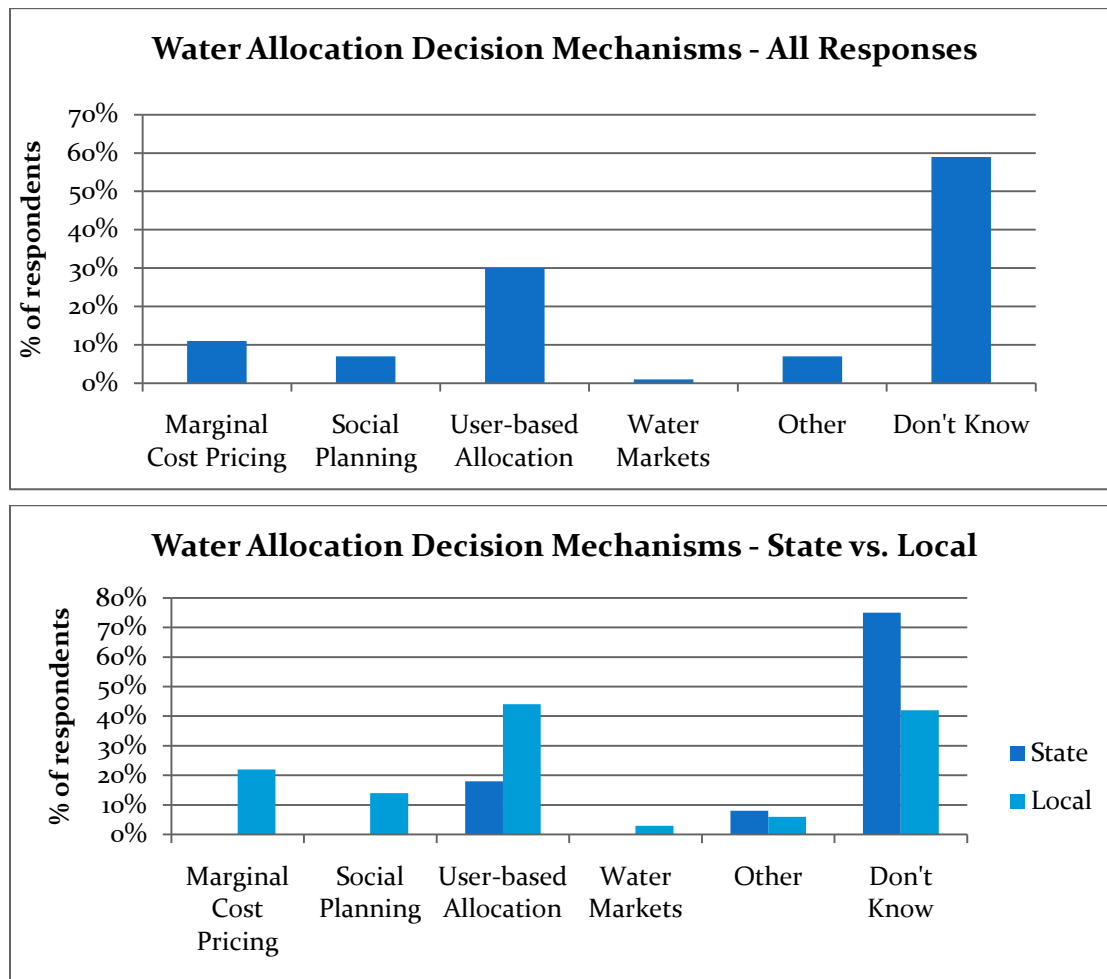


Figure 8: Mechanisms used to manage water allocation decisions

Respondents were asked whether they felt their agency was prepared to make water allocation decisions over the next 20 years (Figure 9). The question was intended to capture whether respondents felt that the mechanisms in place were sufficient to make water allocation decisions in the near future. Overall, 65% of respondents felt their agency was prepared to make water allocation decisions over the next 20 years and 35% did not. When split into subgroups, 85% of elected officials felt that their agency was prepared compared to 58% of managers and staff. The difference in mean responses for state vs. local respondents was also quite large. Of those respondents working in local agencies, 80% felt their agency was prepared, compared to 52% of those working in state agencies. The differences found between both subgroups were found to be statistically significant at the 5% level (appendix D).

It appears respondents were slightly optimistic about their agency’s capability of dealing with water issues in the near future. The results indicate that elected officials tend to be more optimistic than managers and staff members about the preparedness of their agency. This may

be because managers and staff members are closer to the problem and therefore have a more realistic view of the obstacles ahead or the results may reflect the fact that all elected officials are local. Local optimism may indicate that local agencies are in fact more prepared than state agencies. This result is especially interesting when combined with the previous finding that local respondents had a clearer understanding of the mechanisms in place compared to state respondents. Therefore, local respondents may be more aware of the obstacles ahead and the strength of the mechanisms in place to deal with those obstacles.

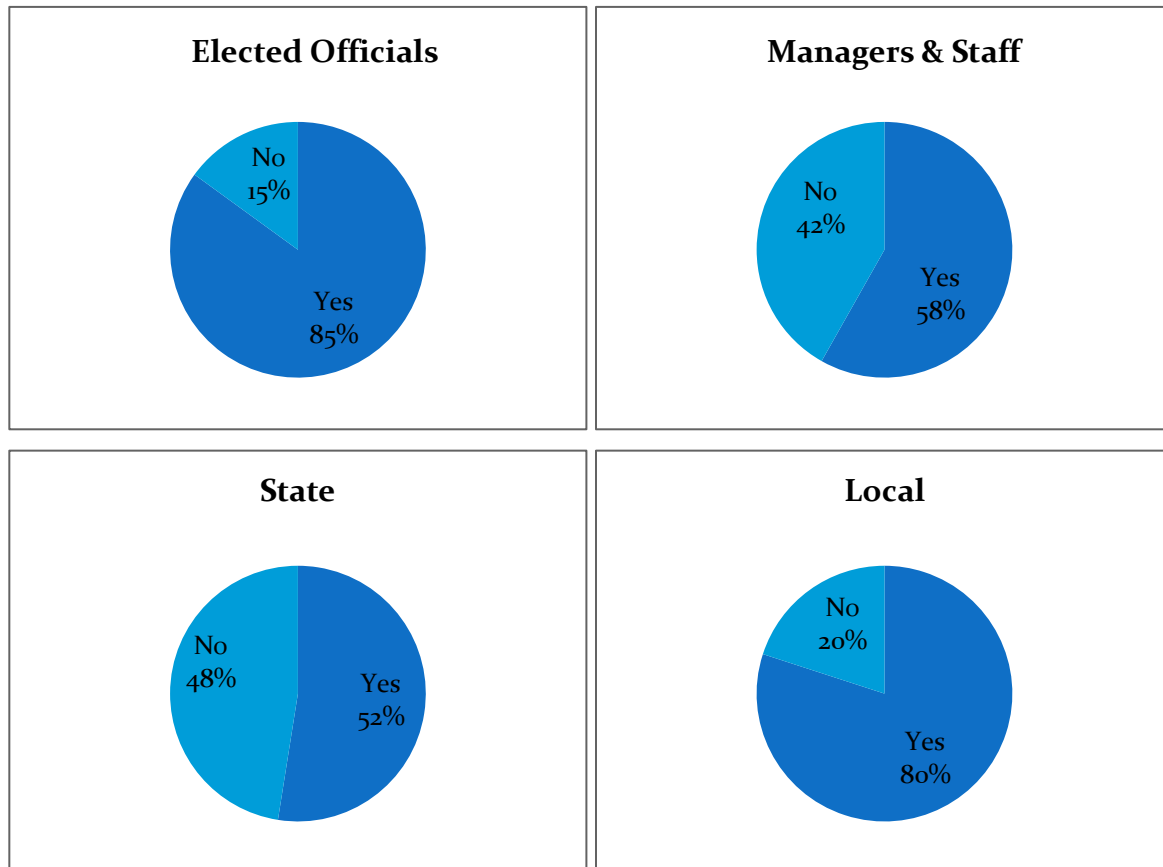


Figure 9: Preparedness to manage water allocation decisions over the next 20 years

Perceptions of local and state roles and responsibilities

The following section examines perceptions of state and local officials concerning their current and future involvement in water issues. The goal is to identify any potential disconnect between the roles that agencies believe they currently fill and the roles they believe they should be filling. State and local subgroups were analyzed and compared through two questions. The first question asked respondents who they believed was currently responsible for water supply, quality and allocation decisions while the second asked who they believe should be responsible for the same decisions.

The results showed that between 35-37% of respondents felt that a mixture of state and local governments should be responsible for all water issues cited. The majority of respondents felt the state was currently responsible and should be responsible for water quality issues, while local agencies are currently and should be responsible for issues of water supply. There is no agreement regarding who is currently or who should be responsible for water allocation. Most

respondents thought state agencies were currently responsible for water allocation issues, but that there should be a mixture of state and local agencies responsible for these issues.

Additionally, the results showed the majority of respondents from state agencies felt that water supply, quality, and allocation issues are currently the responsibility of only the state level agencies or a mix of state and local agencies. On the other hand, the majority of local respondents felt that issues of water supply and allocation are currently dealt with at the local level and the issue of quality is currently dealt with at the state level only.

When asked who should be responsible for water supply, quality, and allocation decisions, most local respondents felt that local agencies should be in charge of water supply and allocation issues, while the state should be responsible for water quality decisions. Similarly, most state respondents felt the state should have responsibility for water quality, but both state and local agencies should take responsibility for water supply and allocation decisions (Figure 10). The differences between state and local perceptions are significant at the 5% level for each water issue both in terms of what level of government respondents believe is currently responsible and what level they feel should be responsible (appendix D). This highlights a clear difference between the state and the local respondents over who should be responsible for water management issues.

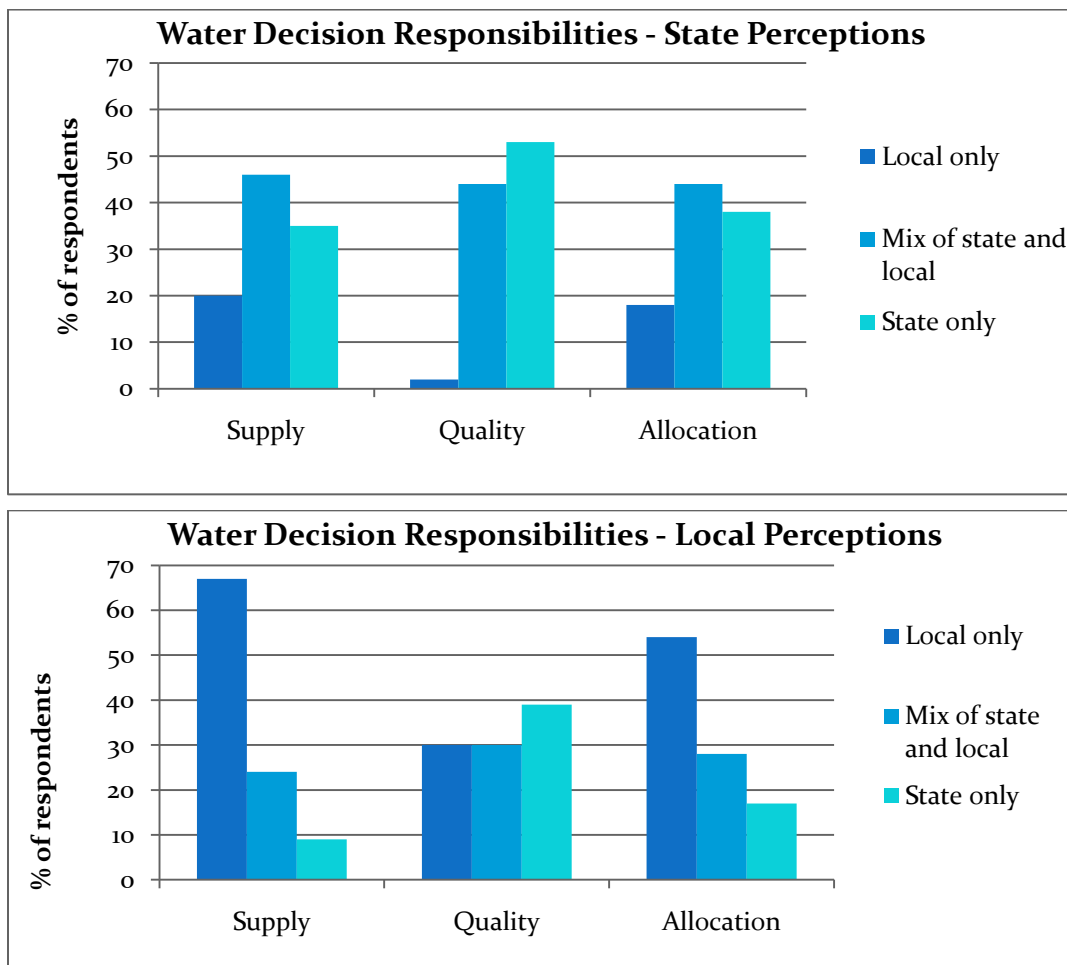


Figure 10: Perceptions of which level of government should be responsible for water supply, quality, and allocation decisions.

The question that arises from the difference in perceptions is whether the difference is due to a fundamental difference in opinion about who should be in control, or whether there is an indication of a belief that current roles should change in the future. To explore this the responses of state and local respondents were compared by perceptions of who was currently responsible and who should be responsible for all water issues (supply, quality, and allocation). While there are still visible differences between state and local respondents, this comparison illustrates that there is not much change in the respondents' perceptions of who is responsible and who should be responsible within groups (Figure 11). This finding indicates that participants don't necessarily want roles to change; they just perceive state and local roles differently depending on what level of government they are currently working in.

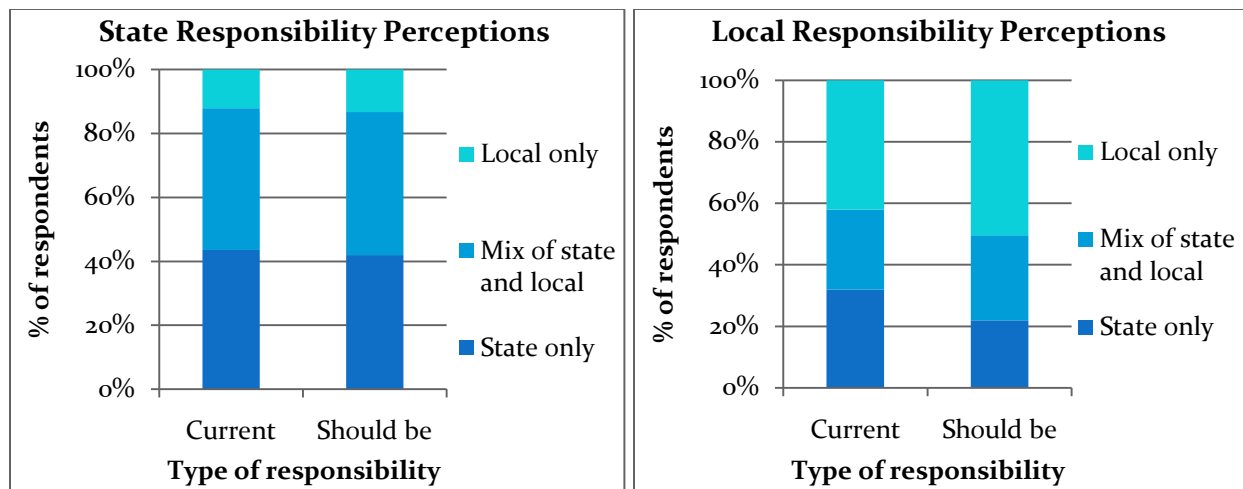


Figure 11: Perceptions of which level of government are currently and should be responsible for all types of water decisions.

Conclusion

The pilot study received 104 responses from elected officials, water managers, and staff who deal with water management within the Triangle. Responses to the survey indicate that there is wide-ranging awareness about current water supply issues. However, there is also a lack of agreement among state and local respondents about the immediacy of these water supply concerns. Significantly more local respondents indicated that water scarcity is currently an issue than state respondents, most of whom see water scarcity as a concern for the future. This may be indicative of knowledge of water supply resources or demand patterns not being shared. It may be helpful for state and local agencies to communicate knowledge of water resources more broadly to facilitate cooperation in future planning.

Knowledge of the specific mechanisms in place to deal with water allocation issues is not widespread. However, respondents' perceptions that agencies are prepared to handle a water shortage in the future indicate that there are mechanisms in place. Again there was disparity between different levels, with local respondents naming more specific mechanisms than state respondents. Local respondents may be more familiar with mechanisms because they need to use them or more of them than state respondents. Alternatively, state respondents may have more information than local respondents on the broader state situation and be more aware of how that

will impact future water supply. Either way, this provides another impetus for additional communication between the two levels of government.

Finally, while there is some desire for shared responsibility in addressing water issues between the two levels of government, there are marked differences of opinion over who should be primarily responsible for water supply and allocation decisions. State respondents tend to feel the state should play a dominant or large collaborative role in all decision making, while local respondents indicate a desire for autonomy in making water supply and allocation decisions. Interestingly, there is no great difference in opinions among respondents of who currently is responsible and who should be responsible for making decisions. This indicates a possible misunderstanding of roles or tension between the levels of government. The Nicholas Institute could serve a very valuable role as a facilitator by bridging the knowledge and opinion gaps between state and local officials.

Appendix A: Respondent Solicitation Email

Subject: Duke University Water Resource Project in the Triangle

Dear Sir/Madam:

A group of graduate students at Duke University are conducting a survey of government officials and managers regarding knowledge and perceptions of water resources in the Triangle region of North Carolina. Your responses will be used to help inform decision makers about water issues in the Triangle.

We are looking for responses from those government officials and managers involved with water resources in the Triangle at the state, county, and city (municipal) levels.

The online survey can be found at the link below and should take approximately **10 minutes** to complete. All responses will be kept anonymous and confidential.

http://dukessri.qualtrics.com/SE?SID=SV_0kdx0rXrGT51Fru&SVID=Prod

The survey will be open until **Wednesday, April 7th at 5:00pm.**

We would truly appreciate your input. If you have any questions please feel free to let us know.

Regards,

Emily Vuxton
Duke University
emily.vuxton@duke.edu

Appendix B: Survey Instrument

Default Question Block

Thank you for taking the time to fill out this survey. This survey is being conducted by graduate students from Duke University and we would really appreciate your input. This survey is expected to take 10 minutes to complete.

The purpose of this survey is to gather information from government officials and managers regarding knowledge and perceptions of water resources in the Triangle region of North Carolina. The data will be used in the future to help inform decision makers about water issues in the Triangle. There are no wrong answers, we are measuring general familiarity with water issues in the Triangle.

All responses are anonymous and will be kept confidential.

Definitions:

Water Supply: The natural sources, wells, pumps and intake and storage structures from which water is supplied for any purpose and user

Water Allocation: The division of water supply to different users

Water Quality: The quality of the water available to users

Water Shortage: Insufficient water supply to meet demand of users

By continuing with this survey, you agree that you have read and understand the above information and consent to participating in this survey.

Please describe what level of government you work in:

- State
- County
- City (Municipal)

What county do you work in or represent?

- Durham County
- Orange County
- Wake County
- Other (Please List)

Please describe your position:

- Elected Official
- Manager
- Staff
- Other (Please List)

How long have you been in your current position?

-

1 year or less

- 1 to 5 years
- 5 to 10 years
- 10+ years

Please describe your highest level of education:

- High School Diploma or GED
- Associate Degree
- Bachelor Degree
- Graduate Degree or higher (Masters, JD, MBA, MD, PhD)

Please describe your educational background and/or training? (Check all that apply)

- Biological, Physical, and/or Environmental Science
- Business Administration
- Engineering
- Public Health
- Public Policy/Political Sciences
- Other (Please specify)

What is the major source(s) of water supply for your municipality or for the major municipality in your county?

Where does your agency get the data used to make water supply and allocation decisions? (Check all that apply)

- National Data Sources
- State Data Sources
- County Data Sources
- City/Municipal Data Sources
- Professional Associations
- Academic Data Sources
- Private Sources
- Other, please list source names here:

- Don't Know

Are you familiar with any of the following efforts to increase water supply in the Triangle region?

Unfamiliar Slightly Familiar Very Familiar Directly

		Familiar			involved with project
Durham, Orange, and Chatham counties working to increase their allocation from Jordan Lake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raleigh and Durham discussion of responsibilities for Falls Lake water quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feasibility of new reservoir on the Little River	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other large-scale project (please describe briefly)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="text"/>					
Other large-scale project (please describe briefly)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="text"/>					
Other large-scale project (please describe briefly)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="text"/>					

In your opinion, how important are the following "new" sources of water to the Triangle region?

	Not at all Important	Very Unimportant	Neither Important nor Unimportant	Very Important	Extremely Important
Water Conservation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water Efficiency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Storm Water Capture and Reuse	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reclaimed Water (Reuse of Treated Wastewater)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
New Reservoirs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reallocation of Water in Existing Reservoirs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Groundwater	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you believe the Triangle region will face a water shortage?

- Yes, the Triangle region is currently facing a water shortage
- Yes, the Triangle region will face a water shortage in the future (Please specify a time period)
-
- No, the Triangle region is not at risk

Please rate the following counties for their current risk of a water shortage:

	No Risk	Low Risk	Neutral	High Risk	Very High Risk	Don't Know
Durham County	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Orange County	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wake County	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate the level of concern for the following topics when you or your agency makes water allocation decisions:

	Not a Concern	Minor Concern	Neither Minor or Major Concern	Major Concern	Don't Know
Water quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water supply levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Budget	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Population growth in your area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Effects of climate change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintaining in-stream flows for fish and wildlife	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please List): <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please List): <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please List): <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Which level of government do you believe is currently responsible for the following? (check all that apply)

	State	Regional	County	City/Municipal
Water Supply Decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water Quality Decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water Allocation Decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which level of government do you believe should be responsible for the following? (check all that apply)

	State	Regional	County	City/Municipal
Water Supply Decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water Quality Decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water Allocation Decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What mechanisms does your agency or office currently have available to manage water allocation decisions? (Check all that apply)

- Marginal Cost Pricing
-

Social Planning

User-based Allocation

Water Markets

Other (Please Specify)

Don't Know

Do you believe that your agency or office is prepared to make water allocation decisions over the next 20 years?

Yes

No, if 'No' what would help you or your agency to make more effective decisions?

Do you have any additional comments regarding the topics covered in the survey?

Appendix C: Question Responses

1. Please describe what level of government you work in:

#	Answer	Response	%
1	State	58	53%
2	County	5	5%
3	City (Municipal)	47	43%
	Total	110	100%

Statistic	Value
Mean	1.90
Variance	0.95
Standard Deviation	0.98
Total Responses	110

2. What county do you work in or represent?

#	Answer	Response	%
2	Durham County	9	20%
3	Orange County	10	22%
4	Wake County	27	59%
5	Other (Please List)	0	0%
	Total	46	100%

Statistic	Value
Mean	3.39
Variance	0.64
Standard Deviation	0.80
Total Responses	46

3. Please describe your position:

#	Answer	Response	%
1	Elected Official	22	21%
2	Manager	21	20%
3	Staff	58	56%
4	Other (Please List)	3	3%
	Total	104	100%

Other (Please List)
Educator
Planning Director
engineer

Statistic	Value
Mean	2.40
Variance	0.73
Standard Deviation	0.85
Total Responses	104

4. How long have you been in your current position?

#	Answer	Response	%
1	1 year or less	8	8%
2	1 to 5 years	41	39%
3	5 to 10 years	29	28%
4	10+ years	26	25%
	Total	104	100%

Statistic	Value
Mean	2.70
Variance	0.87
Standard Deviation	0.93
Total Responses	104

5. Please describe your highest level of education:

#	Answer	Response	%
1	High School Diploma or GED	0	0%
2	Associate Degree	2	2%
3	Bachelor Degree	46	44%
4	Graduate Degree or higher (Masters, JD, MBA, MD, PhD)	56	54%
	Total	104	100%

Statistic	Value
Mean	3.52
Variance	0.29
Standard Deviation	0.54
Total Responses	104

6. Please describe your educational background and/or training? (Check all that apply)

#	Answer	Response	%
1	Biological, Physical, and/or Environmental Science	53	51%
2	Business Administration	9	9%
3	Engineering	31	30%
4	Public Health	6	6%
5	Public Policy/Political Sciences	4	4%
6	Other (Please specify)	16	15%

Other (Please specify)
Education
Earth Science
law
Human Behavior
Journalism/Mass Media
art/communications
Social Work
horticulture/botany
Journalism
marine biology
Social science
education
pharmacist
Social Work
Public Administration
Psy/Econ

Statistic	Value
Total Responses	104

7. What is the major source(s) of water supply for your municipality or for the major municipality in your county?

Text Response
jordan lake
Cane Creek Reservoir, University Lake
Lake Mickie; Little River/Flat river feed; off line reserve in quarry; 10% allocation from Jordan Lake
The Little River Reservoir and Lake Michie

Falls Lake
University Lake, Cane Creek Reservoir
Lake Michie and the Little River Reservoir; as back up Jordan Lake and the Eno River
Lake Michie and Little River Reservoir
Ground water within the County; Eno River for Hillsborough (West Fork and Lake Orange); University and Cane Creek Lakes for OWASA (Chapel Hill/Carrboro)
Falls Lake
Surface water impoundments (Cane Creek Reservoir and University Lake) in Orange County.
Fall Lake and Lake Benson/Wheeler
surface water: University Lake, Cane Creek
Jordan Lake
Cape Fear River
falls lake
Lake Michie, Jordan Lake
OWASA
falls lake via City of Raleigh
lake jordan
Eno River and Lake Orange
Falls Lake
Raleigh
Jordan Lake University Lake Hwy 54 Reservoir
Falls Lake
Cane Creek and University Lake reservoirs; stone quarry
Falls Lake
Surface water resorvoirs
Lake Michie, Little River Reservoir
falls lake and local reservoir
Falls Lake/City of Raleigh
Two reservoirs
Falls Lake
City of Raleigh (CORPUD)
Cape Fear River
Jordan Lake
The Cape Fear River
Cape Fear and Neuse River basins

Statistic	Value
Total Responses	38

**8. Where does your agency get the data used to make water supply and allocation decisions?
(Check all that apply)**

#	Answer	Response	%
1	National Data Sources	33	37%
2	State Data Sources	56	63%
3	County Data Sources	43	48%
4	City/Municipal Data Sources	54	61%
5	Professional Associations	19	21%
6	Academic Data Sources	24	27%
7	Private Sources	15	17%
9	Other, please list source names here:	7	8%
8	Don't Know	13	15%

Other, please list source names here:
monitoring reports
I am not involved in supply & allocation decision making
legislation passed and following rules
N/A
Division Water Res.
OWASA
US Corps of Engineers

Statistic	Value
Total Responses	89

9. Are you familiar with any of the following efforts to increase water supply in the Triangle region?

#	Question	Unfamiliar	Slightly Familiar	Familiar	Very Familiar	Directly involved with project	Responses	Mean
1	Durham, Orange, and Chatham counties working to increase their allocation from Jordan Lake	15	35	24	14	4	92	2.86
2	Raleigh and Durham discussion of responsibilities for Falls Lake water quality	3	17	28	29	16	93	3.68
4	Feasibility of new reservoir on the Little River	26	19	21	12	15	93	2.72

3	Other large-scale project (please describe briefly)	11	2	5	2	4	24	2.38
6	Other large-scale project (please describe briefly)	11	1	1	0	2	15	1.53
7	Other large-scale project (please describe briefly)	10	0	1	0	1	12	1.42

Other large-scale project (please describe briefly)	Other large-scale project (please describe briefly)	Other large-scale project (please describe briefly)
additional access to jordan lake allocation via cary		
Re-use water		
IBT from Kerr Lake		
Jordan Rule implementation	New Phase II designations	
Durham/Cary Reclaimed Water Projects		
Western Wake treatmetn Plant		
regional coordination		
Need for partnership amongst entities in same watershed district		
Kerr Reservoir pipeline	Lake Benson water supply	Harris Lake water supply
New WTP at Lake Benson	New WWTP nr Cary and intake or outfall to Cape Fear	
WWTP expansion	WWTP collections	construciton sites
Jordan Lake/Cary		
Increased use of reclaimed water for irrigation and other approved uses		

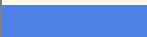


Statistic	Durham, Orange, and Chatham counties working to increase their allocation from Jordan Lake	Raleigh and Durham discussion of responsibilities for Falls Lake water quality	Feasibility of new reservoir on the Little River	Other large-scale project (please describe briefly)	Other large-scale project (please describe briefly)	Other large-scale project (please describe briefly)
Mean	2.86	3.68	2.72	2.38	1.53	1.42
Variance	1.90	1.42	2.01	2.16	0.98	0.99
Standard Deviation	1.38	1.19	1.42	1.47	0.99	1.00
Total Responses	92	93	93	24	15	12

10. In your opinion, how important are the following "new" sources of water to the Triangle region?

#	Question	Not at all Important	Very Unimportant	Neither Important nor Unimportant	Very Important	Extremely Important	Responses	Mean
1	Water Conservation	0	0	3	36	54	93	4.55
2	Water Efficiency	0	1	4	36	52	93	4.49
3	Storm Water Capture and Reuse	1	0	15	46	31	93	4.14
4	Reclaimed Water (Reuse of Treated Wastewater)	1	1	7	48	36	93	4.26
5	New Reservoirs	5	14	34	32	8	93	3.26
6	Reallocation of Water in Existing Reservoirs	3	2	41	37	7	90	3.48
7	Groundwater	2	6	31	38	16	93	3.65

Statistic	Water Conservation	Water Efficiency	Storm Water Capture and Reuse	Reclaimed Water (Reuse of Treated Wastewater)	New Reservoirs	Reallocation of Water in Existing Reservoirs	Groundwater
Mean	4.55	4.49	4.14	4.26	3.26	3.48	3.65
Variance	0.32	0.40	0.58	0.54	1.00	0.66	0.84
Standard Deviation	0.56	0.64	0.76	0.74	1.00	0.81	0.92
Total Responses	93	93	93	93	93	90	93

11. Do you believe the Triangle region will face a water shortage?

#	Answer	Response	%
1	Yes, the Triangle region is currently facing a water shortage		29 32%
2	Yes, the Triangle region will face a water shortage in the future (Please specify a time period)		55 60%
3	No, the Triangle region is not at risk		8 9%
	Total		92 100%

Yes, the Triangle region will face a water shortage in the future (Please specify a time period)
approx. 25 years
5 years
10 years
1 year
any drought; currently have full reservoirs
20 years
no idea
10 years
10-15 years
2015 - 2020
every drought
10
20 years
2015
?
10
1-5 years
2050
every fall
5-10 years
2040
depends on the use of some of the measures above to managed water use more effectively
2nd half of 21st century
10 years?
5 years
Next Drought
5-7 years
20 years

2012
cyclical - 5 months
5 years
30 years
Raleigh says the Dempsey Benton water plant is not now needed for our water. Why the Little River res. when it will not furnish enough water. Yield is over stated. Little River has silted in and its yield is almost nothing..
I am not sure about the triangle region. I only know about our local supply and we are not at risk.
Next long drought
any time we have significant drought
20 years
10 years or less
5- 10 yrs
3 years, 5 months, & 8 Days
20 yrs
Cannot say for sure, although the recent droughts may actually be one extended drought
within 10 years
next drought; long term: 50 years
3 yrs
10 years
10 years dep.on growth
Next 5 years
Next drought. Likely within 5 years
Next few years because of growth, etc.
20 years

Statistic	Value
Mean	1.77
Variance	0.35
Standard Deviation	0.59
Total Responses	92

12. Please rate the following counties for their current risk of a water shortage:

#	Question	No Risk	Low Risk	Neutral	High Risk	Very High Risk	Don't Know	Responses	Mean
2	Durham County	0	4	9	35	14	24	86	4.52
3	Orange County	1	12	15	23	5	29	85	4.25
4	Wake County	0	4	12	36	21	13	86	4.31

Statistic	Durham County	Orange County	Wake County
Mean	4.52	4.25	4.31
Variance	1.31	2.24	1.09
Standard Deviation	1.15	1.50	1.04
Total Responses	86	85	86

13. Please indicate the level of concern for the following topics when you or your agency makes water allocation decisions:

#	Question	Not a Concern	Minor Concern	Neither Minor or Major Concern	Major Concern	Don't Know	Responses	Mean
1	Water quality	0	0	4	66	6	76	4.03
2	Water supply levels	1	3	11	51	10	76	3.87
3	Budget	0	4	19	39	13	75	3.81
4	Population growth in your area	1	2	9	50	12	74	3.95
5	Effects of climate change	7	13	24	13	17	74	3.27
7	Maintaining in-stream flows for fish and wildlife	1	8	14	44	7	74	3.65
6	Other (Please List):	3	1	0	3	5	12	3.50
9	Other (Please List):	2	0	0	2	4	8	3.75
10	Other (Please List)	2	0	0	2	4	8	3.75

Other (Please List):	Other (Please List):	Other (Please List)
Land Use Change (in addition to climate change)	Interbasin Transfer restrictions	Terms of interlocal agreements to sell/purchase water
Development rates		
My agency (DWQ/NPDES) does not make "allocation" decisions.		
Waste assimilative capacity		
Public Apathy	Lack of Political Leadership	Pressure from development lobbies
N/A agency does not make allocation decisions		

Statistic	Water quality	Water supply levels	Budget	Population growth in your area	Effects of climate change	Maintaining in-stream flows for fish and wildlife	Other (Please List):	Other (Please List):	Other (Please List)
Mean	4.03	3.87	3.81	3.95	3.27	3.65	3.50	3.75	3.75
Variance	0.13	0.54	0.61	0.52	1.60	0.72	3.69	3.07	3.07
Standard Deviation	0.36	0.74	0.78	0.72	1.26	0.85	1.92	1.75	1.75
Total Responses	76	76	75	74	74	74	13	8	8

14. Which level of government do you believe is currently responsible for the following? (check all that apply)

#	Question	State	Regional	County	City/Municipal	Responses
1	Water Supply Decisions	51	27	34	48	160
2	Water Quality Decisions	72	25	30	39	166
3	Water Allocation Decisions	54	24	22	29	129

Statistic	Water Supply Decisions	Water Quality Decisions	Water Allocation Decisions
Total Responses	81	82	81

15. Which level of government do you believe should be responsible for the following? (check all that apply)

#	Question	State	Regional	County	City/Municipal	Responses
1	Water Supply Decisions	50	39	30	40	159
2	Water Quality Decisions	70	31	29	37	167
3	Water Allocation Decisions	54	38	22	34	148

Statistic	Water Supply Decisions	Water Quality Decisions	Water Allocation Decisions
Total Responses	83	82	82

16. What mechanisms does your agency or office currently have available to manage water allocation decisions? (Check all that apply)

#	Answer	Response	%
1	Marginal Cost Pricing	8	11%
2	Social Planning	5	7%
3	User-based Allocation	23	30%
4	Water Markets	1	1%
5	Other (Please Specify)	5	7%
6	Don't Know	45	59%

Other (Please Specify)
Education
NONE!! Raleigh is the KING!!!!!!
none - we do not manage allocations
N/A
most decisions of allocation made by another agency

Statistic	Value
Total Responses	76

17. Do you believe that your agency or office is prepared to make water allocation decisions over the next 20 years?

#	Answer	Response	%
1	Yes	49	65%
2	No, If 'No' what would help you or your agency to make more effective decisions?	26	35%
	Total	75	100%

No, If 'No' what would help you or your agency to make more effective decisions?
We don't make these decisions
Integrating groundwater supply planning with surface water supply planning.
\$\$
We are only involved in water quality decisions.
Better understanding of all impacts
I don't think my agency is responsible for making water allocation decisions.
not sure
better hydrodynamic modelling of supplies
we do not manage allocations
An accurate water allocation model
we deal with water quality, not allocation
Objective, non political, planning based on real world realities that exist in each river basin. We need planning that starts at the potential of the basin and works toward a sustainable population capacity while maintaining environmental integrity.
N/A
most decisions made by another agency
comprehensive modeling including water quality and quantity
Better overview of other's needs. Better population projections.

Statistic	Value
Mean	1.35
Variance	0.23
Standard Deviation	0.48
Total Responses	75

18. Do you have any additional comments regarding the topics covered in the survey?

Text Response
You've targeted water quality personnel who do not make water allocation decisions and assumed that they do in your survey.
I don't work that closely to water allocations. Maybe I need to educate myself more on this topic.
Organizational structure of our agency (DENR) is such that water quality and water supply/allocation decisions are not integrated. This is an area of water planning that is ripe for improvement. I anticipate this survey will generate a lot of "don't know" responses from those who are involved solely in water quality management/planning.
Good survey. I do not make allocation decisions. I am pleased to learn about the planning for a new reservoir on the Little River. Please note that sedimentation has historically diminished raw water supplies by reducing storage volume available. Perhaps policy makers should continue to review this issue periodically.
In many governments - water quality and water quantity are handled by different groups of people. Some questions in this survey asked participants to answer questions in one area or the other when they might not know that area well enough to answer (such as the previous question) - this may skew your results.
Survey doesn't address public health issues associated with water.
I don't do anything with water allocation/quantity issues. Only quality.
Water allocation decision need to be made with the entire watersupply of the State open for consideration. The IBT statute should be substantially amended to allow for regionalization of water supplies without the need to go through the IBT process.
You are surveying "government officials and managers involved with water resources," and you assume that all of the participants make water allocation decisions. I don't believe that is the case. You should have included more possible responses. I think your results will be biased because you didn't recognize that not everyone you survey is involved in such decisions, and didn't provide a response allowing the participant to indicate that. All "government officials and managers involved with water resources" might have opinions on water allocation decisions, but they all don't make the decisions. Thanks.
Follow Cary's lead on quality, conservation & water reclamation
Take control from Raleigh and Mayor Meeker!!!!!!!!!!!!!!!!!!!!!!
My agency's focus is water quality and so it is somewhat indirectly related to water allocation and supply.
My agency makes more water quality decisions than water supply decisions. (DWQ vs. DWR)
My work area is not in public water supply. My work unit is involved in water quality issues, not allocation of resources.
I am employed in the surface water quality section, so my expertise in water allocation is limited.
Staff that I am in contact with including myself are chronically demoralized by political pressure to adjust or reduce our recommendations to accommodate the ambitions of development. We strive amid budget restrictions and labor shortages to produce sound data to guide our conclusions. Later we find that our finding were ambiguous to the direction and decisions taken by leaders who were motivated by other goals.

Routinely studies are repeated decade after decade for the simple reason that to study a problem is cheaper and easier to propose than the politically hazardous actions necessary to fix the problems. To study a problem requires relatively little political liability exposure however gives the appearance of action. When it is a foregone conclusion that you will not win the race, how hard will you run? When the team is out of the finals the demoralization feeds on itself. We need brave leadership willing to make the hard decisions and insure our future, otherwise all the levels beneath become evermore entangled in inefficacy and futility.

The agency I work with is mostly responsible for the protection of water quality and to some degree has a voice in issues of water quantity. To compensate for the demands of population and industrial growth, all segments of government are going to have to be involved in conservation and reuse issues and education.

Could not appropriately answer all questions because the county does not make water allocation decisions and neither do the towns. Orange County has a public utility OWASA which makes a number of decisions.

My agency does not deal with water allocation or distribution decisions.

My department works in wastewater treatment and the development of discharge limitations. We do not handle water supply or water supply allocation decisions. We do handle those decisions for the discharge of wastewaters. There is a need to reuse or reclaim certain wastewaters which are not being done. Charlotte-Mecklenburg Utilities for instance has the ability to treat its municipal wastewaters for water reclamation in large quantities, however, they do not have any customers and the cost for distribution is high. But realize, the water is available.

We built a reservoir with two phases, purchased all land in the beginning, area is well buffered

I am not sure what the word "regional" means in previous questions. Reservoir modification considerations, ie digging out reservoirs to provide additional storage volume, have been dismissed in the past, but should be again considered. We will have another drought, and at that time we should be prepared to modify both Falls and Jordan lakes. Studies and permits should be prepared before the drought hits. Cost has been a question in the past, but I suspect cost has not been truly addressed. If a home uses 10,000 cu ft of water per year and the cost of modifying the reservoir is \$8.00 per cubic yard, then an impact fee per home of \$3,000 would cover the costs. The evaporation rate will remain the same on modified reservoirs. If more reservoirs are added, the additional surface area provides for substantial loss of water through evaporation. For example, on a hot summer day, the evaporation from Jordan lake is 90 million gallons. Apex and Cary together use about 23 million gallons per day; I believe this is correct. Just a thought.

Although this is certainly a regional issue, that is why Holly Springs has a pipe directly to the Cape Fear River. If it dries up, we can all go home.

Water is our most limiting resource and is the thread that ties us all together. This valuable resource should be managed more carefully on a river basin basis. It should not be controlled by the major city in the region of the city that just happens to be in the most upstream location. Also, we really need better conservation and environmental education efforts with respect to our water resources.

Statistic	Value
Total Responses	26

Appendix D: Statistical Analysis

KEY:

Variable	Description	Response
Elected	Description of respondent's position.	0 = Manager/staff/other 1 = Elected official
Level	Level of government respondent works in.	0 = Local (county, city/municipal) 1 = State
Q11	Do you believe the Triangle will face a water shortage?	1 = Yes, currently 2 = Yes, in the future 3 = No, not at risk
Q14	What level of government do you believe is currently responsible for the following water issues?	1= State only 2= Mix 3= Local only (regional, county, city/municipal)
Q15	What level of government do you believe should be responsible for the following water issues?	1= State only 2= Mix 3= Local only (regional, county, city/municipal)
Q17	Do you believe your agency or office is prepared to make water allocation decisions over the next 20 years?	1 = Yes 2 = No

Data Analysis for Q #11:

Do you believe the Triangle will face a water shortage?

```
. ttest q11, by(elected) unequal
```

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	80	1.775	.0711012	.6359484	1.633477	1.916523
1	22	1.863636	.0996847	.4675625	1.656331	2.070942
combined	102	1.794118	.0596668	.6026055	1.675755	1.912481
diff		-.0886364	.1224435		-.3352921	.1580193
diff = mean(0) - mean(1)					t = -0.7239	
Ho: diff = 0					Satterthwaite's degrees of freedom = 44.7252	
	Ha: diff < 0		Ha: diff != 0		Ha: diff > 0	
	Pr(T < t) = 0.2364		Pr(T > t) = 0.4729		Pr(T > t) = 0.7636	

As shown in the above t-test, the p-value is 0.4729 for the null hypothesis that there is no difference in means between elected officials (1) and non-elected (0) respondents. This indicates that we fail to reject the null at $\alpha=0.10$, meaning the difference in mean responses for elected officials and managers/staff is not significant for Q11.

```
. ttest q11, by(level) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	51	1.941176	.076244	.5444911	1.788036	2.094317
1	51	1.647059	.0877766	.6268502	1.470754	1.823363
combined	102	1.794118	.0596668	.6026055	1.675755	1.912481
diff		.2941176	.1162664		.0633931	.5248422

```

diff = mean(0) - mean(1)                                t = 2.5297
Ho: diff = 0                                           Satterthwaite's degrees of freedom = 98.0795

Ha: diff < 0                                           Ha: diff != 0                                           Ha: diff > 0
Pr(T < t) = 0.9935                                     Pr(|T| > |t|) = 0.0130                                   Pr(T > t) = 0.0065

```

As shown in the above t-test, the p-value is 0.0130 for the null hypothesis that there is no difference in means between state-level (1) and local-level (0) respondents. This indicates that we reject the null at $\alpha=0.05$, meaning the difference in mean responses for state and local respondents is significant for Q11 at the 5% level.

Data Analysis Results for Q #14:

What level of government do you believe is currently responsible for the following water issues?

1) Water supply

```
. ttest q14_s, by(level) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	46	2.369565	.1136088	.7705322	2.140745	2.598385
1	44	1.840909	.1075539	.713432	1.624006	2.057812
combined	90	2.111111	.0827001	.785321	1.946629	2.275593
diff		.5286561	.1564442		.2177517	.8395606

```

diff = mean(0) - mean(1)                                t = 3.3792
Ho: diff = 0                                           Satterthwaite's degrees of freedom = 87.91

Ha: diff < 0                                           Ha: diff != 0                                           Ha: diff > 0
Pr(T < t) = 0.9995                                     Pr(|T| > |t|) = 0.0011                                   Pr(T > t) = 0.0005

```

As shown in the above t-test, the p-value is 0.0011 for the null hypothesis that there is no difference in means between state-level (1) and local-level (0) respondents. This indicates

that we reject the null at $\alpha=0.01$, meaning the difference in mean responses for state and local respondents is significant at the 1% level for perceptions of who is currently responsible for water supply issues (Q14a).

2) Water Quality

```
. ttest q14_q, by(level) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	46	1.804348	.1188494	.806076	1.564973	2.043723
1	45	1.488889	.0753592	.505525	1.337012	1.640765
combined	91	1.648352	.0722457	.6891803	1.504823	1.79188
diff		.3154589	.1407274		.0351706	.5957472

```

diff = mean(0) - mean(1)                                t = 2.2416
Ho: diff = 0                                           Satterthwaite's degrees of freedom = 75.9092

Ha: diff < 0                                           Ha: diff != 0                                           Ha: diff > 0
Pr(T < t) = 0.9860                                     Pr(|T| > |t|) = 0.0279                                   Pr(T > t) = 0.0140

```

As shown in the above t-test, the p-value is 0.0279 for the null hypothesis that there is no difference in means between state-level (1) and local-level (0) respondents. This indicates that we reject the null at $\alpha=0.05$, meaning the difference in mean responses for state and local respondents is significant at the 5% level for perceptions of who is currently responsible for water quality issues (Q14b).

3) Water Allocation

```
. ttest q14_a, by(level) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	46	2.130435	.1340873	.9094246	1.860369	2.400501
1	44	1.727273	.1143214	.7583224	1.496722	1.957824
combined	90	1.933333	.0904973	.8585328	1.753517	2.11315
diff		.4031621	.1762067		.0528987	.7534254

```

diff = mean(0) - mean(1)                                t = 2.2880
Ho: diff = 0                                           Satterthwaite's degrees of freedom = 86.4146

Ha: diff < 0                                           Ha: diff != 0                                           Ha: diff > 0
Pr(T < t) = 0.9877                                     Pr(|T| > |t|) = 0.0246                                   Pr(T > t) = 0.0123

```

As shown in the above t-test, the p-value is 0.0246 for the null hypothesis that there is no difference in means between state-level (1) and local-level (0) respondents. This indicates that we reject the null at $\alpha=0.05$, meaning the difference in mean responses for state and local respondents is significant at the 5% level for perceptions of who is currently responsible for water allocation issues (Q14c).

local respondents is significant at the 1% level for perceptions of who should be responsible for water quality issues (Q15b).

3) Water Allocation

```
. ttest q15_a, by(level) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	46	2.369565	.1136088	.7705322	2.140745	2.598385
1	45	1.8	.1082459	.7261355	1.581845	2.018155
combined	91	2.087912	.0836417	.797891	1.921743	2.254081
diff		.5695652	.1569208		.2577611	.8813693

```
diff = mean(0) - mean(1)          t = 3.6296
Ha: diff = 0                      Satterthwaite's degrees of freedom = 88.8778

Ha: diff < 0                      Ha: diff != 0                      Ha: diff > 0
Pr(T < t) = 0.9998                 Pr(|T| > |t|) = 0.0005                 Pr(T > t) = 0.0002
```

As shown in the above t-test, the p-value is 0.0005 for the null hypothesis that there is no difference in means between state-level (1) and local-level (0) respondents. This indicates that we reject the null at $\alpha=0.01$, meaning the difference in mean responses for state and local respondents is significant at the 1% level for perceptions of who should be responsible for water allocation issues (Q15c).

Data Analysis Results for Q #17:

Do you believe your agency or office is prepared to make water allocation decisions over the next 20 years?

```
. ttest q17, by(level) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	44	1.227273	.0639076	.4239151	1.098391	1.356155
1	40	1.475	.0799639	.5057363	1.313258	1.636742
combined	84	1.345238	.052187	.4783014	1.24144	1.449036
diff		-.2477273	.1023641		-.4515839	-.0438707

```
Satterthwaite's degrees of freedom: 76.4453

Ho: mean(0) - mean(1) = diff = 0

Ha: diff < 0                      Ha: diff != 0                      Ha: diff > 0
t = -2.4201                       t = -2.4201                       t = -2.4201
P < t = 0.0089                     P > |t| = 0.0179                   P > t = 0.9911
```

As shown in the above t-test, the p-value is 0.0179 for the null hypothesis that there is no difference in means between state-level (1) and local-level (o) respondents. This indicates that we reject the null at $\alpha=0.05$, meaning the difference in mean responses for state and local respondents is significant at the 5% level for perceptions of whether their agency is prepared to make water allocation decisions for the next 20 years (Q17).

```
. ttest q17, by(elected) unequal

Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	63	1.412698	.0625246	.4962739	1.287713	1.537683
1	21	1.142857	.0782461	.3585686	.9796387	1.306076
combined	84	1.345238	.052187	.4783014	1.24144	1.449036
diff		.2698413	.1001588		.0683987	.4712838

```
Satterthwaite's degrees of freedom: 47.454

Ho: mean(0) - mean(1) = diff = 0

Ha: diff < 0      Ha: diff != 0      Ha: diff > 0
t = 2.6941        t = 2.6941        t = 2.6941
P < t = 0.9951    P > |t| = 0.0097    P > t = 0.0049
```

As shown in the above t-test, the p-value is 0.0097 for the null hypothesis that there is no difference in means between elected (1) and non-elected (o) respondents. This indicates that we reject the null at $\alpha=0.01$, meaning the difference in mean responses for elected officials and managers/staff is significant at the 1% level for perceptions of whether their agency is prepared to make water allocation decisions for the next 20 years (Q17).