

The cover features a large, abstract teal shape on the left side, resembling a stylized mountain or a drop. The top right corner has a dark blue background. The title is in white, bold, sans-serif font. Below the title, the subtitle is in a smaller, dark blue font. The authors' names are in white on a dark blue curved band. The university names are in white on a light green curved band at the bottom.

THE STATE OF COMMUNITY WATER SYSTEMS

Pressures, Goals, and
Innovations in North Carolina

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WATER SUPPLY

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INTRODUCTION

Rising population and economic activity in North Carolina present a challenge for the state's water systems. Historically, North Carolina has had sufficient water resources to meet demand, but **population growth combined with other pressures including aquifer depletion and drought have the potential to strain regional water resources and jeopardize water systems' ability to meet future water needs.** As pressures on water supply build, water systems may continue to diversify their supply sources and adopt new practices and technologies. These changes will require new capital investments.

This brief presents **results from a survey conducted in 2020 with water system decision makers from throughout North Carolina** about the pressures on water systems and strategies to ensure long-term water security.

KEY FINDINGS FROM THE SURVEY INCLUDE:

1. Decision makers responsible for drinking water delivery are **concerned about rising water demand.**
2. For water systems in North Carolina's coastal plain, **saltwater intrusion** is also an important area of concern.
3. Some systems are beginning to adopt **demand-based strategies, low-impact development, wastewater reuse, and aquifer recharge.**

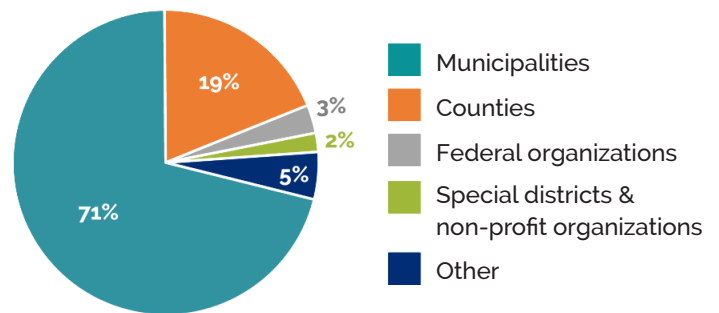
ABOUT THE SURVEY

General Information

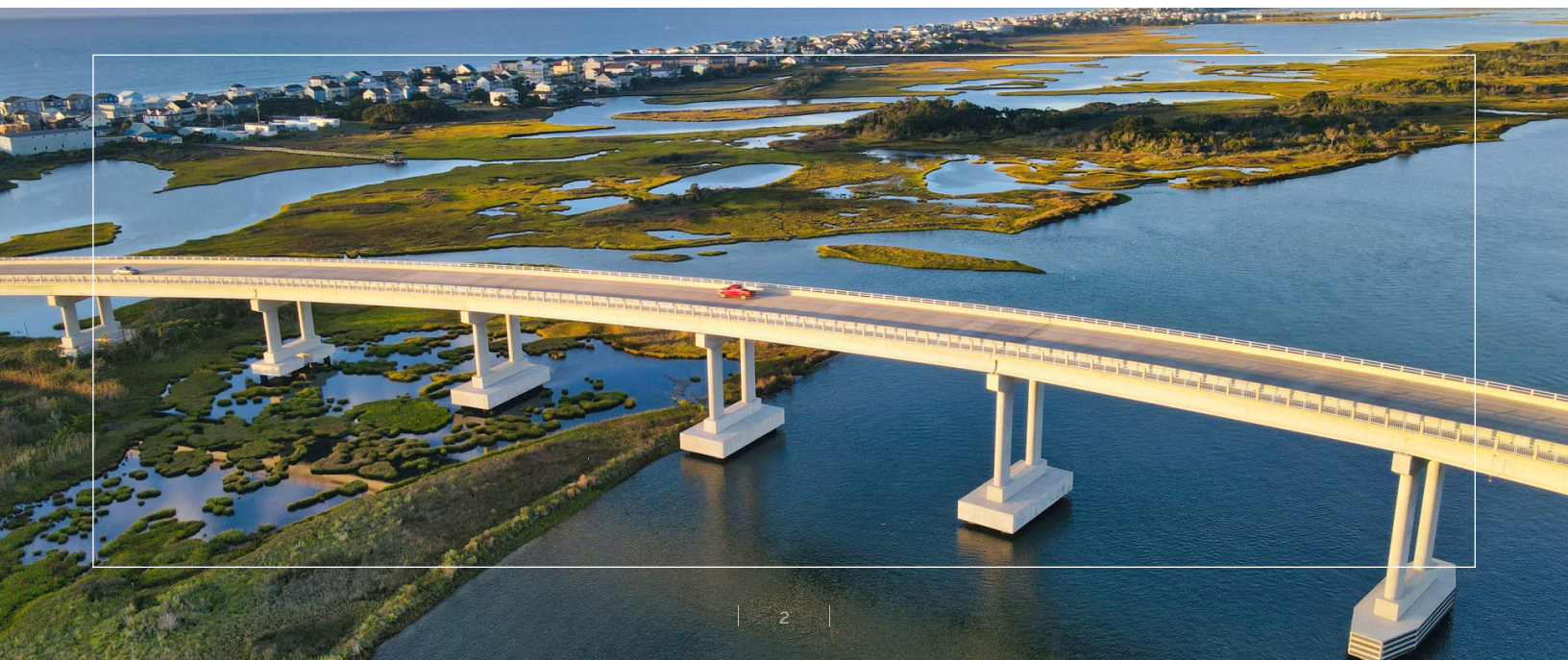
From May to October 2020, we asked professionals involved in the operations, management, and decision making for **community water systems** (CWSs) in North Carolina about their perceptions relating to provision and maintenance of adequate water supply. The goal was to understand how those responsible for CWSs perceive current pressures (or lack thereof) on water supplies, how they manage water resources, and their insights about infrastructure-related decisions for these systems. The text and graphs that follow present results from the survey.

Participating CWSs

Systems surveyed were CWSs owned mainly by municipalities (71%) and counties (19%), followed by federal organizations (3%), special districts and non-profit organizations (2% each), and finally, one privately owned system and one state-owned system. We received responses from systems ranging widely in population size, the smallest serving just over 100 people, and the largest serving more than 250,000.



We used information from **North Carolina Local Water Supply Plans** (LWSPs) and subsequent searches of water systems' websites to identify 717 potential CWS respondents across 591 systems. Of those contacted, 144 completed surveys for 131 CWSs, a 22% response rate. Most survey respondents were directors or managers, with an average of 17 years' professional experience related to water management (**Figure 1**). As shown in **Figure 2**, respondents were mostly employed in the Coastal Plain region (51%), followed by the Piedmont (37%) and the Mountain regions (11%).



FINDINGS

Figure 1:

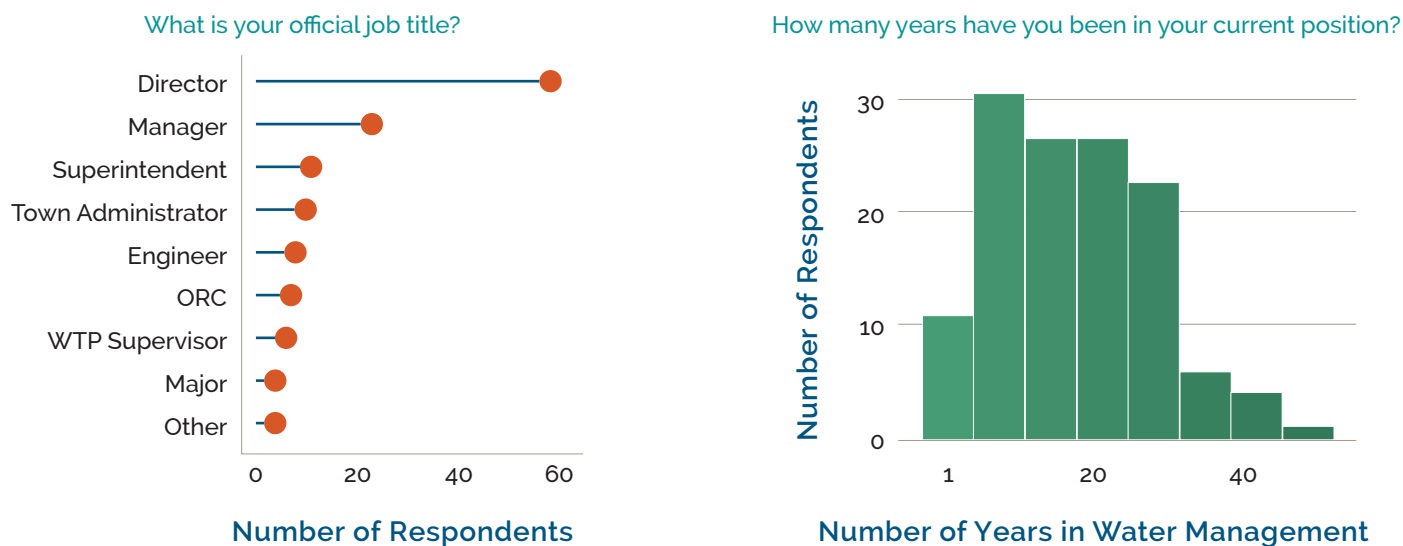


Figure 2: Distribution of responses from the three North Carolina Regions.

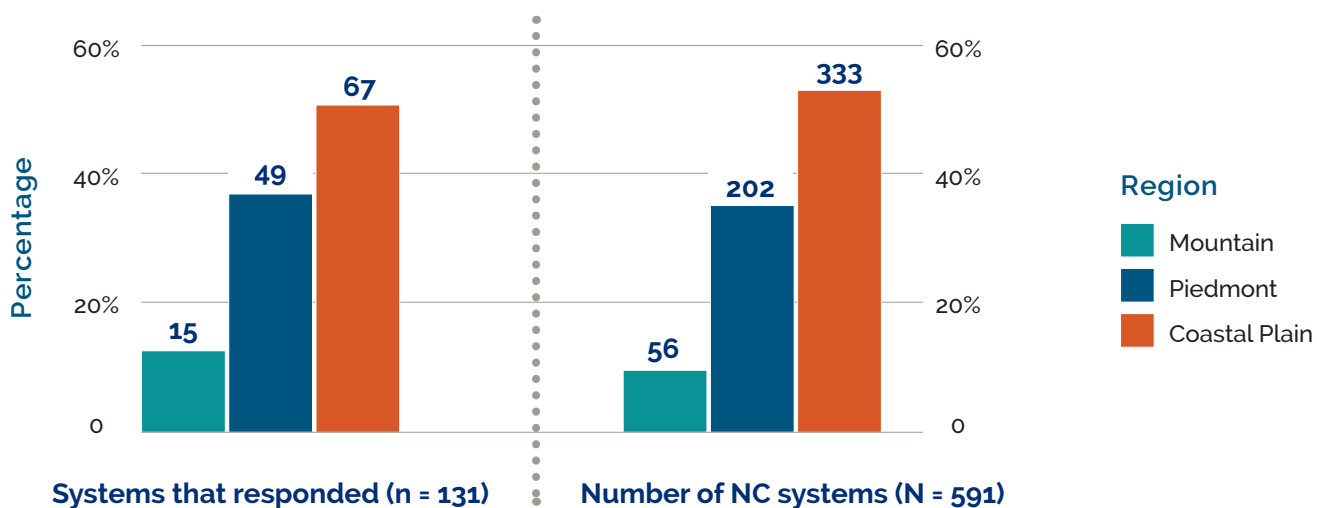


Figure 2. shows the distribution of responses from the three North Carolina Regions, where the **distribution in our sample** (left) is similar to the **distribution of the population of 591 systems** (right). Systems from the state's Coastal Plain region submitted the most responses, followed by those in the Piedmont region and the Mountain region. The number above each bar indicate the number of systems by region.

Concerns and Perceived Pressures

Figure 3: How worried are you about your system’s ability to supply water in the next 10 years?

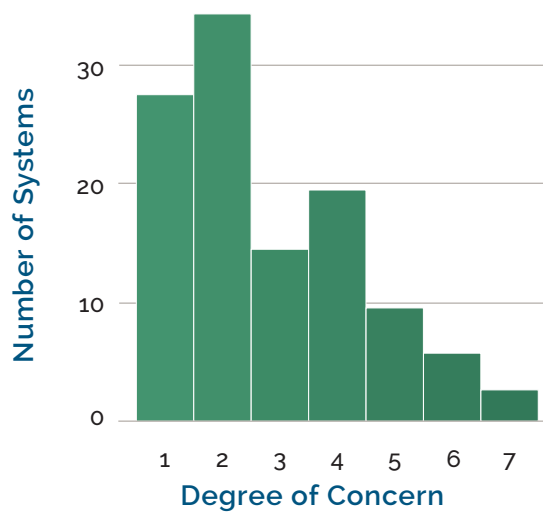


Figure 3 shows the **number of systems, given reported concern about ability to supply water in the next 10 years** on a scale from 1 (“Not at all worried”) to 7 (“Extremely worried”). The survey revealed widely varying concern about pressures on future water deliveries. Respondents from most systems (83%) indicate little to moderate concern (scoring 1-4) about ability to supply water in the next 10 years. Yet, substantial percentages of respondents perceive that particular challenges, especially rising water demand and saltwater intrusion, are severe problems.

Figure 4:

We would like to know how what problems you think might place pressure on your system’s ability to supply enough water to meet demand over the past/next 10 years.

For the following items, please select your response on a scale from 1 to 7, 1 meaning “Not at all a problem”, 7 meaning “A severe problem.”

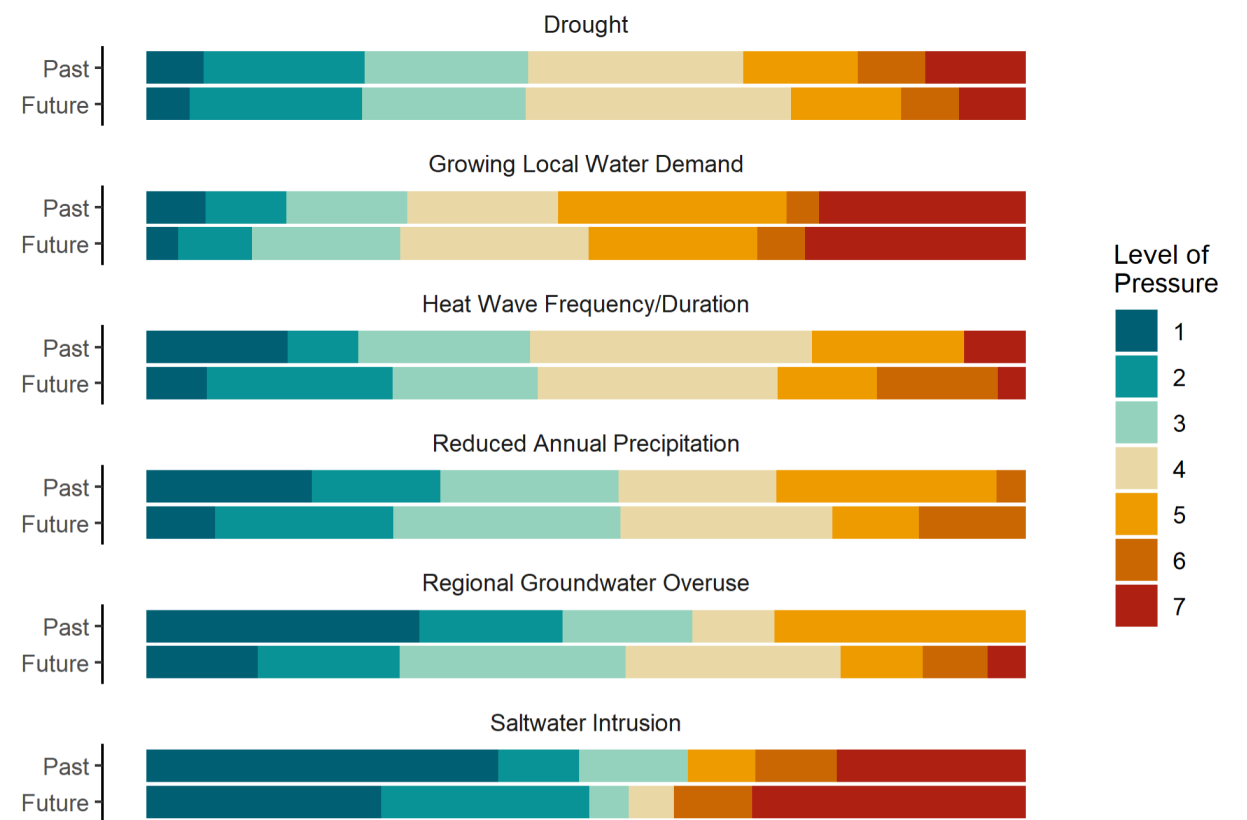


Figure 4 shows the **extent of perceived pressures in the past and for the future. Overall, representatives for most water systems expressed little to moderate concern for most pressures.** However, approximately half of water systems perceive that growing water demand has placed pressure on water supplies over the last decade, and even more expect that this will continue over the next decade. Although a minority of the systems experience more than moderate pressure from saltwater intrusion, a large percentage of those systems expect that this phenomenon will impose severe pressure over the next 10 years.

Water Portfolio Diversification

How are North Carolina's water systems responding? For some, next steps may include diversifying water sources. Others reported adoption of innovative management strategies and technologies. This section discusses water managers' perceptions about water resource governance, some of the practices and technologies they have already adopted, and what they are considering for the future.

Figure 5:

For the following statements, please indicate the extent to which you agree on a scale from 1 to 7, 1 meaning "Completely disagree" and 7 meaning "Completely agree."

To ensure long-term water security...

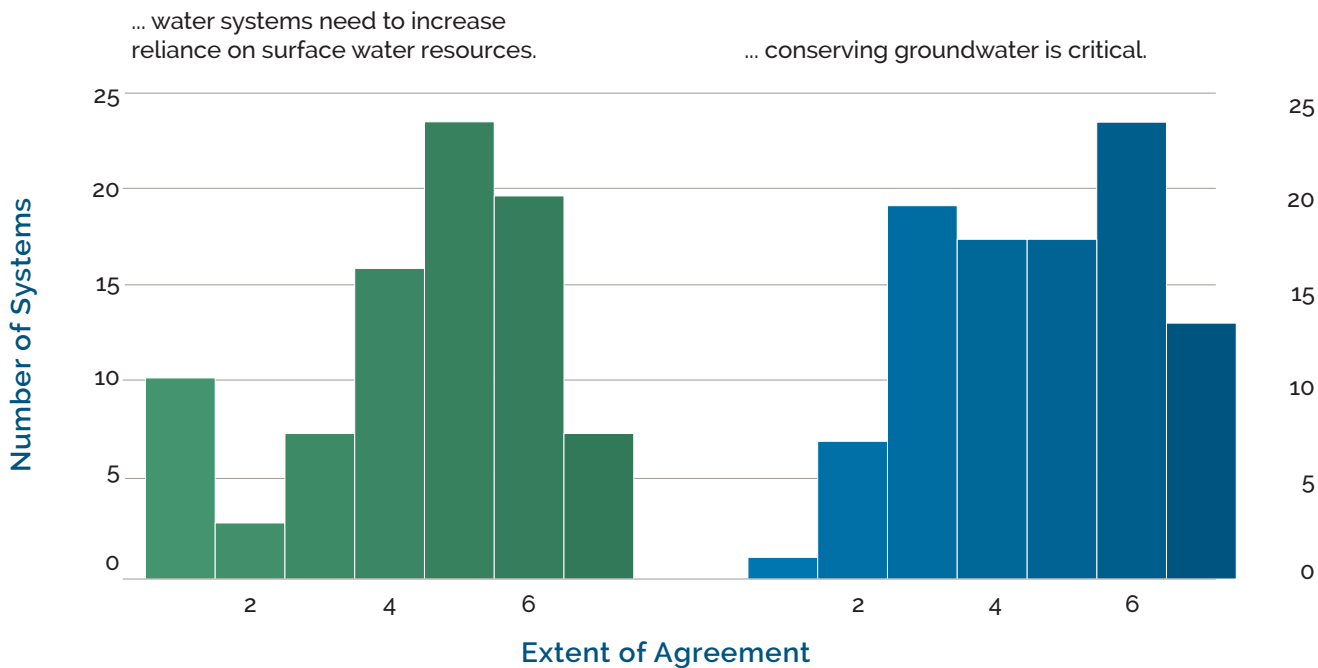


Figure 5 shows **perceptions relating to use of surface water and groundwater resources.** Respondents from most sytems believe that there is a need to increase reliance on surface water resources, and a substantial portion perceive that conserving groundwater is critical to ensure future water security.

For the following statements, please indicate the extent to which you agree on a scale from 1 to 7, 1 meaning "Completely disagree" and 7 meaning "Completely agree."

To ensure long-term water security...

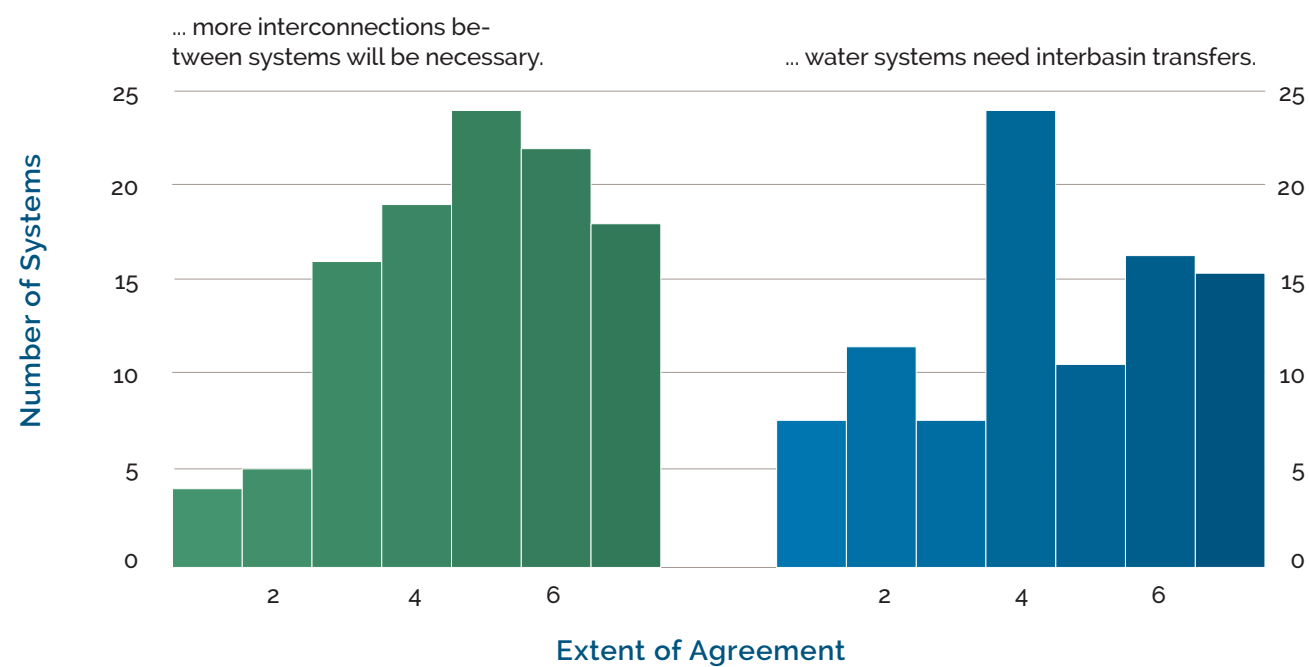
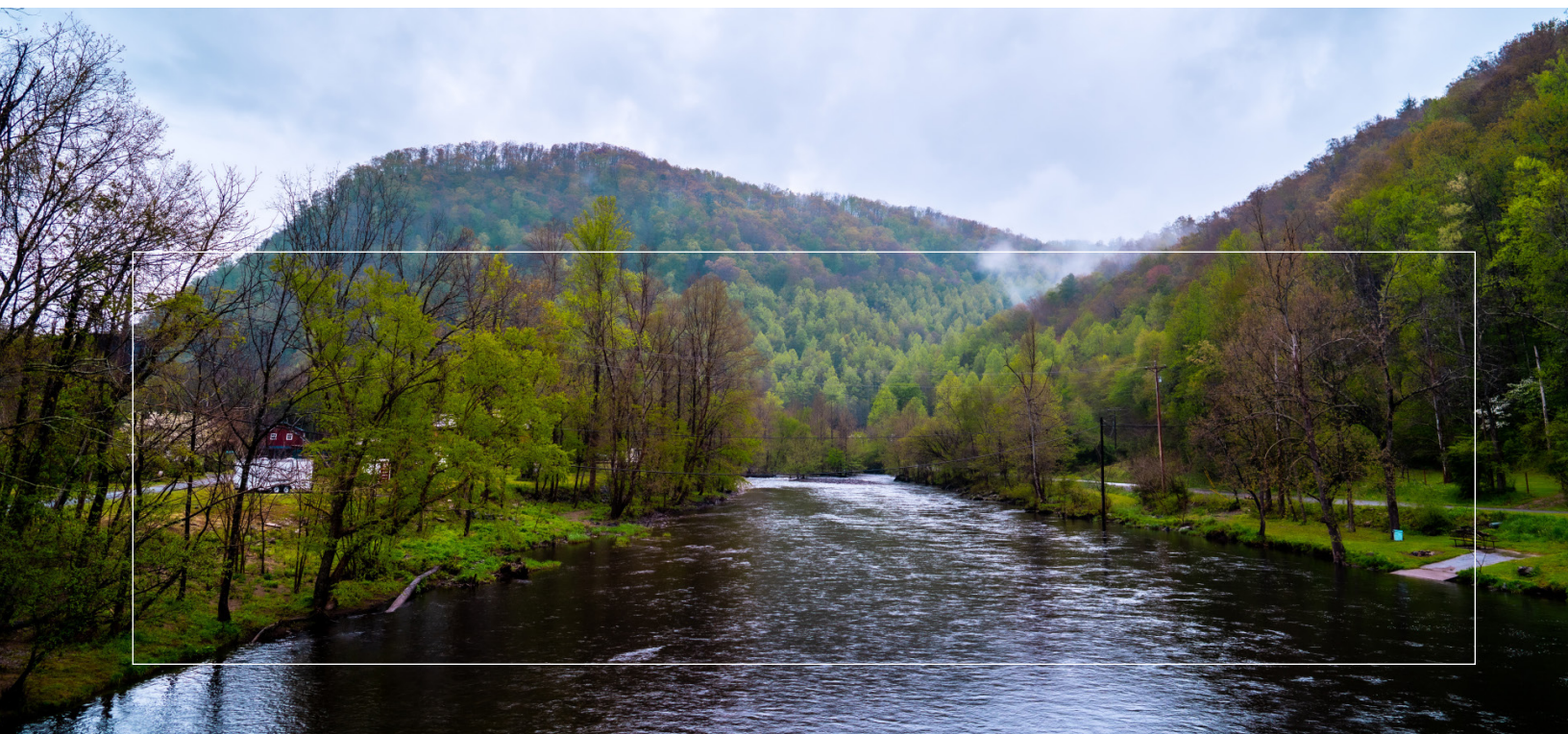


Figure 6. shows perceptions relating to interconnections and interbasin transfers. The graph on the left indicates that most respondents agree that more interconnections will be necessary to ensure long-term water security. There was less agreement about a need for interbasin transfers—the largest portion of respondents selected a score of 4 on the agreement scale, halfway between "Completely disagree" and "Completely agree."

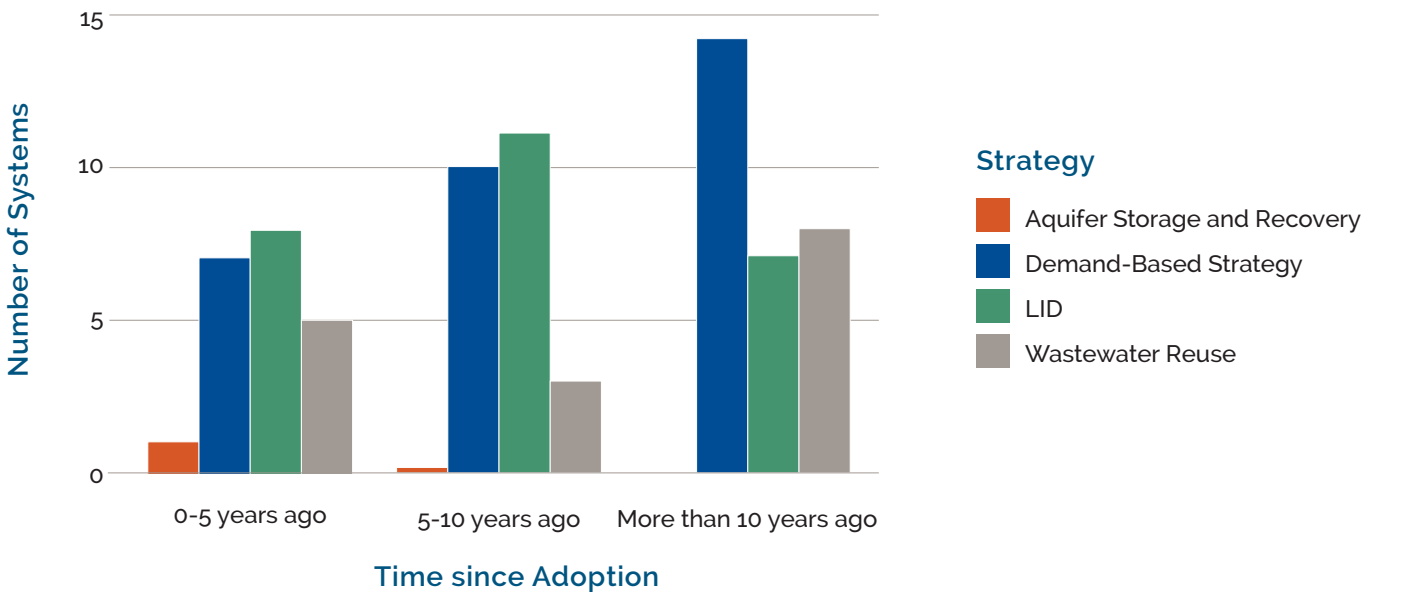


Water Management Practices and Technologies

In addition to interconnections and/or interbasin transfers to ensure adequate water supply, some systems have adopted a variety of other strategies to conserve water and to diversify the water-supply portfolio (Figure 7 below).

Figure 7: Water management technologies and approaches, and systems' time since adoption.

To what extent have the following problems put pressure on your system's ability to supply enough water to meet demand in the past 10 years on a scale 1 ("No pressure") to 7 ("A lot of pressure")?



As shown in Figure 7, some systems have—within the past 10 years—implemented demand-based approaches (e.g., tiered price structures, drought-based restrictions, and rebates for buying efficient efficient water-use fixtures), wastewater reuse (e.g., for irrigation, use in water features, or for potable purposes), aquifer storage and recovery to replenish groundwater resources and to store for later use, and low-impact development (i.e., approaches to minimize runoff and pollutants, to promote infiltration, and to harvest rainwater). Demand-based approaches and wastewater reuse strategies have been in place for the longest period of time. More recent approaches have included LID and aquifer storage and recovery. Overall, these strategies are still uncommon, however, with 26% of systems not reporting any adoption of innovations.

CONCLUSION

Those responsible for managing North Carolina water systems do not anticipate significant changes in the pressures on water delivery in the decade ahead. Rising water demand is the concern most widely shared by water system decision makers. For systems responding to our survey, many of which are located in the state's coastal plain, saltwater intrusion is also perceived as a severe pressure that will only grow in the coming years.

To address these pressures, **some water systems have adopted strategies including new technologies, innovative management approaches, and diversifying their water-supply portfolio.** Increased reliance on surface water resources and system interconnections are widely seen as critical to ensuring long-term supply. Yet, there are mixed views about increasing the number of interbasin transfers. Professionals in some systems also believe conserving groundwater will be necessary, especially in the Coastal Plain region. Finally, in addition to diversifying resources, some systems have **adopted innovative approaches to conserve and store water supplies**, and to **strategically manage wastewater resources.**

Overall, results from this survey of water system managers suggest that water systems will continue to gradually adapt to changing pressures on water resources. In the coastal plain, where pressure from saltwater intrusion is widely perceived as severe, pressures to diversify water sources or adopt new practices and technologies may become more urgent. Such shifts—regardless of the motivation—**will require capital investments to update current infrastructure**, especially to ensure efficient and reliable water supplies where systems are currently facing increasing—and in some cases, unprecedented—pressures.

Results from this survey of water system managers suggest that water systems will continue to gradually adapt to changing pressures on water resources



Photo by CEphoto, Uwe Aranas

APPENDIX

In addition to the standardized questions about perceived pressures on CWSs (Figure 4), respondents had the option to offer any other insights about what they have seen as pressures on their respective system(s), and what they anticipate will be a pressure in the next 10 years. Their answers have been included verbatim below. Table A1 includes perceptions about the past 10 years, and Table A2 covers content for the next 10 years. Responses have been inductively coded has relating to infrastructure, government, finance, water quality, demographics, and weather.

To what extent have the following problems put pressure on your system's ability to supply enough water to meet demand in the [past 10 years, next 10 years] on a scale scale from 1 ("No pressure") to 7 ("A lot of pressure")? Please list here any other pressure(s) not mentioned in the previous question.

Table 1: Perceived pressures on water supplies over the past 10 years.

Infra.	Gov.	Fin.	Qual.	Dem.	Weath.	Description:
x						Water loss/ unaccounted for water in wholesale systems
x						Aging infrastructure, system distribution infrastructure, related costs and replacement, interruption in service
x					x	Main Distribution line interconnect failure/break due to storm
x						Water leaks on a regular basis. Each leak discovered is fixed immediately upon discovery.
x		x				Many sections of our water system are very old, causing the need for extensive flushing to reduce disinfection by products and to maintain optimal water quality. Budget challenges prohibit main line replacements - eliminating the possibility of reduced flushing. Another issue associated with old pipes is water leaks. It is assumed that much of our water system's unaccounted for water losses are due to main line leaks, making a leak detection program needed for every old water system.
x						Inter-basin Transfer Limitations
	x					Potential source water studies and limitations by regulators
	x	x				Costs to implement alternate water source mandate by the State and resulting increase in water rates to cover the debt incurred in establishing the alternate source.
x	x					Possible State Takeover of Assets or Intereference with Operations
x	x					Interbasin Transfer Regulations Could Affect This Capability
	x					Government Regulation
x	x					IBT permitting timeline (added 4 years to developing a new water source)
					x	Emergency/severe weather events e.g. hurricane
x		x			x	Hurricane damaged assets with significant capital cost to repair/replace.
	x					Not having the funds or support from other government agencies (i.e. county and next town) to secure a second water source.
		x				Financial restraints

cont.

cont.

Infra.	Gov.	Fin.	Qual.	Dem.	Weath.	Description:
		x				Cost of chemicals, keeping a steady work force
x		x				Funding is the largest pressure. Treatment facilities are >70-years old and distribution system is over 100 in some areas.
			x			Emerging contaminants place the most pressure on water and wastewater treatment
			x			PFAS contamination
				x		Population Growth
				x		Increase in tourism

Table 2: Perceived pressures on water supplies over the next 10 years.

	x					Increased Regulatory Hurdles
x						less pressure in future with implementation of a less "drought-impacted" supply source planned for construction
				x		Irrigation Needs
x						ageing infrastructure
x						Infrastructure failure / limited access
x						System distribution infrastructure
			x			Emerging contaminants place the most pressure on water and wastewater treatment
x				x		As mentioned previously, increased leakage and extensive flushing of old water system main lines is anticipated and will certainly continue to present challenges in meeting future demand
			x			Raw water source volumes
			x			Source water protection issues – security
					x	Hurricane damaged assets with high capital cost to repair/replace.
				x		increase in tourism
	x					Man-made pressures by way of policies and actions
		x				Funding is the largest pressure. Treatment facilities are >70-years old and distribution system is over 100 in some areas.
	x					State Interference in operation of assets