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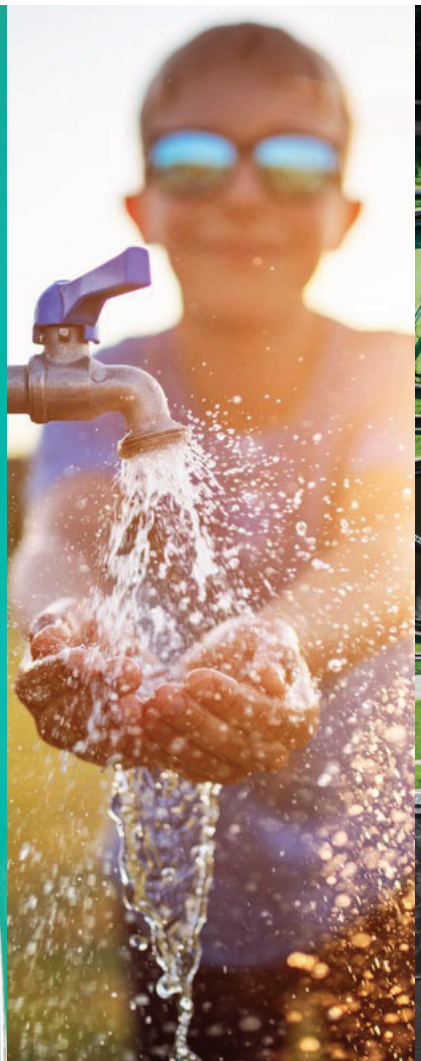
APPENDIX I – RELATED STUDIES

Two cited studies detailing estimated EPA economic impacts of water regionalization and local impact of Flock Cameras and their impacts on cost savings.

US Water Alliance

UNC
SCHOOL OF GOVERNMENT
Environmental Finance Center

Strengthening Utilities Through Consolidation: The Financial Impact

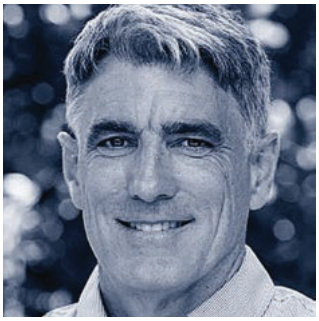
Preface

The US Water Alliance and the UNC Environmental Finance Center are committed to advancing fact-based, common-ground solutions to our nation's most pressing water challenges. Currently, the water sector is extremely diffuse. There are tens of thousands of water utilities and authorities in America. This is also a time of growing complexity and unprecedented change in the water sector. Collaboration and cooperation will be essential to securing our nation's water future. As the adage goes—there is strength in numbers.

Consolidating water services is one of many potential approaches that enables utilities to meet today's needs and tomorrow's demands. Pooling resources and streamlining operations and decision-making can enhance efficiency, but to get there, leaders need a clear picture of the payoff to justify the journey. Information about consolidation options and financial impacts is essential to understand what this approach can do to increase financial stability in the water sector.

To address this need, the US Water Alliance and the Environmental Finance Center teamed up to synthesize the body of evidence about the financial outcomes possible with water utility consolidation. This report examines the experiences of eight communities who consolidated utility service in different ways and for different reasons.

Breaking down silos in water will require skilled leadership and deep understanding of the tools and methods at our disposal. To that end, we hope to grow understanding by providing insight about what financial impacts communities might expect through consolidation.



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This report was informed by an experienced set of water sector leaders. Thank you to all those who took the time to be interviewed and provide feedback on this report, including:

- **C. Tad Bohannon**, Chief Executive Officer, Central Arkansas Water
- **Jesse Cain**, City Manager, City of Colusa
- **Maureen Duffy**, Vice President, Communications and Federal Affairs, American Water
- **Jim LaPlant**, Chief Executive Office, Iowa Regional Utilities Association
- **Shelli Lovell**, General Manager, Marshalltown Water Works
- **Kenny Waldroup**, Assistant Public Utilities Director, City of Raleigh
- **John Walton**, Director of Marketing, Logan Todd Regional Water Commission

Table of Contents

Introduction

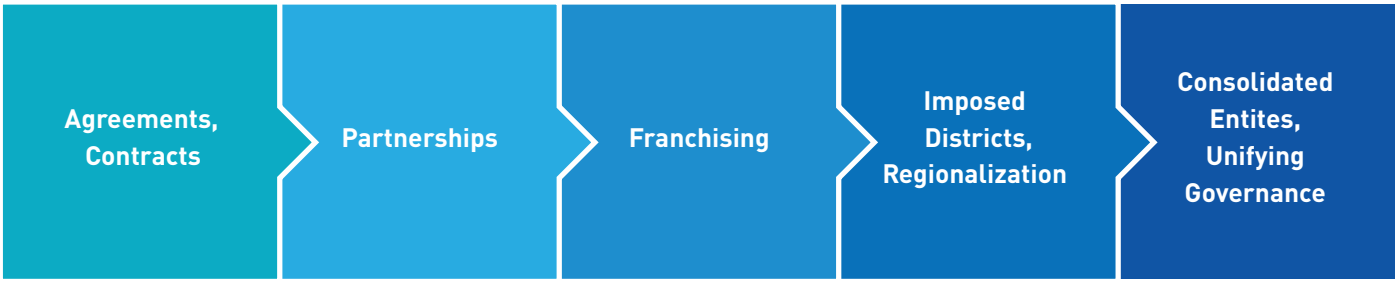
The water sector is at a crossroads. Most water systems in use today were built for communities that look different than the ones they now support. Population and demographic shifts, modern water quality threats, aging infrastructure, and related challenges are bearing down on water systems. Providing affordable, reliable, and high-quality water service is a difficult business. Consider a few salient facts:

- **Water infrastructure is aging and failing.** In 2017, the American Society of Civil Engineers gave the nation's water infrastructure a "D" grade and the nation's wastewater infrastructure a "D+."
- **Significant funding is needed.** The American Water Works Association estimates drinking water systems need to invest $1.7 trillion in infrastructure over the next 40 years.[1] The Environmental Protection Agency's needs survey estimates the United States requires $271 billion for wastewater and stormwater needs over the next 20 years.[2]
- **Affordability is a growing concern.** Water rates and fees are already rising and outpacing the Consumer Price Index.[3] New investments contribute to growing concerns about water service affordability.

The water sector faces many barriers to addressing these challenges. One challenge is fragmentation. There are currently over 51,000 regulated community water systems owned and managed by thousands of entities ranging from large metropolitan cities to mobile home park owners.[4] Furthermore, there are nearly 15,000 wastewater treatment plants, and over 1,000 stormwater utilities in America.[5;6] By comparison, the United Kingdom only has 32 regulated water utilities and Australia only has 82 water suppliers.[7] On average, each utility in Australia and the UK serves a much greater percent of the population than do systems in the United States.

In this landscape, water utilities may struggle to maximize benefits from their investments, save costs by operating at scale, and tackle challenges efficiently. Luckily, there are many ways utilities can collaborate with one another to streamline and improve water service. Utility partnerships can take many forms—from informal collaboration agreements to merging the financial and governance functions of separate entities. For example, some utilities undertake joint contracting for services which can lower prices; others partner on projects like emergency planning; some may have franchise agreements in place to share water supply.

Figure 1
Approaches to Collaboration Between Utilities



Consolidation is just one approach on this spectrum of options for how utilities can work together to provide high quality water service. Water utility consolidation occurs when two or more distinct legal entities become a single legal entity operating under the same governance, management, and financial functions. It may or may not include physically interconnecting assets. Consolidation also occurs at the regional level even when assets are spread out by merging the governance, management, and finance supporting geographically spread assets.

Current research and information on consolidation is less robust relative to other ways in which utilities engage in regional collaboration. Communities need access to facts, data, and information to support informed decision making. Towards that end, the US Water Alliance and the Environmental Finance Center at the University of North Carolina developed this report focused on the financial outcomes utilities have realized through consolidation. This report focuses on the impacts of different consolidation arrangements on customer rates, utility budgets, and debt. In some of the case studies, we also touch on economic implications, such as the broader costs and benefits to society beyond the utilities and customers involved.

Researchers at the UNC Environmental Finance Center identified and profiled a range of different consolidation models from across the country and studied the financial impacts resulting in each case. A team of graduate students from Duke University provided additional research including preparing a literature review that inventoried past research on consolidation.

With this report, the US Water Alliance and the Environmental Finance Center aspire to fill the gap in current research about the economic attributes associated with different consolidation models. We hope this research helps communities understand the opportunities, trade-offs, and financial impacts of consolidation.

Defining Key Terms

Types of Consolidation

Consolidation occurs when two or more legal entities become one operating under the same governance, management, and financial functions. Consolidation can include:

- **Direct Acquisition**, where a higher-capacity utility acquires the assets, operations, and customers of another system and absorbs them into its existing governance, operational, and financial frameworks.
- **Joint Merger**, where two or more relatively equal partners both adjust governance, operations, and financial frameworks to create a new entity that is owned and controlled by the previously separate parties.
- **Balanced Merger**, where two or more entities consolidate with the goal of establishing a governance structure that provides a basis for at least some direct participation by the pre-existing utility in future decision-making.

Regionalization and Regional Agreements

Regional approaches can also generate financial efficiency. These approaches do not combine legal entities but do pool utility resources, buying power, and technical expertise to do more across a wider area than a single utility could do alone. In some cases, utilities may develop regional partnerships to collaborate on issues of joint interest, like workforce development. In other cases, regionalizing could put one organization in charge of a particular project or function that takes place across many utilities' service areas.

Part One:
A Synthesis of Financial Impacts

Consolidation can be a tool to create fewer, more independent, high-capacity utilities—potentially benefiting ratepayers, local communities, and the broader water sector. However, communities need to weigh the benefits with the challenges of consolidating utilities. For example, consolidation can trigger a cascade of avoided future costs to a local utility, which can then be passed on to customers in the form of savings. But, in the near-term, some communities will face increased costs to address regulatory requirements and infrastructure investment backlogs. Communities need to look at financial factors over time and in local context. In some cases, utility consolidation may have more to do with improving service than reducing costs.

Financial Benefits

Communities contemplating whether to consolidate utilities need to consider a multitude of information. The most critical pieces are knowing what the value to the community would be and how long it could take to realize. Assessing, estimating, and quantifying benefits may be daunting, but doing so is essential to know whether benefits outweigh the costs and challenges. Benefits can be spread among customers, systems involved, and the broader economy. Potential financial benefits from water utility consolidation include:

- Economies of scale and operating efficiencies;
- Increased access to capital at a lower cost;
- Lower or equal customer rates for a specified level of service;
- Revenue stability;
- Reduced exposure to regulatory penalties;
- Improved planning and risk management; and
- Increased opportunities for economic development.

Economies of Scale and Operating Efficiencies

In rural and urban settings, consolidation often results in greater economies of scale. In other words, water, wastewater, and stormwater services involve dozens of separate business functions that can benefit from being spread over larger groups of customers.

Consider operating expenses. Reading 50 meters per month usually costs significantly more per meter than reading 50,000 meters. Maintaining a large network of assets rather than a smaller network of isolated assets can also be cost-effective. Similarly, the prices smaller systems pay for chemicals and services are often much higher than the price paid by their larger counterparts. Essential chemicals, such as chorine, are available in much lower unit costs when bought in bulk.

Staffing costs also benefit from economies of scale. Salaries for highly-trained managers have increased in tandem with the regulations and environmental challenges those managers are entrusted to handle. A skilled utility professional serving 500 customers may be equally able to serve a community with 5,000 customers. In this case, spreading the cost of a professional manager over more customers can reduce costs.

Increased Access to Capital at a Lower Cost

Water is a capital-intensive enterprise. There are high costs associated with investing in and maintaining the vast infrastructure that water utilities operate. Costs are climbing with the need to upgrade, retrofit, and make systems more resilient. Several case studies in this report show that consolidated utilities can access capital from investors at a lower cost. When utilities consolidate, they pool resources to serve larger customer bases. As a result, consolidated systems may receive better terms and interest rates on bonds and commercial loans from private capital markets to fund capital improvements.[8]

Regional consolidation may also qualify systems for subsidized public funding options not available for non-regional efforts. These sources of funding vary by state but may include subsidized State Revolving Fund loans or state planning grants that can save communities money on principal costs and interest payments.

Lower or Equal Customer Rates for a Specified Level of Service

Once a water utility reduces or minimizes capital and operating costs, the level of funds needed from customers may change. In many situations, financial benefits from consolidating are tempered by rates needing to rise to address overdue issues and pay the near-term costs of consolidating. However, in less common situations, customers may see immediate or short-term rate reductions.

Rate parity across customer bases is typically a more common goal than rate reductions. Customers within a single geographic region served by multiple water service providers might pay different prices for the services they receive. Carefully structured consolidation can equalize rates among customers within a service area and slow future rate increases for all involved.

Revenue Stability

The water sector is experiencing major changes in its revenue business model.[9] Utility consolidation can make systems less vulnerable to revenue shortfalls. Consolidated systems that tie together more diverse water users may be able to mitigate revenue fluctuations and spread the cost of filling shortfalls over a larger customer base when they do occur. Several case studies in this report demonstrate how systems can maintain revenue and fully optimize capacity through consolidation. This model works particularly well if systems consolidate when considering new investments. While consolidation may alleviate some revenue challenges, utilities should not view consolidation as a fail-safe way to protect communities from inherent risks like overoptimistic projections, large customer losses, or the cost of retrofitting and building systems resilient enough for future circumstances.

Reduced Exposure to Regulatory Penalties

Communities often consider consolidation because of regulatory pressure, placing more weight on avoiding unwanted penalties than on saving revenue. From treatment facilities to ailing collection systems, consolidation is increasingly becoming one of the main solutions for achieving cost effective regulatory compliance. Consolidating utilities can shift regulatory responsibility, streamline and reduce the cost of regulatory approvals, and, in some cases, provide immediate regulatory financial relief.

Improved Planning and Risk Management

Water service keeps local economies running, communities healthy, and the environment safe; that means the risks utilities plan for and manage carry significant costs. Consolidation has allowed many utilities to mitigate risk and benefit from integrated planning. A particular risk, like diminishing water supply, may even be the driver for why communities consider consolidation. The organizational and water resources planning processes under a consolidated utility can also lead to a more comprehensive, less piecemeal strategy than when spread across multiple systems or localities.

Increased Opportunities for Economic Development

Some financial savings are apparent on water utility budgets, rate sheets, and other financial documents. Other benefits may occur off the books in the broader community, despite being direct and visible outcomes from consolidating water utilities. For example, communities facing water shortages or lacking wastewater services can struggle to grow or develop their local economies. Businesses hesitate to locate in places where access to water supply or quality of water services are in question. Consolidation may give these communities the opportunity to address water supply or water infrastructure challenges that deter growth or lead to decline.

Table 1
Observed Financial Benefits and Related Case Studies

Financial Benefit	Related Cases
Economies of scale and efficiencies	Iowa Regional Utilities Association, page 30 City of Raleigh, page 21 Hampton Roads Sanitation District, page 25
Increased access to lower cost capital	City of Raleigh, page 21 Logan Todd Commission, page 33 Town of Colusa, page 18
Lower or equal customer rates	Central Arkansas Water, page 11 City of Raleigh, page 21
Revenue stability	City of Raleigh, page 21 New Jersey American Water, page 46
Reduced exposure to regulatory penalties	Citizens Energy, page 14 City of Raleigh, page 21 Hampton Roads Sanitation District, page 25
Improved planning and risk management	City of Raleigh, page 21 Central Arkansas Water, page 11 Hampton Roads Sanitation District, page 25
Increased opportunities for economic development	Logan Todd Commission, page 33

Key Considerations

Decision-makers weighing water utility consolidation can improve financial outcomes by anticipating roadblocks along the way. Some of the key financial considerations to consider include:

- Up-front costs;
- Real and perceived unequal distribution of benefits;
- Savings timeline;
- Different starting points; and
- Unequal or conflicting incentives.

Up-Front Costs

The initial financial consideration in utility consolidation is the high up-front investment needed to move through the consolidation process and establish the consolidated system. Planning, studies, and the staffing capacity to undertake this process can be expensive. In many cases, infrastructure improvements, new projects, or physical interconnections between infrastructure assets will also be needed.

Real and Perceived Unequal Distribution of Benefits

One challenge related to consolidating utilities is that the financial benefits cannot always be distributed equally. A region may experience aggregate benefits from a less fragmented approach to water management while individual communities or utilities may not experience any benefit. Some may even experience financial loss, and consolidation is especially difficult in these cases. Even though financial savings for the larger region can look promising, utility leaders typically make decisions with their individual utility or community in mind. Addressing inconsistencies among customers and systems can be challenging and may require compromise and commitment to solutions that ensure water services are affordable for all customers.

Savings Timeline

Communities and their utilities can find ways to smooth out or accelerate anticipated net savings or cost avoidance. Smoothing costs means reducing the burden of individual payments by spreading them out over a longer timeframe. Smoothing net savings means realizing savings in smaller increments over a longer timeframe, often with the goal of realizing some savings sooner. These can

be important considerations when utility decisions are made by elected leaders whose term limits are shorter than the time it would take to realize savings. Often these officials hope to show ratepayers real savings or cost avoidance during their term in office. Models and financial instruments that can make savings accrue evenly over time or accelerate savings can encourage these leaders to support consolidation. Models with high up-front costs may be politically difficult for elected leaders to support, despite long-term savings. Restructuring existing debt to reduce costs can help in these cases.

Different Starting Points

Long-term thinking and analysis are also critical to improving the chances of consolidation taking place and realizing financial benefits for the community. Water utility and government leaders who come together to partner, regionalize, or consolidate often start the process from very different financial points. Partners that begin the process with very different rate schedules, asset values, savings, and liabilities need to put in effort, accounting prowess, and negotiating finesse to harmonize agreements.

Unequal or Conflicting Incentives

Communities are more likely to see a solution through if the incentives that need to be in place for consolidation to occur are present and clear. In some instances, a higher-capacity and financially-healthier utility may see few incentives to fully consolidate with a lower-capacity system and choose a less robust option as a result. When this happens, it can reduce incentives to consolidate in the future, leaving the additional benefits that opportunity could have provided unrealized. Identifying regional benefits from the outset can help communities with less incentive better understand why consolidation may be important for long-term sustainability.

Summary

Consolidation is an important tool for communities to consider but is not the right option in all cases. Water utilities and key stakeholders must assess their options carefully. Many positive financial and economic outcomes can accrue from utility consolidation, but communities must also consider and prepare for all the related challenges. Communities that have successfully consolidated utilities have several common characteristics: understanding the financial impacts; patience; long range planning; external incentives; and leadership.

Part Two:
Financial Case Studies

Communities considering utility consolidation can learn from those who have already gone through the process. This section of the report provides eight case studies of communities that have consolidated or regionalized water service. Taken together, the case studies illustrate the diverse drivers, agreements, institutional arrangements, and outcomes associated with water utility consolidation.

These case studies are not comprehensive analyses of utility consolidation. Rather, they focus on the financial dynamics. There are many important and complex social, environmental, and political aspects involved in each case not addressed in this report. For example, while long-term rate savings for customers are discussed in the following case studies, the community response and experiences during the consolidation process are not covered. Though each case includes some information as background, the politics, governance decisions, and legal processes and agreements deserve further research and assessment. Nevertheless, these cases provide important information on key considerations and financial impacts. This is a necessary first step to build understanding about consolidation options and benefits.

Central Arkansas Water

Two municipal water departments consolidate to provide an affordable and reliable water source for the future

Date of established agreement	2001: Signed Consolidation Agreement merging Little Rock and North Little Rock water departments to establish Central Arkansas Water (CAW)
Services involved	Ownership, management, and provision of drinking water assets, services, and supply in 2011 and wastewater services authorization granted in 2017
Governance model	Two municipal utilities merging to form a single larger publicly owned utility governed by a seven-member board of commissioners
Communities involved	2001: • City of Little Rock • City of North Little Rock Additionally: • Brushy Island Public Water Authority • 145th Street Water and Sewer Improvement District • Wye Mountain Public Water Authority • Maumelle Water Management CAW also provides retail water to City of Sherwood and wholesale water to more communities.
Population served	450,000 people over a 360-square mile service area
System capacity/demands	3,000 metered service connections with the capacity to provide approximately 157 million gallons of potable water per day and an average daily demand of 62 million gallons
External policy drivers and incentives	A study by University of Arkansas at Little Rock (2000) commissioned by both cities recommended consolidation
Financial and economic impacts	• Rate equalization and stabilization • Increased efficiency and reduction in duplication related to water supply investment needs • The ability to borrow greater amounts of money due to the larger customer base and higher credit ratings
Revenue flows	Customers from multiple communities pay uniform fees directly to the consolidated utility

Summary

For systems facing regional water supply challenges, the creation of Central Arkansas Water (CAW) exemplifies the potential for consolidation to result in positive financial impacts for the utility and community. It helped stabilize rates and eliminated rate differences between residents of a large region of central Arkansas. Moving from a water supplier and purchaser wholesale relationship, two municipal water systems in North Little Rock and Little Rock fully merged to create a single consolidated water utility. The consolidated CAW shares water supply costs across the two jurisdictions, generates efficiency by combining distribution system maintenance and customer service functions, equally distributes rates, and borrows capital at a lower cost to invest in infrastructure or supply needs. Since it was created, other smaller utilities have joined CAW.

Context

In 1936, the Arkansaw Water Works Company, a private utility, provided drinking water to both Little Rock and North Little Rock At the time, the region needed a reliable, cleaner water source than the Arkansas River, and the City of Little Rock sought a Public Works Administration grant to build a reservoir. To be eligible to receive the public grant funds to improve their citizen's water

service, Little Rock had to purchase the Arkansaw Water Works Company's facilities south of the Arkansas River and create a public utility. As part of the agreement to purchase those assets, Little Rock agreed to continue to provide water to Arkansaw Water Works Company for several customers north of the river. One of those customers was North Little Rock, which subsequently purchased the Arkansaw Water Works Company's facilities north of the Arkansas River creating their own public water utility in 1959, though they still purchased water from Little Rock.

The arrangement provided some benefits but also led to continuous conflicts that lasted until their comprehensive consolidation. The two entities' unique historic relationship, having been joint customers of Arkansas Water Works Company and then having become two separate systems, created multiple challenges in maintaining a stable relationship. The regional arrangement prior to consolidation was mandatory but also rife with conflict. Conflicts primarily emerged over rates and the need for a long-term contract. North Little Rock wanted to be charged the same rates Little Rock was charging Arkansaw Water Works Company, which the Arkansas Supreme Court decided were no longer adequate. However, in the same opinion, the Court established that Little Rock could not cede its obligation to provide water to North Little Rock because of the process it agreed to when it created its municipal system. There were further disputes over capacity and North Little Rock's inability to expand its service area because of the demands it would place on Little Rock as the provider.

Tensions over rate increases, rate differentials, difficulties in agreeing to a formal long-term contract arrangement, and concerns about future regional water supply increased, and the two municipal entities reached a standstill in 1999. That year, the City of Little Rock hired Black & Veatch to do a rate and revenue study to assess the city's utility needs and rate structure. The findings showed inequity in the current rates and that master-metered wholesale customers, such as North Little Rock, were paying less than the true cost of their water. Black & Veatch recommended Little Rock establish a cost of service rate structure, requiring significant rate adjustments for each customer class. The Little Rock Water Commission adopted the recommendations despite the objections of water purchasers, including North Little Rock.

North Little Rock was given the choice to pay the increased rates or seek out a different water supply. According to a 1999 report by Marlar Engineers and Garver Engineers, the costs of an independent water supply for North Little Rock were estimated at $189 million.[10] North Little Rock's resistance put Little Rock in a difficult place as well. The city had invested $31 millions' worth of capital improvements to be able to accommodate a greater treatment capacity that would largely go unused if North Little Rock pursued an independent supply.

The two cities sought help from the University of Arkansas at Little Rock to find a solution. They commissioned the university to do a study to evaluate rates, regional supply needs, and the relationship between the two entities.[11] The study, *Water for Our Future: Overcoming Regional Paralysis*, identified three main stumbling blocks to cooperation, all of which involved financial details and concerns: water rates, establishment of a long-term contract, and fair cost burdens in light of past investments in the system. The study eventually determined consolidation was the best solution both to promote equitable water rates and to assure access to a reliable regional water supply.

Case Overview and Financial Outcomes

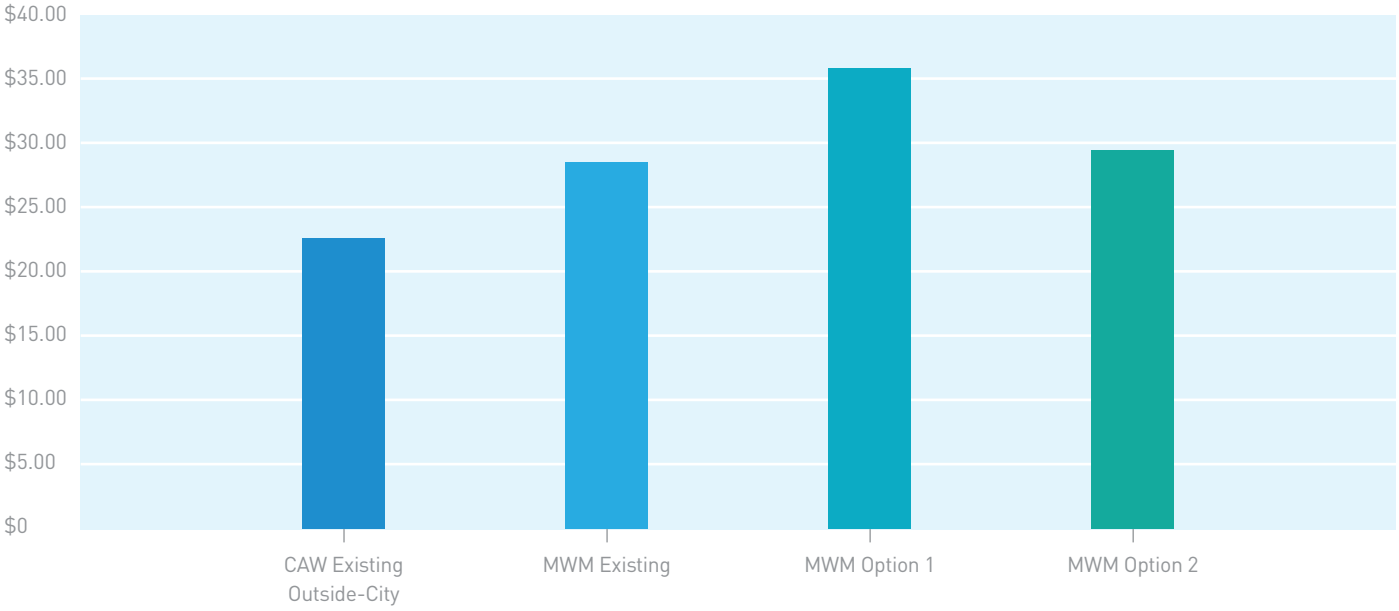
The cities decided to consolidate in 2001 based on the recommendations in the University of Arkansas at Little Rock report; the goal was to find regional solutions to water supply issues. The study helped convince the cities to move past geographical differences and corporate interests and toward the good of the entire customer base. Both cities' governing bodies and water commissions came to a unanimous decision to merge Little Rock Municipal Water Works and the North Little Rock Water Department into Central Arkansas Water. Ultimately, the consolidation equalized rate structure for both cities, created additional revenue bonds, and brought in new customers. These financial outcomes benefited customers, as well as the water utility.

Under the agreement, a new Consolidated Commission would propose a schedule to incrementally equalize rates, which would go into effect in 2002 and charge similarly situated classes of customers in Little Rock and North Little Rock equal rates within 10 years. This change was important, as customer rates for both Little Rock and North Little Rock were substantially below the state average in 2000. Residents in Little Rock paid $7.27 per month and North Little Rock paid $12.17 per month per 5,000 gallons of water. Households in North Little Rock paid 67 percent more for comparable service than in Little Rock, which contributed to some of the tension. The rate equalizing schedule eliminated concerns about the proposed rate increases for North Little Rock, and the commission achieved its goal and restructured rates two years ahead of schedule. By 2018, with the equalization period already

Figure 2

Consolidation Benefits to Maumelle Water Management[15]

Example Water Bill Using 2015 Rates (5/8" Meter with 4,400 Gallons)



Note: Does not include tax and fees; MWM bills include the water portion of the Debt Surcharge fee based on water's proportionate share of proposed debt.

over, rates for families within the municipal boundaries of the two communities became equal at $21 per month for 5,000 gallons, a higher rate for customers but significantly lower than other rates across Arkansas and the country.[12]

Additionally, the agreement granted authority to Central Arkansas Water to issue revenue bonds and sell water to new customers outside of Little Rock and North Little Rock. As of 2018, CAW maintains an AA2 credit rating, a higher rating than any previously held before the consolidation.[13] The merger also gave Little Rock the financial security it had been lacking without a contractual obligation from North Little Rock. Meanwhile, North Little Rock avoided the need for almost $200 million dollars of investment for additional water supplies.

CAW has continued to grow with the addition of several small communities including Maumelle Water Management (MWM) in October 2015. Even for communities outside municipal boundaries, CAW rates remain significantly lower than what MWM customers paid at the start of negotiations (see Figure 2). According to financial projections made prior to the merger of CAW and MWM, a typical MWM customer using 4,400 gallons per month was slated to pay at least $44.00 and possibly much more by 2020 if the cities' water services remained independent.[14] The same study estimated that MWM customers joining CAW would pay $32.69 for the same service in 2020.

Conclusion

The Central Arkansas Water's consolidation provided financial benefits to Little Rock, North Little Rock, and small systems who would subsequently merge. It also ended a decades-long dispute over water capacity, control, and cost issues, while improving water security for the region. This case highlights challenges that may occur when communities partially regionalize under a less than ideal framework. The wholesale-purchaser relationship existed for years prior to the consolidation, avoided duplication of some services, and led to some financial benefits. Yet, the lack of long-term agreement, the basic structure of the arrangement, and tension over control and rate fairness led to an unsustainable situation. Full consolidation brought together two relatively financially healthy systems to create a larger entity where costs for acquiring a long-term regional water supply could be distributed more equally across a larger customer base. This solution reduced less duplication and avoided costly unused capacity. By forming a larger more stable entity, the region can access capital at a lower cost because the combined entity improved credit worthiness. The further consolidation of other smaller systems enables CAW to acquire more assets to support its system while providing rate stability, sustainable infrastructure, and long-term supply for the customers of the smaller systems.

Financial Case Study

Citizens Energy Group

Energy, water, and wastewater systems consolidate to streamline service and reduce rates

Date of established agreement	2011: Citizens Energy Group (Citizens Energy) purchased the water and wastewater systems serving Indianapolis
Services involved	Ownership, management, and provision of gas, centralized steam production, water, and wastewater services
Governance model	Large, not-for-profit energy service provider acquires a separately governed public water and wastewater system
Communities involved	• Marion County • Portions of Boone County • Portions of Brown County • Portions of Hamilton County • Portions of Hancock County • Portions of Hendricks County • Portions of Johnson County • Portions of Morgan County • Portions of Shelby County
Population served	800,000 people over more than 200 square miles of service area
System capacity/demands	• 4,000 miles of pipeline and 10 water treatment plants fed from several reservoirs • 3,000 miles of sewer lines and two treatment plants with combined average flow capacity of 125 million gallons per day
External policy drivers and incentives	2006 Consent Decree between US EPA and Indianapolis that would require an estimated $1.4 to $1.7 billion dollars in improvements to the city's water and wastewater systems
Financial and economic impacts	• Estimated combined $40 million in annual savings for customers • Monetization of the water and wastewater system assets resulting in over $400 million available to Indianapolis for essential community investments
Revenue flows	• Water and wastewater customers of acquired systems become customers of merged system • Merged system responsible for covering required purchase price as well as recurring payment in lieu of taxes

Summary

Citizens Energy Group's (Citizens Energy) acquisition of Indianapolis's water and wastewater system is an example of how consolidation can be used to reduce utility costs by integrating the provision of different utility services. Prior to the acquisition, the city was under pressure to cut costs resulting from the need to comply with an expensive 2006 Consent Decree. This became the primary driver to consolidate water and energy service. The city anticipated saving roughly 40 million dollars per year in capital and operating expenses from combining gas, steam, chilled water, water, and wastewater services with Citizens Energy. Those savings helped ensure rate increases would be less than if the city retained ownership of its water and wastewater utilities. The city also monetized its past investments through the purchase price Citizens Energy paid and a stream of payments in lieu of taxes (PILOT). The city and Citizens Energy decided to pursue consolidation by calculating and later presenting the business case supporting their decision. The Indiana Utility Regulatory Commission reviewed and approved the plan through a highly structured utility regulatory process. Resulting positive financial impacts were carefully tracked and documented.

Context

Water and wastewater provision in the Indianapolis region have a long history that includes a variety of ownership, management, and governance models, including partnerships with the private sector. In 2002, the city purchased ownership of the area's water system from a private company and hired another entity to operate and manage the water system assets. Meanwhile, the city maintained an agreement with a different private operator to manage their wastewater system. Each service fell under different regulatory and governance models. The water system was governed by the city's Board of Water Works and regulated by the Indiana Utility Regulatory Commission (IURC). The city's wastewater system was governed by a sanitary district associated with the Indianapolis Department of Public Works.

In 2009, the city solicited ideas for transforming its water and wastewater system to better meet the costs of regulatory compliance and alleviate high debt. Indianapolis received 23 separate proposals, and ultimately selected the region's nonprofit energy service provider, Citizens Energy.[16] Citizens Energy's structure was appealing because it had separate divisions sharing costs and providing services in an integrated manner throughout the entire Indianapolis region. The city and Citizens Energy spelled out the initial framework in a memorandum of understanding (MOU).

Today, Citizens Energy provides water and wastewater services to hundreds of thousands of homes and businesses in Marion, Johnson, Morgan, Hendricks, Boone, Hamilton, Hancock, and Shelby counties. Drinking water comes from 10 treatment plants and sources including the White River, several reservoirs, and the Indiana Central Canal. Citizens Energy also owns and operates two wastewater treatment facilities that treat over 70 billion gallons of wastewater per year. The service area is more than 200 square miles. Citizens Energy also has inter-jurisdictional agreements in place to provide wastewater services for several nearby cities and districts.

Prior to consolidating its water and wastewater systems under Citizens Energy, the city faced an estimated $4 billion in necessary infrastructure improvements, as well as significant costs for other city infrastructure needs including roads, sidewalks, and bridges. The city, the State of Indiana, and the US Environmental Protection Agency entered into a consent decree in 2006 and agreed to develop a long-term plan to meet the requirements to reduce sewage overflow during storms[17]. The long-term plan was approved in 2007. One report estimated the total cost of the plan alone at $1.8 billion dollars over 20 years. The city projected water rates would need to increase by over 100 percent and wastewater rates by over 400 percent by 2025 to cover such substantial infrastructure costs.

Citizens Energy, however, would be able to implement the improvement plans using lower rate increases, providing strong incentive for the city. Nevertheless, the transaction required addressing a range of important financial arrangements and details.

Before the city consolidated systems under Citizens Energy, it terminated its water system management contract with Veolia Water in advance of its 2021 contract end date. The IURC reviewed and accepted a termination payment of $29 million dollars as part of the transfer order. At the same time, consumer advocacy groups were pushing back against the idea of selling the utilities to a non-municipal governed entity. Some were concerned the water and wastewater utilities were valuable commodities owned by the city with the potential to generate income, whereas a one-time influx of cash from the sale created only short-term economic benefits. Others expressed concern that Citizens Energy would not be as accountable to residents as the city's elected officials.

Case Overview and Financial Outcomes

Despite these various challenges, Citizens Energy finalized the acquisition of the city's water and wastewater systems in 2011 and added the water and wastewater systems of the neighboring City of Westfield in 2014 under a separate corporate identity, Citizens Westfield.

The city was motivated to support the consolidation for financial reasons. Through the acquisition, Citizens Energy assumed debt liabilities from the city for both the water and wastewater systems. Citizens Energy paid the city $262.6 million for the wastewater system. Citizens Energy also agreed to take on approximately $1.4 billion of outstanding water and wastewater debt and the responsibility for complying with regulations. Indianapolis's consent decree cost an estimated additional $1.8 billion at that time.

Citizens Energy generated savings by streamlining water, wastewater, and energy services together. Operational and capital savings were an essential element of the arrangement as described in the MOU and as presented to the IURC for approval. The IURC order approving the acquisition cited testimony about expected savings and required Citizens Energy to report on their progress toward achieving these savings (referred to as synergies). Citizens Energy saved money on many projects by reevaluating the best and most cost-effective way to undertake the project, utilizing a competitive bidding process, and canceling other projects after reconsidering their costs and benefits. The city benefited from this integration of utility services and the sale's proceeds.

The savings in the first three years were reported as more than twice what was projected at the time of the transfer (see Tables below). Net "synergies," or savings, projected at the time of the acquisition were $24.6 million for Year 1, $48.5 million for Year 2, and $59.3 million for Year 3. The cumulative savings by Year 3 are documented as $329.15 billion.

Table 2
Projected savings as presented in each *Semi-Annual Report Regarding Savings and Other Matters*

Synergy Category	Year 1	Year 2	Year 3
Operations & Maintenance Expense	$16.5 M	$24.6 M	$33.5 M
Capital Expenditures	$18 M	$26.4 M	$27.3 M
Total Synergies	**$34.5 M**	**$51 M**	**$60.8 M**
Costs-to-Achieve	$9.8 M	$2.4 M	$1.4 M
Net Synergies	**$24.6 M**	**$48.5 M**	**$59.3 M**

Table 3
Savings in Year 3 as presented in the sixth *Semi-Annual Report Regarding Savings and Other Matters* (Savings in thousands)

	Year Three Savings	Cumulative Savings	Average Savings
Operations & Maintenance	20,787	34,310	11,437
Capital	127,732	251,316	83,772
One-Time Healthcare/Pension Adjustments	0	49,629	16,543
Costs-to-Achieve Prior to Acquisition	0	6,106	6,106
Net Savings	**148,519**	**329,149**	**105,646**

Citizens Energy paid significant transaction costs to complete the acquisition in addition to taking responsibility for the city's existing water and wastewater debt. To reduce the burden of these costs, the IURC settlement agreement allows for Citizens Energy to add up to $14 million to the utility debt to cover the transaction costs.

The decision to consolidate services under Citizens Energy impacted the city as well. Local governments often enjoy indirect financial benefits when they own their own water and wastewater systems, and the loss of these benefits can hinder regionalization efforts. These benefits can include the ability to share general government management and administrative costs (e.g. human resources, general management, fleet management, etc.) with departments and units within the local government. Local government asset owners may also receive significant financial benefits in the form of payments in lieu of taxes (PILOT), dividends, and other transfers between utilities and general government. To compensate for these lost benefits, the acquisition terms agreed to by Citizens Energy, the city, and the IURC include a schedule of PILOT payments that the city used to securitize a $145 million debt issuance to support general government assets and services. The payments are set for 2010 through 2039. They started at about $11 million per year in 2010 and will rise to almost $28 million per year by 2039. Proceeds from the sale and the issuance of the PILOT-backed bonds were a positive outcome for the city and incentivized the arrangement.

Conclusion

The Citizens Energy consolidation model provides an interesting example of the operational efficiencies available when different utility services within the same region are consolidated. The case also highlights an approach used to monetize and compensate the city for its historic investments in the water and wastewater systems. The payments the city received from the agreement were one of the major benefits cited by the city and were essential drivers of the consolidation. Without the deal being structured to reward the city, the consolidation may not have occurred.

City of Colusa

Small privately-owned water district consolidates with city to address contaminated drinking water supplies

Date of established agreement	2017
Services involved	Treatment and distribution of drinking water
Governance model	A municipal utility annexed and consolidated an unincorporated subdivision with a separate water system
Communities involved	• City of Colusa • Walnut Ranch subdivision (system previously owned by Del Oro Water Company)
Population served	• City of Colusa after consolidation: 2,175 accounts • Walnut Ranch prior to consolation: 182 people/79 connections
System capacity/demands	Consolidated Colusa System • Five wells • Two storage tanks • Distribution system
External policy drivers and incentives	• State order to comply with the maximum contaminant level for arsenic • California Law (Senate Bill 88) that encourages and, in some cases, requires system consolidation • Low-interest Colusa County Loan • State Revolving Fund program ($500,000 planning grant) • Pending loans from the State Water Resources Control Board's Division of Financial Assistance
Financial and economic impacts	• The costs of providing water in a small community now shared among much larger customer base • Eliminated need to build facilities for new water supply for less than 200 people • Significant reduction in customer water bills projected over time
Revenue flows	Walnut Ranch customers will pay temporary surcharges to cover cost of consolidation and then will eventually pay same rates as other Colusa customers

Summary

The consolidation of the Walnut Ranch District with the City of Colusa provides a snapshot of how a community served by a small private water company overcame contaminated drinking water supply problems through annexation to a nearby town. The Del Oro Water Company (DOWC) originally provided water service in Walnut Ranch, a small subdivision on the outskirts of the City of Colusa. Low water quality caused DOWC and Walnut Ranch residents to pursue alternative sources of water which eventually resulted in DOWC selling the system and Walnut Ranch becoming part of Colusa and their water system. The project was made possible through the support of state agencies and the enactment of state level policies that promote and support consolidation.

Context

The Del Oro Water Company (DOWC) owns and operates water supply systems in several districts in Butte, Colusa, Glenn, Humboldt, Kern, Shasta, Tulare, and Tuolumne counties in central California. DOWC provides service to approximately 20,500 people throughout California. However, under California's regulatory regime, each system is treated separately for rate setting. If a single system requires significant investments, those costs must be borne by the individual system and cannot be shared among customers served by systems in other parts of the state.

Walnut Ranch is a small subdivision community south of the City of Colusa in Northern California. Up until 2017, the community was unincorporated and was served by a small water system that was owned by the Del Oro Water Company. The Del Oro Water Company Walnut Ranch District (DOWC-WR) water system had two wells and a 5,000-gallon tank to serve 182 people.

DOWC-WR faced numerous water quality challenges. The water had high levels of arsenic, manganese, and iron with one well exceeding the drinking water standard maximum contaminant level for arsenic. Because of these exceedances, the California State Water Resources Control Board sent Walnut Ranch an order to comply with the maximum contaminant level for arsenic in July 2010. Around that time, the local newspaper reported that low water quality caused "almost every resident" to buy bottled water, and the metals were affecting residents' plants, water heaters, and sidewalks.

DOWC searched for alternative sources to provide their Walnut Ranch District customers with potable water at a reasonable cost. Eventually Walnut Ranch residents and DOWC-WR focused on pursuing a connection to the Colusa municipal system. After one of the wells owned by DOWC-WR physically collapsed in 2012, the City of Colusa constructed an Emergency Transmission Interconnection to supply water to the residents of the Walnut Ranch subdivision. The estimated total cost of the interconnection project, including engineering and legal costs, was $93,845. The Public Utilities Commission approved DOWC-WR to collect a surcharge of $20.58 per customer per month for 60 months to recover the costs from the project. Although some residents of Walnut Ranch hoped the Emergency Transmission Interconnection could supply their water on an ongoing basis, the city's position was that the interconnection should only be used on an emergency basis, rather than a permanent solution.

After years of trying to resolve water quality issues, Walnut Ranch subdivision residents coalesced around consolidation in the form of annexation to the City of Colusa as a solution to their poor water quality and septic issues. Their efforts to drive consolidation were nudged along when the California legislature passed Senate Bill 88 in 2015, which authorized the State Water Resources Control Board to mandate failing water systems to receive extension service from or to consolidate with other water systems.

Case Overview and Financial Outcomes

Planning for the city to annex Walnut Ranch began in 2010. Walnut Ranch residents agreed to pursue a special assessment to cover the $107,261 needed to pay pre-annexation costs. In January 2011, the Board of Supervisors of Colusa County voted to put a measure to levy the parcel tax on the ballot. Later that year, 92 percent of voters approved the measure. The tax amount was $687.57 per year, paid in two installments, on each parcel in the unincorporated area for two years.[18]

The annexation process moved forward quickly after voters approved the assessment. In April 2014, the City Council authorized the staff to submit a State Revolving Fund planning grant application to formally consolidate with the Walnut Ranch District water system. The application for $500,000 was approved in 2015. The City Council awarded the contract to CEC Engineering to provide engineering services to prepare for annexation, to value the current system, and to develop technical specifications for some of the upgrades needed to consolidate the Walnut Ranch system with the city system.

DOWC agreed to sell the assets of the Walnut Ranch District, which the city acquired in April 2017. The City of Colusa purchased the wells, transmission and distribution mains, plant and pumping equipment, and property used in its operation for $280,000. The purchase was funded with one percent annual interest from the city's Water Enterprise Fund. Residents of Walnut Ranch will repay the city for the purchase of the water system through a loan surcharge ($65.00 per month) that will last approximately four and half years. After the consolidation, many of the facilities previously used by the District, including the well, sand separation, and pressure tank equipment were no longer required and were decommissioned.

Prior to the consolidation, Walnut Ranch customers paid a flat rate of $106.85 per month, not including the surcharge related to the emergency interconnection described above. After becoming customers of the City of Colusa, they began paying published City of Colusa rates. A typical residential customer pays approximately $60 to $80 total depending on what they use each month.

The City of Colusa intends to upgrade the existing system and replace distribution pipelines in Walnut Ranch. The construction will include upgrading the existing 6" water main in Walnut Ranch to the city standard of 8" to provide adequate water pressure for service. The city has applied to the State Water Resources Control Board's Division of Financial Assistance for project funding. Table 3 below summarizes the main costs associated with the consolidation and how those costs were covered.

Table 4

Consolidation Costs and Cost Recovery

Activity	Amount	Cost Recovery	Rate Impact
Emergency Interconnection	$93,845	DOWC investment retired through temporary surcharge	$20.58 per month for 60 months
Pre-annexation planning (2011)	$107,261	County special assessment tax	Equivalent to $57.30 per month for 2 years
Annexation related costs	$500,000	Planning grant—no repayment required	None
Purchase of DOWC Assets	$280,000	Colusa "Loan" retired by temporary loan surcharge	$65.00 per month for approximately 4 ½ years
Planned Distribution System Improvements	$2,022,258 (estimated)	State Water Resources Control Board's Division of Financial Assistance Loan or Grant	To be determined
Total	**$3,003,364**		

Conclusion

The Del Oro Water Company-Walnut Ranch case offers insight into the role higher levels of government such as state administrators of SRF funds, and others, can play in consolidation—particularly when it comes to overcoming some of the high costs of planning and implementing a consolidation. The case also shows the financial benefits of moving from a fragmented utility with an extremely small customer base to a larger customer base able to spread costs more evenly.

Financial Case Study

City of Raleigh Public Utilities Department

Seven local utilities merge into a full-service regional water and wastewater provider

Date of established agreement	• 1990s: Discussion and planning began • 2000: First consolidation agreement approved • 2006: Last agreement executed
Services involved	All aspects of water and wastewater provision including asset ownership and customer service
Governance model	A large municipal utility incorporated the assets and customers of six surrounding medium-sized municipal utilities through planned asset transfer and capacity purchase. City managers from affected utilities sit on the Utility Advisory Committee with Raleigh management and consult with Raleigh on key issues.
Communities involved	• City of Raleigh • Garner (July 18, 2000) • Rolesville (August 7, 2001) • Wake Forest (June 6, 2005) • Zebulon (August 2, 2006) • Wendell (June 26, 2006) • Knightdale (April 28, 2006)
Population served	195,000 customer accounts, 570,000 people over a 299-square mile service area
Consolidated system capacity/demands	50 MGD of average daily water supply demand, a capacity of 102 MGD, and 48 MGD of average daily wastewater treatment demand with a capacity of 65.2 MGD
External policy drivers and incentives	• Wake County, the region's county government and not a direct service provider, provided leadership and guided the consolidation through planning efforts culminating in the preparation of the Wake County Water and Sewer Plan, the blueprint for the consolidation • Informal state environmental agency agreement to expedite and streamline regulatory approvals if utilities regionalized
Financial and economic impacts	• Reduced duplication in water and wastewater asset investment • Larger customer base • Created regional uniform rates projected to be lower than what communities would have paid without consolidation • Reduced operation and maintenance costs • Access to lower cost capital
Revenue	Consolidated communities paid Raleigh back for improvements to complete consolidation and purchased capacity through negotiated payments over time. During consolidation transition period, revenue came from development fees and the difference between consolidated utility rates and Raleigh rates. After consolidation transition period, Raleigh imposed uniform rate structure and collects rates directly from all customers.

Summary

The City of Raleigh's water and wastewater utility transformed from a single, city-focused utilities department into a regional full-service provider. This model highlights the positive financial impacts and efficiencies that can arise when a high capacity urban utility takes on ownership and operations of the water and wastewater services of its small to medium-sized neighbors. In this rapidly growing area of the country, utilities consolidated to provide services in a more cost-effective and unified manner. The communities that consolidated with Raleigh realized cost savings, lower rates, and increased water security. The larger community gained regional support for future water and sewer permitting activities and reduced competition for limited new water resources.

Context

Raleigh and the surrounding areas of Wake County have experienced some of the highest growth rates in the country. In 2000, the city had 276,000 residents, but by 2010, that number had increased to 383,000. This pressured many public services, including the provision of water and wastewater services. Growth had many financial implications for Raleigh and its neighboring communities who had to increase their capacity to meet increasing demand. Many of the region's water and wastewater systems already faced high capital expenditures due to an increasingly strict environmental regulatory climate. Within a relatively small region, multiple water and wastewater providers were working independently to provide safe and environmentally sound services to their populations. Competing for regional resources, at times, delayed mutual solutions and imposed unnecessary costs on customers.

One of Raleigh's neighbors, the Town of Garner, was considering building a major facility for hundreds of millions of dollars. The State Department of Health and Environmental Resources (which has since re-organized into the Department of Environmental Quality, or DEQ) was charged with reviewing and approving water system permits and urged communities in the region to consider consolidating. DEQ entered into an informal MOU with Raleigh and Garner suggesting they could benefit from a more streamlined regulatory approval process if they consolidated systems.

Around this time, the leaders of Wake County were instrumental in organizing funding for a major regional water and wastewater planning effort. While uninvolved with direct service provision, the county was involved in a range of land use planning and economic development efforts. A taskforce of stakeholders from throughout the county, including many leaders from towns that provided their own water and wastewater service, led the planning effort. The resulting Water and Sewer Plan was finalized in 1998 and analyzed a range of regionalization scenarios. At the time, leaders saw increased regionalization as a means of providing economic benefits to the region while reducing fragmentation and customer cost variations. At the time, customers in the same region being served by different utilities were paying between $9.91 and $25.86 on their monthly water bill. [19]

The political and financial environment was also conducive to moving forward with regionalization. Some communities, like Roseville, also had capacity needs that drove them to consolidate.

Several years after the development of the plan, the Town of Garner was the first to execute an agreement with Raleigh to transfer their assets and customers. Over the next six years, five other towns entered into similar agreements with Raleigh transforming how utility services were provided in the western part of the county.

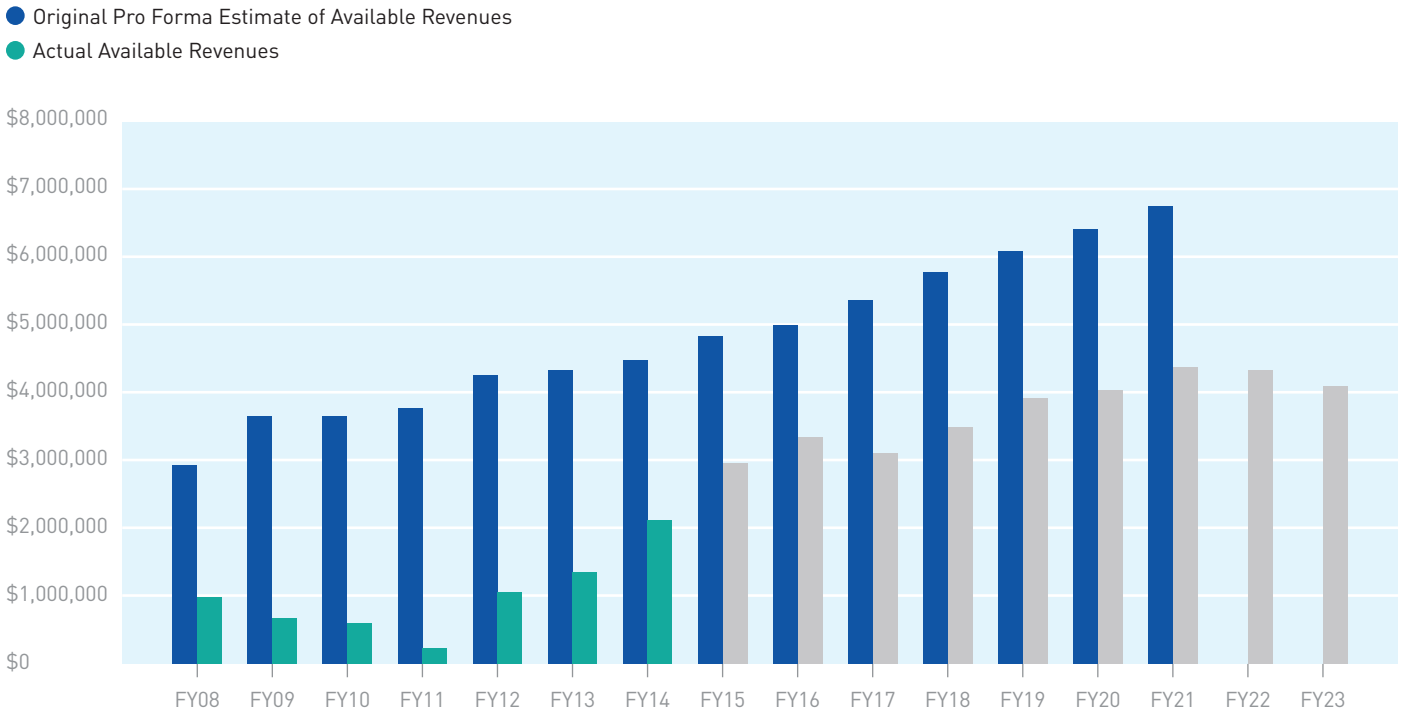
Case Overview and Financial Outcomes

Raleigh used identical agreement frameworks with each community that transferred in; each utility essentially bought, or reserved, an amount of treatment/supply capacity from Raleigh. Utilities also paid for some of the added costs of carrying out the physical connections and improvements needed for Raleigh to serve their customers. Prior to the consolidation, some of the area utilities already had agreements and relationships with Raleigh that impacted their assessed consolidation cost. For example, Garner purchased capacity from Raleigh prior to the full consolidation and was being served as a wholesale customer.[20] The total cost of carrying out consolidations, well over $150 million, was ultimately paid by the customers and tax payers of the consolidated utilities.[21, 22] Raleigh facilitated the transfer by crafting these payments in the form of low-cost debt that the municipalities could pay back over time. One of the primary financial benefits of this arrangement, if not the major driver, was reducing overall customer cost.

Each town was given the freedom to decide how to pay for the associated costs of the consolidation. At the time of the consolidation, the retail rates of the consolidated utilities were higher than rates paid by Raleigh's existing customer base. The utilities chose to have their customers continue to pay those higher rates so the difference could help pay for the cost of the consolidation. Some of the systems also used development and impact fees to shorten the length of time needed to pay off their balances. The length of time it took for utilities to repay Raleigh differed for each utility. Once the costs of the consolidation and the costs associated with capacity acquisition and other necessary projects were fully paid, customers within each consolidated town would pay the same rate as customers in Raleigh. In all cases, future rates were lower than what customer paid prior to the consolidation.

Raleigh's financial accounting system tracks the balance due over time from each of the systems compared to the projections. As of 2018, four of the six towns had paid off their cost obligations and had rates equal to Raleigh. Many of the consolidated towns expected to lower rates for customers sooner. In reality, a number of factors led to discrepancies between the financial predictions and the actual payback timeframe. First, the financial crisis post-2007 caused development to significantly slow down in the consolidated communities. Less development meant fewer accounts than expected and a reevaluation of future capacity needs from Raleigh. Around the same time, the region experienced a drought so severe that residents in Raleigh debated putting a moratorium on new growth. While necessary for future water security, decreased water consumption drove down revenues from the consolidated communities. The drought caused a 25 percent drop in demand per account system-wide. Figure 3 shows the impact some of these trends had on the cost recovery projections for the Town of Zebulon.

Figure 3
Actual Revenue Compared to Estimated Revenue for Zebulon



At the time of the consolidation, the Town of Zebulon was projected to accumulate enough revenue to pay the City of Raleigh back for capital improvements and capacity by 2021. This date has since been shifted back several times. The table below summarizes the rate trends for the communities involved in the consolidation.

Table 5

Customer bills for water and wastewater in Raleigh and Surrounding Towns

Municipality	Date Consolidation Payments Completed (or Projected to be Completed)	1998 (6,000 gpm) (Water/Sewer Plan)	2010 (4,500 gpm) (Brown and Caldwell)	2017 (EFC) (4,500 gpm/6 CCF)
City of Raleigh	NA	$9.91	$35.50	$65.03
Town of Wake Forest	2014	$23.14	$58.00	$65.03
Town of Garner	2010	$19.34	$35.50	$65.03
Town of Knightdale	2018	$18.80	$50.00	$95.43
Town of Wendell	2021	$18.30	$56.00	$100.33
Town of Rolesville	2015	$25.86	$55.00	$65.03
Town of Zebulon	2023	$26.00	$74.00	$123.00

The lower sales and slower economy delayed some of the expected rate benefits, but these factors would have been a financial issue regardless of whether the consolidation occurred.

Consolidation helped increase Raleigh's Moody's credit rating to AAA, the highest rating on the scale indicating a debtor's ability to pay back debt. Raleigh's neighbors, while financially healthy compared to many local governments, are not able to match Raleigh's credit. If one of the smaller communities, like Knightdale which has a lower A2 Moody's rating, were responsible for borrowing funds to support water assets in its community, the cost of capital would be higher than what Raleigh would pay.

The consolidation was designed and promoted primarily to achieve rate equality. Participating systems have yet to calculate the actual net savings from consolidation compared to what they would have spent under the status quo. However, a 1998 study estimated the aggregate savings potential of consolidation for all 12 Wake County water utilities operating at the time including the seven that consolidated into the Raleigh system. According to the study, a consolidated approach could save the region an aggregate of approximately $350 million, 8 percent lower than the cost if the systems remained fragmented.[23] Many of the consolidated utilities operated small inefficient facilities that at the time of the consolidation would have required significant investments to maintain and accommodate the utilities' growth. In the case of Wake Forest, estimates suggested improving their assets would have cost over $50 million compared to a cost of approximately half that for consolidating with Raleigh.

Conclusion

Raleigh has become the primary water and wastewater service provider in the eastern part of the county through agreements with six eastern municipalities. Overall, Raleigh's consolidation had positive financial impacts on rate equalization and reduced duplicative water and sewer facilities in the region. However, the impacts were not immediate for most communities and required careful planning and patience. The influence of Wake County and the State in supporting the communities, serving as neutral advocates, was instrumental in creating the momentum to complete this ambitious initiative.

Financial Case Study

Hampton Roads Sanitation District

Regional wet weather program saves money, protects the Chesapeake Bay

Date of established agreement	• 1940: Original establishment of consolidated treatment utility • 2014: MOU to consolidate Regional Wet Weather Management Program (RWWMP) Implementation
Services involved	• Ownership and management of regional wastewater transmission and treatment assets • Planning, financing, and project management of RWWMP initiatives
Governance model	Political subdivision of Virginia with MOU and interlocal agreements with local governments
Communities involved	14 incorporated local governments: • City of Chesapeake • City of Hampton • City of Newport News • City of Norfolk • City of Poquoson • City of Portsmouth • City of Suffolk • City of Virginia Beach • City of Williamsburg • Town of Smithfield • Gloucester County • Isle of Wight County • York County • James City Service Authority
Population served	1.6 million people, 460,000 accounts
System capacity/demands	• 154 MGD Average Daily Wastewater Flow • 250 MGD aggregate plant capacity • Over 3,000 square mile service area
External policy drivers and incentives	• 2010 Federal Consent Decree • 2007/2014 State Special Order by Consent
Financial and economic impacts	• Estimated $1.1 billion (in 2013 dollars) reduction in the overall cost of major water quality improvement program • Reduction of future rate increases • More equitable distribution of regional water quality improvement costs, potential restructuring of utility debt (not fully realized)
Revenue flows	Cost of large regional water quality initiative are passed on to customers of different utilities equally

Summary

Hampton Roads Sanitation District (HRSD) offers insight into the financial benefits of consolidation and collaboration when communities are faced with the high cost of regulatory compliance. HRSD and the localities it serves were compelled to make significant upgrades to their shared network of wastewater assets to improve environmental outcomes. To address these regulatory requirements, HRSD and the localities pursued a collaborative strategy. HRSD led the crafting and implementation of a regional solution. Through this arrangement, HRSD made improvements to local assets that otherwise would have been the responsibility of individual localities. Although a more comprehensive consolidation model in which all the utilities fully merged likely would have presented an opportunity for greater cost savings, the localities opted for an incremental consolidated approach that balanced some savings with maintaining local service and control.

Context

HRSD was created by the State of Virginia in 1940 as a regional mechanism to prevent pollution in the Chesapeake Bay. Oyster harvests had long suffered. Tourists and residents complained of the declining quality of the area's water. Forming HRSD was the region's first attempt at solving its water pollution problems. HRSD's history has since been defined by efforts to regionalize and further manage increasing wastewater pollution.

By the early 2000s, HRSD provided wastewater transmission and treatment services to a population of 1.6 million with 1,600 pumping stations and nine wastewater treatment plants designed to treat up to 249 million gallons per day. HRSD owns and operates this wastewater infrastructure and provides wholesale treatment services to 14 other "retail" utilities that own the assets and interface with customers. The localities maintain their wastewater collection systems and are responsible for all aspects of customer service and billing.

Poor water quality linked to the existing wastewater and stormwater management systems caused the US Environmental Protection Agency (EPA) and the Virginia State Water Control Board (SWCB) to issue several consent decrees to HRSD and the 14 localities in its service jurisdiction. The consent orders addressed the persistent issue of recurrent, unpermitted sewer system discharges into the area's water resources, including the Chesapeake Bay, which threatened public health and the surrounding environment. The consent orders required HRSD to use new modeling techniques and monitor the sewer system, assess their condition and capacity, and create a Regional Wet Weather Management Plan (RWWMP). This plan describes how the region could increase stormwater management capacity and retrofit and upgrade aging infrastructure to minimize unpermitted discharges.

The localities subject to the consent orders agreed to cooperate in a regionalization study to support the RWWMP. The Hampton Roads Regionalization Report, completed by HDR and McGuire Woods in August of 2013, modeled the costs of several scenarios for infrastructure upgrades that would fulfill the EPA and Virginia Department of Environmental Quality's (DEQ) requirements. In one option, HRSD would fully consolidate with the localities, managing all regional wastewater customer service, collection, and treatment, including the RWWMP investments. The study estimated the net present value of this option cost $948 million less than if all the utilities proceeded independently. Of this, operation and maintenance cost savings were valued at $386 million, with an additional $562 million savings due to RWWMP capital investments.[24] The study recommended this full consolidation, based not only on the economy of scale cost savings provided but also because making system upgrade decisions would be more efficient.

However, the fully consolidated model was not adopted due to challenges with implementation. Consolidating the assets and operations of 15 utilities into a single utility required overcoming numerous legal, financial, technical, and political issues and dozens of complex decisions. The 2013 regionalization study analyzed a number of these. For example, the consultant team reviewed the legality of consolidating HRSD and the localities into a single entity with regional authority. The scope of the review included HRSD's enabling legislation, the authorizing legislation of the assets of the localities, federal and state law, the contracts of debt carried by the entities, and any contracts that governed the ownership or operation of the wastewater collection system. The review concluded that there was no existing legal impediment to regionalization of assets.

A full consolidation also required significant asset transfers, which could impact customers differently depending on where they are located. Communities could choose to freely give their wastewater assets to HRSD for an agreed-upon reimbursement, or to lease their assets to HRSD. Regardless, localities would want to ensure they did not "pay twice" for assets. This could be a concern if a locality previously paid off an asset that was then sold to the consolidated utility at a cost passed on to all the consolidated system's ratepayers, including those from the original locality.

The regionalization study also examined how consolidation would affect rates. Figure 4 shows that, on an aggregated regional basis, the costs of wastewater management would be lower under a full consolidation than the non-consolidated approach. On an individual utility basis, however, the situation is much more complex. Most of the localities' ratepayers served by HRSD stood to benefit from regionalization in the medium to long term compared to what they would spend if they acted independently. In fact, eleven of the localities would have lower rate increases.[25] Specifically, the average ratepayer in Gloucester, Isle of Wight, and Suffolk would see rates cut in half for some period of time after the consolidation occurred (Figure 5). However, some utility customers would pay more under a merged utility.

Notably, full consolidation would yield no short-term benefits nor lower rates for some communities, such as the City of Newport News and the City of Virginia Beach. Other communities could have higher rates. The City of Williamsburg, for instance, could see higher rates ($2 to $3 per month) even before full implementation of the RWWMP began (Figure 6).

Figure 4
Aggregate rate projections across service areas studied ($/ccf)

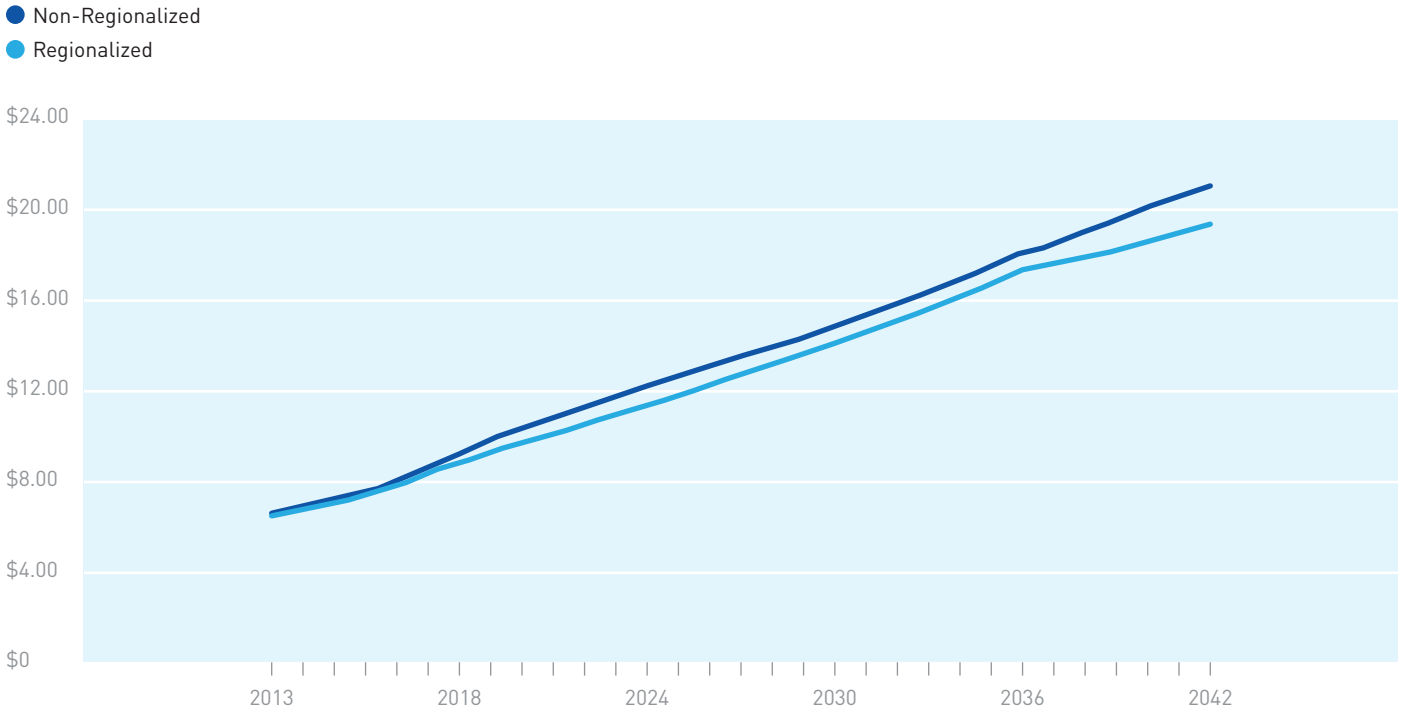


Figure 5
Rate projections for Gloucester ($/ccf)

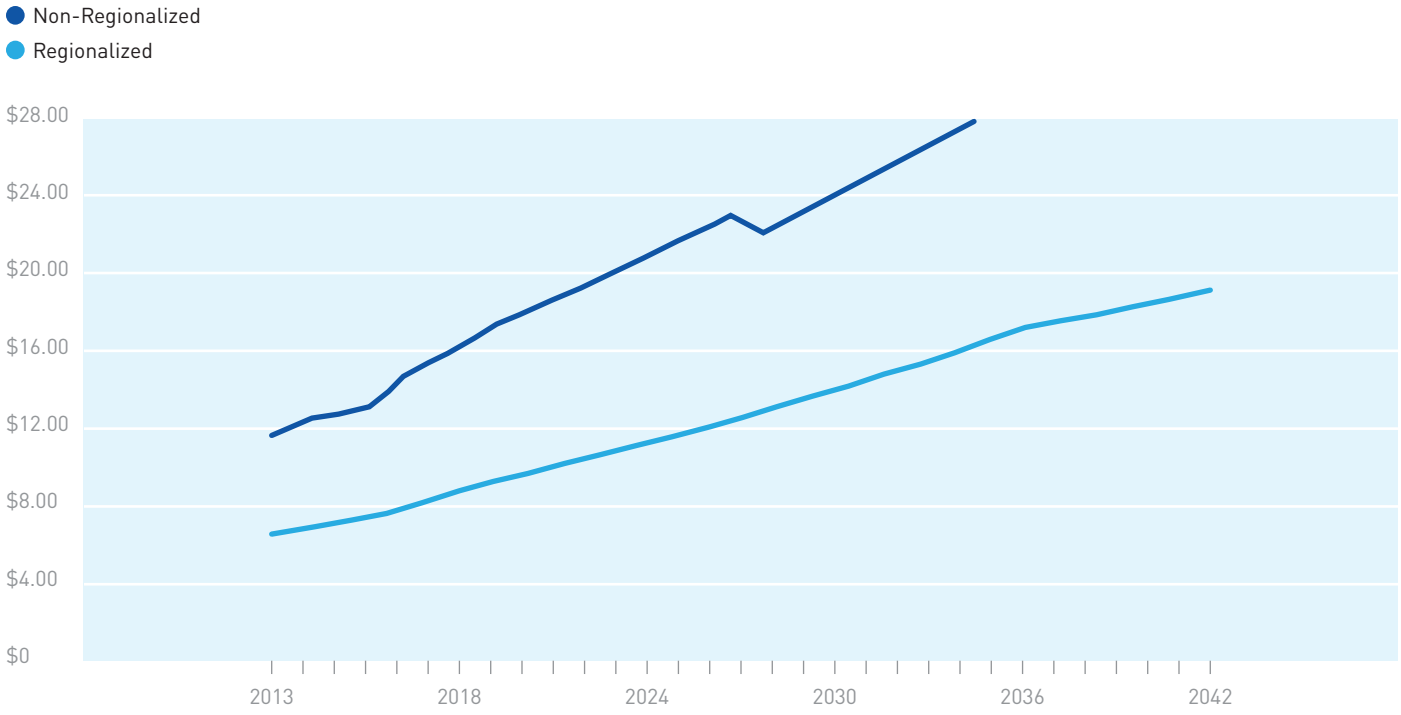
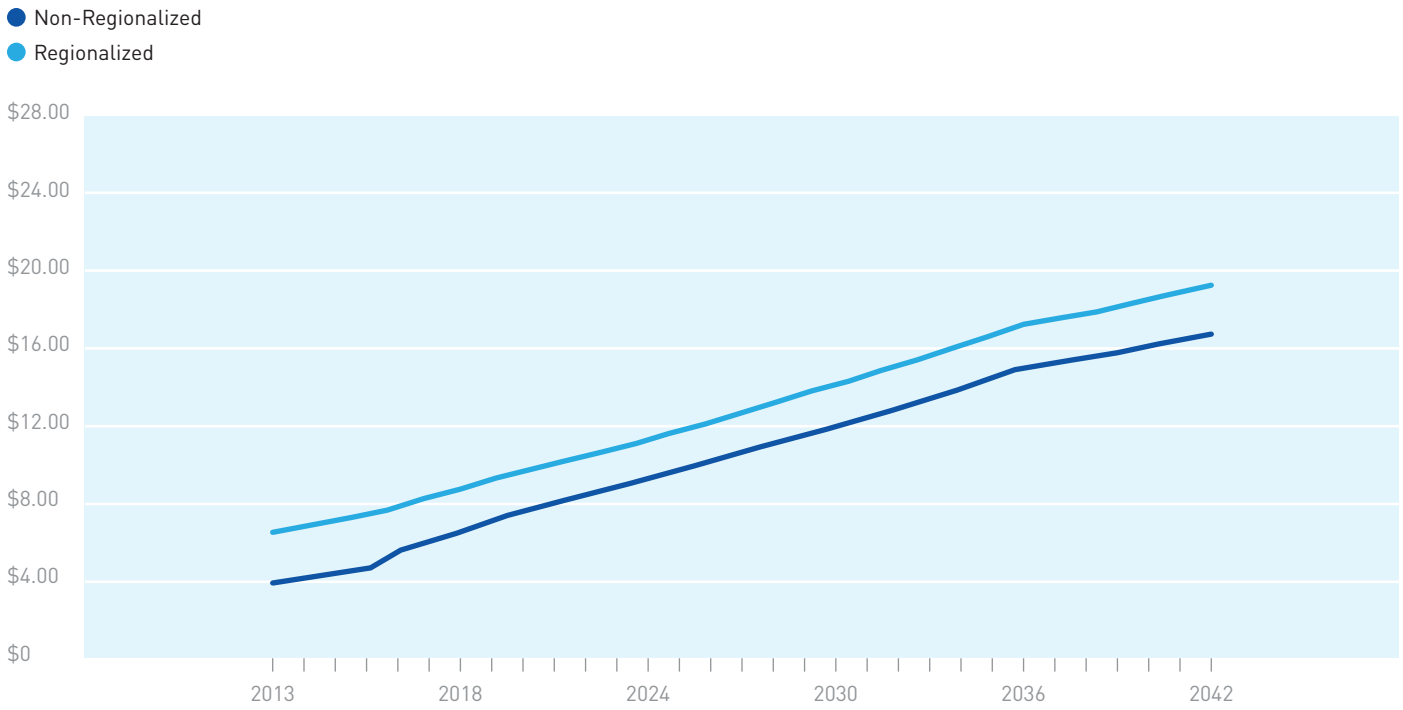


Figure 6
Rate projections for Williamsburg ($/ccf)



Regardless of the regional model the localities chose, rates had to increase. However, the full consolidation model including all communities presented a lower and slower rate increase than a model without full consolidation.

The study also found that a full consolidation would have no impact on HRSD's credit rating. Although HRSD would take on more debt, an increase in the collection of rate payments was sufficient to cover the debt. One challenge, however, would be deciding how to blend the debt of multiple agencies together in a way that would have the least impact on the ratepayers.

Case Overview and Financial Outcomes

Ultimately, the full consolidation model was unable to garner sufficient support to take place. Concerns related to local control and the specifics of how the full merger would occur. However, the communities involved developed and presented an alternative model that significantly increased consolidated responsibilities under HRSD. This alternative option captured many, but not all, of the financial benefits in the full consolidation option. Under this new model, HRSD is responsible for improvements that otherwise would have fallen to the other utilities, yet they maintained control of all other aspects of their systems. In March 2014, a Memorandum of Agreement (MOA) was signed by representatives of HRSD and the local utilities in favor of this hybrid compromise arrangement. Under this agreement, communities continue to own wastewater infrastructure, offer local service and maintenance, and manage customer accounts. HRSD funded and implemented RWWMP improvements across all the region's wastewater systems, paid for by standard regional rate increases across their service area.

Hampton Roads Sanitation District's approach will lead to a fully coordinated investment of billions of dollars and spread responsibility costs evenly across customers in the region. The resulting MOA avoided the fractured, uncoordinated approach communities would have taken to address a major pollution problem. Each utility would have passed cost burdens on to local customers, likely with variations in costs for the protection of a shared regional resource. Implementing projects with low cost efficiencies was also more likely if utilities remained separate. The transfer of the RWWMP responsibilities to HRSD allowed the regional entity to embrace larger, potentially more innovative, efficient, and cost-effective projects.

HRSD is quantifying financial benefits from regionalization. Over time this will provide more insight on this kind of alternative strategy for regulators and communities facing similar large-scale challenges.

Conclusion

The HRSD case demonstrates positive financial impacts of increased collaboration while highlighting the practical obstacles that make it difficult to fully take advantage of the benefits of consolidation. The example shows how financial impacts can be uneven and, in some cases, individual communities and ratepayers may even be worse-off financially with full consolidation even if the region as a whole is better off. In the end, decision makers chose an option that eased the burden of financing the wet weather program while maintaining aspects of local control rather than an option that would have provided more financial benefits to the region as a whole.

Iowa Regional Utilities Association

Rural water systems consolidate to provide reliable, higher quality water supply

Date of established agreement	• 1977: Jasper County Water Association established and recruited member-customers from multiple communities, predominantly within Jasper County boundaries • 1988: Name changed to Central Iowa Water Association as service continued to expand outside of Jasper County boundaries • 2000: Name changed to Iowa Regional Utilities Association (IRUA), addition of rural wastewater services
Services involved	Management, and provision of drinking water and wastewater services
Governance model	Private, nonprofit, member-owned association governed by a nine-member Board of Directors with representatives from different geographical regions throughout the system
Communities involved	• Originally involved Jasper County, and small portions of Marion, Polk, and Marshall Counties • Currently involves 18 counties in central and northeast Iowa
Population served	• Water supply distribution to 18 counties, within which 77 small communities are served • Wastewater services to 23 small communities or neighborhoods • Serving approximately 55,000 people through 14,635 retail customer accounts plus 25 wholesale community agreements
System capacity/demands	• 4,625 miles of pipeline • 27 water towers with a total storage capacity of 12,300,000 gallons • Average treated drinking water demand is 130 million gallons per month
External policy drivers and incentives	• Originally, southern and western Iowa communities and rural areas were suffering from lack of adequate water supply, with wells drying up during dry weather • The Farmers Home Administration (predecessor to USDA Rural Development) heavily promoted regional water systems with the state; IRUA is one of 19 planned regional water systems in Iowa
Financial and economic impacts	• Shared administrative, operational, and debt service costs over a larger revenue base • Expanded water sources and supply capacity • Enhanced economic development in rural communities
Revenue flows	Customers from multiple communities (including wholesale, residential, business) pay fees to the central utility

Summary

The Iowa Regional Utilities Association (IRUA) epitomizes how a regional, consolidated utility can partner with numerous rural communities using different levels of consolidated services to provide better water quality and a more reliable water supply and wastewater service for a large region. What started as a modest effort involving a few communities became a sizeable regional utility spread across 18 counties with more than 15,000 water and wastewater customers and almost 5,000 miles of pipeline. IRUA draws water from three municipal sources and owns a three million gallon per day wastewater treatment plant. Expanding the regional system continues to spread costs and debt across a larger base of customers and stabilizes water quality and supply for many rural communities. The variety of water sources provides more reliability for customers, and the larger revenue base generated funding for more skilled staff. The consistency of water quality and supply had the secondary benefit of enhancing the economic development in the rural communities IRUA serves.

Context

In the 1970s, Iowa began its regional water supply efforts with the creation of the Rathbun Regional Water Association. Rathbun continues to be the largest regional water system in Iowa. Representatives of the Farmers Home Administration, the predecessor to the current USDA Rural Utilities Service, supported a local effort to make use of the Rathbun reservoir as a regional water source. Seeing how the Rathbun system increased financing efficiencies and attracted funding agencies inspired the creation of other regional systems across the state.

In 1977, residents of Jasper County formed a steering committee which led to the creation of the Jasper County Water Association. The initial regional system covered the Town of Newton, within the boundaries of Jasper County, and slightly extended into three other surrounding counties. The system started with 950 miles of pipeline and served 2,000 customers. Although the Jasper County Water Association saw regional benefits and efficiencies arising from the original collaboration, the Board of Directors of the Association, as well as the funding agency (Farmers Home Administration), supported the goal of continuous growth and expansion to regionalize with other rural water systems.

With this expanded service area, the Jasper County Water Association became the Central Iowa Water Association in the late 1980s. Regional efforts continued to grow and began including rural wastewater systems in 2000. The entity added wastewater services and changed its name to the Iowa Regional Utilities Association. Today, the IRUA has almost 5,000 miles of pipeline and provides services to more than 55,000 people across 18 counties.

Case Overview and Financial Outcomes

The success of the continuous expansion of IRUA is based largely on its ability to consolidate with rural water and wastewater systems using different consolidation models. While many of the communities they serve have been fully consolidated through complete acquisition of assets and customers, IRUA has taken steps to respect the unique identities of the communities they serve. For instance, IRUA's system relies on over 25 water towers located in or near many towns in their service area. In many cases, IRUA opted to retain name of the community they serve on the water tower rather than promoting their own name. In other cases, IRUA re-painted water towers, but added an important community symbol or name such as the local high school name or mascot. These water towers promote partnerships among the regional entities that maintain a sense of community presence and ownership through the proud display of a town name.

The IRUA model has been successful in Iowa because, like other regional systems in the state, it meets the needs of a large region with a diverse base of rural water users. IRUA provides customers with a reliable water supply as well as wastewater services to a variety of customers including farms, rural residents and communities, small municipalities, and businesses. IRUA acts as both a customer—through its purchase agreements with three municipalities for its water supply—and as a service provider, by serving 14,635 customers.

In its early development phases, Jasper County Water Association considered building its own water treatment plant. One study showed that buying water from the City of Newton would result in benefits for both Newton and Jasper County. Instead of a treatment facility, the utility focused its investments on distribution lines and water tanks.

The total construction cost of IRUA assets, including the main office, pump stations, towers, water lines, etc., was approximately $202,451,774. To finance the construction, IRUA received numerous USDA-RD/CoBank loans and $24,902,462 in grants from USDA and the Community Development Block Grant (CDBG) program.

IRUA brought positive financial impacts to the region, particularly the relatively stable rates over the entirety of IRUA's existence. Beginning in 1977 and extending for the next 36 years, the average annual rate increase for IRUA was a mere 1.33 percent, significantly lower than the Consumer Price Index (3.85 percent).

Communities that opted to remain independent from IRUA did so often with significant cost to their customers. For example, the community of State Center chose to proceed with the construction of their own small treatment facility rather than purchase wholesale water from IRUA or become an IRUA retail customers. A State Center water customer that uses 4,000 gallons a month will be charged $73 per month compared to the IRUA retail rate of $55.[26]

In addition to rates, understanding the full economic benefits of consolidation requires considering the value of improved water quality that higher capacity systems, large and small, can produce. For example, IRUA now provides wholesale water to the City of Janesville. Prior to deciding to purchase water from IRUA, Janesville relied on water from their own wells that was much harder than IRUA's treated water (286 mg/L compared to 125 mg/L). The costs of harder water can be significant, such as reduced appliance energy efficiency or the need for home water softening. Taking these into consideration, remaining independent could have cost Janesville customers an additional estimated $3 to $4, about 15 to 20 percent more, for every thousand gallons of water they purchased.[27]

Although the rates have risen slowly over the past 40 years, rural systems overall have far fewer customers per mile of pipe than large, urban systems. This creates a much higher debt load per customer, resulting in higher rates. Still, IRUA has rates comparable to the larger municipalities located in the region and has some of the lowest rates of all the regional systems in the state.

Conclusion

The IRUA model highlights the benefit of pooling community resources together in a comprehensive, regional water supply and service plan. This model replaced a highly fragmented patchwork of water systems with a large centralized operation and capital management system. The consolidation provided rural customers with improved expertise and assets that are typically found in larger, more urban settings.

Financial Case Study

Logan Todd Regional Water Commission

Twelve systems create treatment facility to provide a reliable regional water supply and drive economic development

Date of established agreement	• 1995: Formed by the Logan County fiscal court • 2003: Began serving treated water to its constituent distribution systems
Services involved	Wholesale drinking water supplier
Governance model	Twelve water systems joined together to create a Joint Powers Agency, a new nonprofit entity. The twelve utilities continue to exist as independent entities, and the agency has a 12-member board made up of one representative from each.
Communities involved	12 autonomous water systems: • Four water systems in Todd County: Elkton, Guthrie, Trenton, Todd County Water District • Seven water systems in Logan County: Lewisburg, Russellville, Auburn, Adairville, South Logan Water Association, North Logan Water District, East Logan Water District • One water system in Christian County: City of Oak Grove (joined in 1999)
Population served	52,000 people with the potential to expand to serve over 100,000 people
System capacity/demands	The central treatment facility provides drinking water supply to the 12 individual small systems, which each serve between 390–3300 customers each. Seven of the 12 systems serve less than 1,000 customers. After it was created, the Logan Todd Regional Water Commission (LTRWC) installed an 85-mile transmission line to distribute its water to the 12 small systems.
External policy drivers and incentives	• Local Chamber of Commerce advocated for the arrangement due to water's impact on regional economic development • Infrastructure funders showed preferences for regional solutions
Financial and economic impacts	• Partnership helped attract very favorable financing terms • Created economic benefits for the region that otherwise would not have been possible, including $800 million of economic activity resulting from two new aluminum manufacturing facilities • Increased efficiency and reduced duplication related to water supply investment needs • Equalized wholesale treated water rates for all 12 customers regardless of the size or location
Revenue flows	Individual utility bill customers, revenues pay for wholesale water provision

Summary

The development of the Logan Todd Regional Water Commission's (LTRWC) demonstrates the positive financial impact of regionalization in creating a more cost effective, reliable drinking water supply and bolstering the local and regional economy. Prior to the creation of the LTRWC, the 12-member utilities of the agency faced significant water quality concerns and water shortages. In 1988, water shortages tangible negatively impacted economic growth in the region. The City of Russellville lost a bid for a new poultry processing plant that would have brought local jobs and boosted the local economy due to insufficient potable water supply. The formation of a regional water system secured water supplies and was able to attract very favorable capital financing. In creating the LTRWC, a Joint Powers Agency, twelve systems retained their individual distribution systems while purchasing water wholesale from a central treatment facility. The central treatment facility obtains water from a reliable water source. Since then, the region has supported existing and attracted new businesses and industries through a reliable water supply.

Context

The region's water shortage crisis began with a drought in 1998. Many of the region's water systems were suffering from water quantity and quality issues, however, water shortages in the City of Russellville in Logan County were especially prominent. The city needed a reliable water source, especially because they were responsible for selling water to three other utilities. Because Russellville was unable to provide ample potable water, a poultry plant was unwilling to locate to the region. In 1990, the Logan County Chamber of Commerce recognized the harmful impact water shortages were having on the economy and formed the Logan County Water Advisory Group to study water supply needs in the region.

In 1995, the Logan County fiscal court established the LTRWC. Many of the utilities involved relied on undependable springs or water sources contaminated by nematodes or *Cryptosporidium*. Treatment facilities were aging, and the reservoir used by one of the larger systems had a severe leak. In 1996, an engineering study determined the region needed a new raw water source. Although the study included recommendations for intermediate solutions, the LTRWC was denied funding for those options from several sources which forced them to build a completely new treatment plant. The LTRWC identified the Cumberland River in Clarksville, Tennessee as its best available source of water and worked to obtain permits across the state line to proceed.

Kentucky statutes are amenable to interlocal cooperation and regional solutions, helping to move the project forward. Over the last two decades, Kentucky implemented a variety of policies and incentives to promote regionalization, which further motivated the LTRWC coalition to work together.[28] The 12 communities involved in the regional effort included municipally-owned systems with their own treatment plants, water districts that purchased finished water, and a privately-owned system that also purchased finished water. Differences in available financial resources or the individual challenges communities faced left some disinclined to give up local control or to cooperate with neighboring communities. Several felt they would not benefit from a regionalization effort as much as others. Systems with more financial strength saw regionalization as a way to improve future planning.

Case Overview and Financial Outcomes

Eventually, all the communities got on board and secured funding to develop the new raw water source and treatment plant. By the end of 1998, 11 of the member communities agreed to purchase water contracts from the LTRWC. In 1999, Oak Grove became the twelfth member of the regional entity.

Construction for the project cost over $70 million, and funding sources included:

- $49.8 million from USDA loan (one of the largest in USDA history)
- $10.4 million from Kentucky Drinking Water State Revolving Fund loan (the first ever in the state)
- $5 million from Kentucky Infrastructure Authority 20/20 Grant
- $1 million from Community Development Block Grant
- $5,000 from Area Development Grant Fund
- $3.5 million from state funds and $3.3 million from appropriation/earmarks
- $19,000 from system contributions
- $4 million from other funding sources

With this funding, the George W. Arnold Water Treatment Plant was built in Guthrie, Kentucky, attracting new businesses and economic development to the area. Two aluminum manufacturing facilities, one currently operating and one slated to open in 2020, will bring $800 million to the region's economy. These industries alone have contributed greater benefits to the region than the cost to build the plant. Aluminum manufacturing facilities require a reliable water source and could not have located in the area without the new source and treatment plant. Other businesses and services have also come to the area, including restaurants, retail, and medical facilities.

With respect to further regionalization, the LTRWC has signed a contract with the city of Springfield, Tennessee to join the JPA and purchase wholesale water for 40 years. On top of those purchases, the JPA secured funding from USDA Rural Development, Kentucky Infrastructure Authority, as well as a bond issuance to extend service lines to Springfield. According to staff from LTRWC, the bids were awarded for the Springfield project, coming in $3.5 million under budget. Construction began in August of 2018 and includes twenty miles of Ductile Iron, a two-million-gallon tank, a generator, and pumps at a cost of approximately $22 million.

Conclusion

This example shows how economic benefits of water regionalization have as much to do with general regional economic benefits as specific water system financial savings. The Logan Todd Regional Water Commission attracted new businesses and industry to the area which could not have existed without the regional water system providing a reliable supply. The direct and indirect economic benefits to the region far outweighed the costs of building the water treatment plant and developing a new water source. The communities involved invested in the regional water system, but their ability to earn grants and favorably-termed loans meant they did not have to spend anything near the true cost of the regional system. The LTRWC provides a strong example of how multiple small water systems can form a partnership to share costs, improve water quality, and ensure the long-term supply of drinking water for a region while improving the economic prospects of their individual citizens and communities.

New Jersey American Water

Borough-owned water systems consolidate with statewide investor-owned utility to tackle needed, costly capital improvements

Date of established agreement	• 1886: American Water (formerly known as American Waterworks and Guarantee) was founded. It is now the largest publicly-traded US water and wastewater utility company • 2015: New Jersey Board of Public Utilities approved the acquisition of the Haddonfield water and wastewater system by New Jersey American Water
Services involved	Ownership, management, and provision of drinking water and wastewater services
Governance model	• Investor-owned water and wastewater utility company • American Water itself includes regulated utilities in approximately 1600 communities in 16 US states • Each utility is managed at a regional or state level and regulated by the State within which it is located • New Jersey American Water is regulated by the New Jersey Board of Public Utilities
Communities involved	• Haddonfield, New Jersey • New Jersey American Water
Population served	• New Jersey American Water: 2.7 million residents in 191 communities • Haddonfield Borough: 4,500 water and wastewater customer accounts
System capacity/demands	• New Jersey American Water: Water and wastewater services to 191 communities in 18 counties • Seven surface water treatment plants and 247 wells with a combined total capacity of 460 MGD • 8,500 miles of water main pipes and 400 miles of sewer main pipes • Haddonfield Borough system: 51 miles of water main pipes, and 55 miles of sewer main pipes
External policy drivers and incentives	New Jersey legal framework and policies (e.g. allowing single tariff pricing) for regulating multi-system utilities is favorable to consolidation by allowing the assets and rate base of acquired systems to eventually be fully integrated with other systems throughout a utility
Financial and economic impacts	• Stable and predictable rates because of New Jersey American Water's ability to spread costs over a broad customer base, 650,000 accounts as opposed to Haddonfield's 4,500 • Access to a significant capital improvement budget • Safeguard against unreasonable rate increases due to regulation by the state utility commission
Revenue flows	Customer fees from small community now added to the broad base of existing fees paid to the central utility

Summary

The Borough of Haddonfield water and wastewater systems consolidated with New Jersey American Water. This case provides a snapshot of the types of economic and financial impacts communities can gain when a low capacity system consolidates with a large private water and wastewater utility company.

In the case of Haddonfield, the borough postponed and flattened the rate increases needed to fund millions of dollars of upgrades and repairs to its aging water and wastewater systems. New Jersey American Water's much broader revenue base covered the costs of those upgrades and smoothed out (and potentially minimized) rate increases. This spread out the anticipated local upgrade and repair costs for Haddonfield over the 650,000 accounts of New Jersey American Water instead of the 4,500 accounts of the borough. Immediately after buying Haddonfield's utilities, New Jersey American Water invested in updating the system. Originally, the company planned to invest approximately $16 million over the first five years to modernize the Haddonfield system; ultimately, they surpassed this commitment and invested over $18 million.

An analysis conducted by the borough showed a lower projected rate increase for the Haddonfield customers after consolidation than would occur if the borough continued to operate on its own. Haddonfield now benefits from the economies of scale that accompany being part of such a large utility, has access to a larger capital improvement budget, and is has more expertise on staff for regulatory. Haddonfield further recovered a portion of the historic investment it made in its system through a cash payment from American Water. The payment was large enough to retire existing water and wastewater debt and leave approximately $12.5 million available for other essential governmental services.

Context

American Water was founded in 1886 and is now the largest investor-owned water and wastewater utility in the United States. American Water has 15 state-regulated subsidiaries which provide water and wastewater services to 15 million people in 46 states and Canada. One of the company's subsidiaries is New Jersey American Water, which provides services to 2.7 million people throughout the state.

The Borough of Haddonfield, New Jersey owned and operated its water and wastewater utility for almost 130 years. During that time, the borough funded all the system costs through a quarterly water and wastewater bill to its residents. The borough did not use property tax revenues for any water or wastewater costs. In fact, according to Commissioner John Moscatelli, the borough took excess revenue from the water and wastewater utility and used it to offset property taxes for a long period of time.[29] That meant when the borough decided to invest in infrastructure starting in 2003, the current rates could not keep up with the significant investments needed. Between 2003 and 2008, the borough spent almost $16 million in repairs, and in 2013, a community advisory committee determined rates would need to be raised by 25 percent to cover the debt service. The Commissioners approved and implemented the rate increase in 2014. Around the same time, an engineering study estimated an additional $50 million of improvements would be needed over the following 30 years.

Given an already steep rate increase to cover the previous capital debt and anticipated rate increases to meet future obligations, the borough proposed several options. Most options involved some level of consolidation. The borough considered partnering with another utility for purchasing power and shared staffing, outsourcing utility management, or leasing the utility. In the end, the borough decided the best option would be to sell the water and wastewater systems and advertised a bid for the sale.

New Jersey American Water came in with the highest bid. The borough projected full consolidation provided the best financial scenario. In November 2014, the Commissioners of Haddonfield put the sale of the borough utilities to the company on the ballot through a referendum. Voters approved the sale by an almost two to one vote. The New Jersey Board of Public Utilities (BPU) approved the sale and finalized the purchase the following May 2015. New Jersey American Water commenced ownership, management, and operation of the utilities immediately.

Case Overview and Financial Outcomes

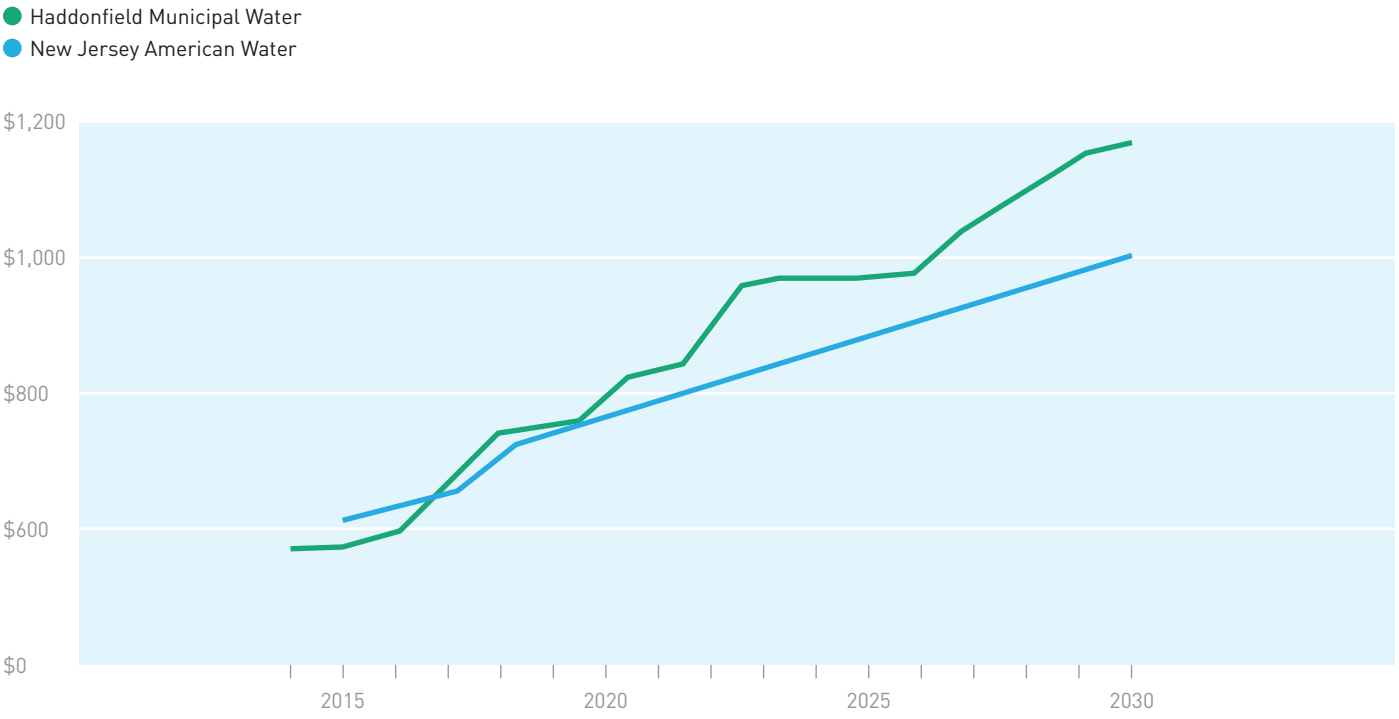
The contract required New Jersey American Water to invest $6.5 million in the Haddonfield systems for repairs and upgrades in the first year after the purchase. The company surpassed this level of investment in the first three years. New Jersey American Water invested an additional $9.5 million spread out over the following four years. Within the first five years following consolidation, investment in the borough's systems totaled $16 million.

Borough residents finance the cost of these investments over time as customers of New Jersey American Water. The terms of the agreement postpone impacts on water rates for at least three years. After this period, Haddonfield customers will pay the same rates as other American Water's users. The borough's drinking water rates at the time of consolidation were relatively close to the rates in New Jersey American Water's larger service area—approximately $550 per quarter for the borough's average user compared to $650 for the company's average user. Despite these slightly higher rates, though the overall savings and benefits from consolidation will keep rates lower than if Haddonfield had to upgrade and repair systems on its own. While Haddonfield customers' water rates would be subject to a rate freeze, the proposal did not specifically provide for a wastewater rate freeze. Haddonfield's wastewater rates, including fees for treatment, were about $575 compared to New Jersey American Water's average of $700. Residents saw a noticeable increase in their wastewater rates of 12.5 percent in the first year, and then 3.5 percent afterwards.

Figure 7

Projected Annual Water Bills[30]

(Based on an average household use of 58,000 gallons/year)



Original chart created by and based on analysis by the Borough of Haddonfield.

Prior to the sale, the borough completed a rate projection for 35 years to compare how rates would be affected if the entity consolidated with New Jersey American Water versus if the borough remained independent. Those projections estimated that New Jersey American Water plans for rates to either be lower or at least comparable to the borough's rates for the next 30 years. Furthermore, the borough's rates will remain considerably lower than rates in other areas of New Jersey.

New Jersey American Water proposed to incorporate the costs associated with acquiring and upgrading Haddonfield's water and wastewater facilities into its larger utility asset portfolio, or rate base, in its currently pending general rate case. If approved, the cost of providing service to Haddonfield will be intermingled and shared with costs of providing service to the New Jersey American Water statewide customer base.

New Jersey is one of many states which allow investor owned utilities to implement single tariff pricing where noncontiguous water and wastewater systems in different parts of the state share a single rate structure. In effect this pools resources ultimately spreads costs over a large customer base. In some cases, customers from acquired systems join the large rate pool immediately. In other cases, like Haddonfield, rate integration is phased in. This phasing works to Haddonfield's advantage because their current rates are lower than New Jersey American Water rates. However, the consolidation also impacted the economic regulation of rate setting for the borough. As part of New Jersey American Water, Haddonfield customer rates are now under the jurisdiction of the New Jersey Board of Public Utilities (BPU), and the BPU has to vet and approve all future rate increases. If the borough had transferred their water systems to another governmental water utility, rates may not have been subject to the same level of oversight.

Haddonfield also benefited financially from the consolidation through the sale of the utility. New Jersey American Water bid $28.5 million, the highest of the three bids the borough received. The borough paid off the nearly $16 million in existing debt for the water and wastewater systems that it had accrued between 2003 and 2008. It also put the remaining $12.5 million dollars toward the borough's general obligation debt. According to the Commissioners, the proceeds from the sale eliminated most of the borough's debt and freed up roughly $1.3 million dollars in taxes per year. Some of that tax money has already been invested in road improvements in the community.[31]

Aside from debt service and related savings, the consolidation led to additional financial impacts that had both positive and negative cash flow implications. First, the borough was allowed to keep rent received from its cellular antennae contracts for ten years at a total value of about $600,000. Second, although not contractually required, New Jersey American Water made offers of employment to every Haddonfield employee affected by the sale of the utilities. Entities like New Jersey American Water do not have to pay certain union wage contracts, which can make projects more expensive for local governments.

Before consolidation, the city paid some other government employees using utility revenues and had to find other funding sources for these positions after the consolidation. The borough estimated this cost at $340,000 per year. Additionally, the borough would have to pay New Jersey American Water a total sum of $169,000 per year for its 315 fire hydrants and needed to contract out for snow plowing, which could cost up to $57,000 per year. Prior to consolidation, Haddonfield staffed utility workers to plow snow.

Finally, New Jersey American Water agreed to continue the borough's senior discount program for 10 years for senior customers who were already enrolled in the program. Haddonfield customers are now eligible to participate in the company's low-income customer assistance program, Help to Others, which assists customers with grants as well as service charge discounts for those who qualify.

Conclusion

Transitioning from a small independent system to a larger consolidated system or transitioning from a government-owned system to a privatized system can be challenging and have significant financial impacts. The Borough of Haddonfield did both simultaneously. The resulting transition is likely to lead to financial tradeoffs. As outlined above, Haddonfield gets clear economy of scale benefits from joining New Jersey American Water that carry real and significant financial benefits. However, this consolidation did have financial downsides. The non-risk adjusted cost of capital for New Jersey American Water's capital investments is higher than what a government owned utility typically incurs, and private utilities typically have less access to short and long-term tax-exempt debt which are available to communities like Haddonfield. In the case of Haddonfield, the borough's leaders and ultimately their citizens accepted the financial impacts, deciding that the positive impacts from consolidation outweighed the negative ones. Haddonfield found itself in a situation similar to what many communities are facing—they needed to quickly and efficiently invest in their water and wastewater systems to protect the public and environmental health of the community. The long-term impacts of the transition will take years to determine. Ultimately, the transition may be evaluated not on the ability of the new system to catch up, but rather on its ability to not fall behind again in the future.

About the US Water Alliance

The US Water Alliance advances policies and programs to secure a sustainable water future for all. Our membership includes water providers, public officials, business leaders, environmental organizations, community leaders, policy organizations, and more. A nationally recognized nonprofit organization, the US Water Alliance brings together diverse interests to identify and advance common ground, achievable solutions to our nation's most pressing water challenges. We:

Educate the nation about the true value of water and the need for investment in water systems. Our innovative education and advocacy campaigns, best-in-class communications and media activities, high-impact events, and publications are educating and inspiring the nation about how water is essential and in need of investment.

Accelerate the adoption of One Water policies and programs that manage water resources to advance a better quality of life for all. As an honest broker, we convene diverse interests to identify and advance practical, achievable solutions to our nation's most pressing water challenges. We do this through national dialogues, knowledge building and peer exchange, the development of forward-looking and inclusive water policies and programs, and coalition building.

Celebrate what works and spread innovation in water management. We shine a light on those who engage in groundbreaking work through storytelling, cataloguing and disseminating best practices, and spearheading special recognition programs that focus attention on how water leaders are building stronger communities and a stronger America.

About the UNC Environmental Finance Center

The Environmental Finance Center is dedicated to enhancing the ability of governments and other organizations to provide environmental programs and services in fair, effective, and financially sustainable ways. We reach local communities through the delivery of applied research, interactive training programs, and technical assistance. We see one of our major roles as increasing the capacity of other organizations to address the financial aspects of environmental protection and service delivery. In addition to direct community outreach, we work with decision makers to assess the effectiveness of environmental finance policies at a regional or state level, and to improve those policies as a way of supporting local efforts.

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Flock Safety Technologies in Law Enforcement: An Initial Evaluation of Effectiveness in Aiding Police in Real-World Crime Clearance

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Abstract. A growing number of law enforcement organizations are using and integrating Flock Safety technologies, specifically automated license plate readers (ALPRs), to enhance their crime control functions. While these technologies have significantly improved through development, their effectiveness in real-world usage requires evaluation. This study analyzes data collected by a representative sample of small, medium, and large agencies that use Flock technologies to measure the impact of Flock ALPR using regression analysis that measures product variables with public Uniform Crime Report data. Initial findings suggest a positive impact of Flock technologies on clearance rates. This warrants further examination of the impact of Flock technologies on specific crime types and statistical comparisons before and after these technologies were implemented.

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Introduction

This paper attempts to quantify and fill an existent knowledge gap surrounding the efficacy of automated license plate reader (ALPR) cameras for law enforcement. In recent years, the conversation surrounding ALPR has shifted from "Do they help solve crime?" to "How do they solve crime, and how much?" This trend largely parallels ALPRs' product maturation and greater real-world usage by law enforcement agencies. Whereas older studies noted prohibitive cost (Dobbs 2014), recurrent technical issues (Lum et al 2010 65), and small deployment sizes (Koper et al 2012 41) as blockers to effective ALPR performance, studies conducted after ALPR cameras rapidly became more performant, more cost-effective, and more seamlessly embedded in law enforcement workflows have demonstrated statistically significant law enforcement outcomes. More recent studies have found that the use of ALPR can be attributed to increases in follow-up arrests (Ozer 2016 124), to identifying more stolen vehicles and making more arrests as a result (Potts 2018 15), to improvements in case closure rates for both auto theft and robbery in areas of high-density ALPR deployment (Koper and Lum 2019 320), and towards generally improved traffic safety (Zmud et al 2021 33).

Nonetheless, existent research on ALPR effectiveness typically does not attribute crime clearances to ALPRs directly, with case studies relying upon retrospective attribution based on case clearances over time or comparing ALPR-equipped groups with non-ALPR-equipped groups. Further, existing research relies either upon handfuls of anecdotal interviews with ALPR-equipped law enforcement agencies or deep dives into the ALPR use data of a single city, agency, or even a subset of officers within an agency at a time.

Methods of Inquiry

In this paper, we consider the most expansive and tightly attributed survey of ALPR crime clearance data to date in order to deepen our understanding of what leads a law enforcement agency to solve more or less crime with ALPRs. This dataset was sourced from a survey of Flock Safety ALPR customers conducted from April to June of 2023. Though this data must be presented in an aggregated form as a condition of its collection,[1] we explain the collection process and data validation in detail.

From there, we combine agency-attributed ALPR crime clearances with historical FBI-reported crime data to calculate the portion of crime solved within each of the law enforcement jurisdictions with data of sufficient quality for inclusion. We then use those clearance rates as the dependent variable in a statistical model that finds a line of best fit for how much crime a theoretical "typical" agency would solve with Flock Safety ALPR cameras given their use of Flock Safety's cameras and software products, the agency's resources independent of their ALPR cameras, and relevant socioeconomic factors for the agency's jurisdiction based on the real data for the reporting agencies. The factors extrinsic to the ALPR data were selected following the FBI's best practices for comparing law enforcement agency outcomes. We explored several appropriate modeling techniques, searching for the framework that produced the highest combined correlation coefficient to our dataset.

In our analysis, we isolate the relative impact of ALPR-centric, agency-centric, and jurisdiction-centric factors upon ALPR-assisted crime clearances. Acknowledging the broad, general conclusions of this preliminary, exploratory study, we conclude by noting the additional

[1] Law enforcement agencies were understandably concerned about potential subsequent disseminations of line-by-line, case-by-case information from their jurisdictions. Because this study was always intended to be a broad survey of Flock-assisted closures that would not require delving more deeply into crime types or seasonality, we made the concession only to present aggregated data early on to maximize our response rate.

avenues for more targeted research via statistical tests coupled with in-depth qualitative data that this general model suggests.

Data Collection and Validation

Part one: Raw numbers of crimes solved

Respecting how complicated it is to attribute crime clearances to a single technology amidst so many potential factors, the request was simple: "How many arrests have you made that can directly be attributed to the use of a Flock Safety camera?" Respondents were asked for the corresponding case records, which we then audited individually to ensure that attributions were clear and that they were only for offenses reported to the FBI, filtering out reports of clearances for minor traffic offenses, stolen vehicles recovered without an arrest, and instances where it was otherwise unclear what the referent of a report was.

As a whole, the survey responses faced the same challenges noted by Zmud et al in 2021 talking with individual agencies: consistently capturing this kind of data is very difficult, and practices are in no way standardized across different ALPR-equipped agencies. Some records came from records management systems (RMS); some from Flock Safety's reporting tool that allows agencies to track ALPR outcomes; some were tracked manually in Microsoft Excel or Google Sheets. While some agencies using an RMS had clear, easily identifiable designations for ALPR-assisted clearances, it was often the case that ALPR assistance was identified only in unstructured text in the "Notes" section of an RMS, necessitating careful searches by analysts to identify exhaustively the ALPR-assisted clearances. The opposite problem was the case with records kept by hand in a spreadsheet tool–though it was clear in this case that Flock assisted

with the crime in question, it often required very careful auditing to ensure that the clearance was for a crime reported to the FBI and not for a minor traffic offense.

We controlled for the imperfect data records by requesting records from a very high number of law enforcement agencies. Of the customers surveyed, we received 477 replies; of those replies, 246 replies provided data; of those 246 data points, 195 provided sufficient granularity surrounding clearance data to warrant further investigation.

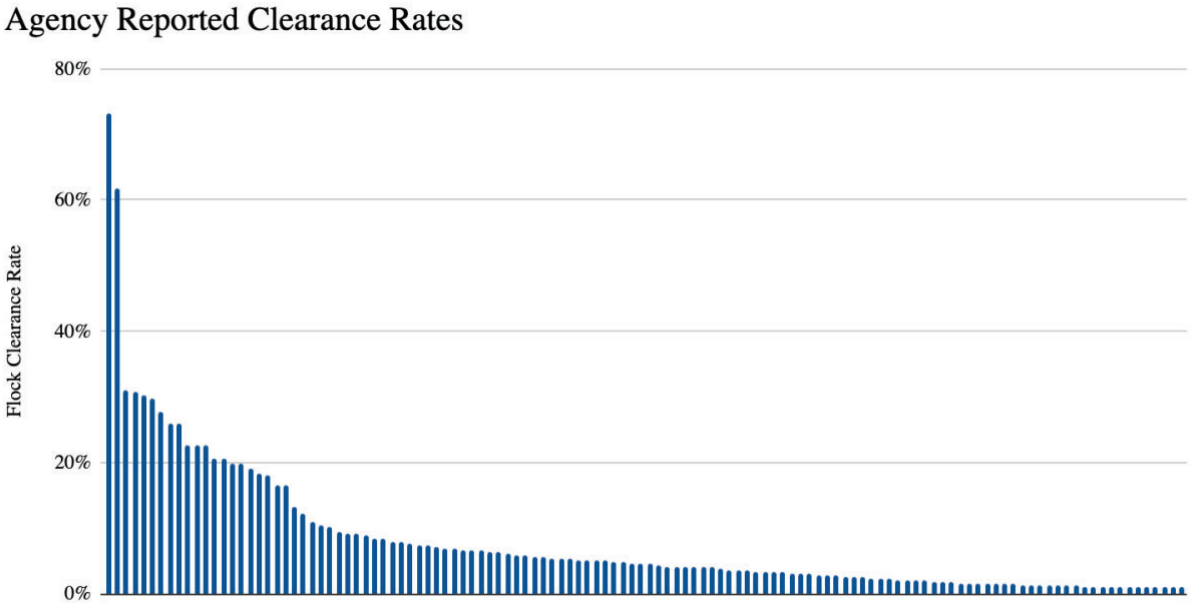
Part two: Overall percentage of crimes cleared

The reporting agencies varied widely in the overall crime rate within their jurisdictions. With this in mind, we sought next to standardize the raw number of reported crimes solved with Flock Safety ALPRs. Determining how much of the overall crime in an agency's jurisdiction those clearances represented, we then approximated a "Flock-assisted clearance rate".

To ensure a consistent reporting framework for overall crime, we opted to use the overall crime data reported by survey respondents to the FBI's Uniform Crime Reporting (UCR) program. To use the latest data while accounting for the unusual 2020-2021 period in crime statistics, we used the average number of crimes for each year the agency reported to the FBI since 2016 as our denominator. Not every agency uses the FBI UCR system, and non-reporting agencies were thus excluded from subsequent analysis.

Implausible outliers on both the low and high ends emerged from dividing this numerator–the number of Flock-attributed arrests in the survey–and this denominator–the average crimes reported to the FBI from 2016-2021. On the low end, it emerged via follow-up conversations with respondents that exceptionally large jurisdictions often simply were not equipped to report comprehensively on Flock-assisted clearances. On the high end, additional scrutiny of the FBI-reported crime statistics revealed wide fluctuations in the reporting years that

led to artificially low averages. Both classes of outliers were excluded from subsequent analysis. Below is a distribution of Flock ALPR-assisted clearance rates.



Data Analysis

Part one: Flock-internal and Flock-external factors considered

Two additional data sets were used beyond the survey responses and the UCR data: the reporting agency's internal data with Flock Safety, and the most recent census data for their jurisdiction.

The former consisted of the following metrics throughout the reporting period: how many cameras the agency owned; the median ALPR cloud data upload speeds; how often cameras experienced high, medium, and low impact service issues; how often officers at the reporting agency used Flock Safety's software tools; how many additional ALPR cameras the agency had access to via inter-agency sharing and community-owned cameras; and how many other Flock

Safety customers were within 50 kilometers of the agency's jurisdiction. This data was sourced from Flock Safety's cloud data warehouse for the time period corresponding to the survey respondent's reporting period.

Census data was acquired via the application programming interface on the census website using Flock Safety's internal mappings of law enforcement agency jurisdictions to census subdivisions. Factors to consider were drawn from the FBI's cautionary best practices on ranking law enforcement agency effectiveness (https://ucr.fbi.gov/ucr-statistics-their-proper-use) and included the following categories and specific metrics: population density; economic prosperity (percentage of persons in poverty, median household income); urbanization (commuter statistics, population delta between 2010 and 2020, number of traffic intersections, and, again, population density); youth concentration and family makeup (persons per household, median age). Population statistics were also collated with the reported number of sworn officers for each jurisdiction's originating agency identifier to determine relative law enforcement resources for each responding organization.

The table below describes the individual metrics in greater detail.

Independent Variable	Definition
Device Penetration	
Number of Flock Devices	Number of Flock devices owned by customer
Active Device Days	The sum of the number of days each customer-owned device was active
Devices per Sworn Officer	The number of devices normalized by the number of sworn officers recorded by the FBI based on the agency ORI number
Devices per Population Serviced	Number of devices normalized by the size of the population served. Collated with US Census data based on the county subdivision associated with the agency ORI
Product Performance	
Median ALPR cloud data upload speed	Median time in seconds between an image being captured by a Flock Safety ALPR camera and an alert being sent to end users
90th Percentile ALPR cloud upload speed	90th percentile time in seconds between an image being captured by a Flock Safety ALPR camera and an alert being sent to end users
Percentage of days with service issues	Separated into days with only high-impact issues, days with high and medium-impact issues, and days with any (high, medium, or low) impact issues.
Product Adoption	
Agency Monthly Product Adoption	Percentage of registered users at the reporting agency who logged into any part of Flock Safety's software

Agency Monthly Hot List Adoption	Percentage of registered users at the reporting agency who logged into the Hot List (i.e. alerting) component of Flock Safety's software
Agency Monthly Search Adoption	Percentage of registered users at the reporting agency who logged into the Search (i.e. investigations) component of Flock Safety's software
Network Effects	
Percentage of cameras in state accessible	Total number of Flock Safety cameras customer has access to within the state via network sharing divided by the total number of Flock Safety cameras within the state.
Shared Devices per Sworn Officer	The number of Flock Safety cameras customer has access to normalized by the number of sworn officers recorded by the FBI based on the agency ORI number
Number of Nearby Flock Customers	Number of Flock Safety customers within a 50 km radius of that customer
External Factors	
Population Change Percentage	Percentage change in population served by the agency as measured by the change in population from the 2010 US Census to the 2020 US Census
Median Income	Median income of the population served by the agency as reported by the US Census
Poverty Rate	Percentage of families within the agency's jurisdiction below census-determined income thresholds as reported by the US Census
Persons per Sworn Officer	Size of the population served by the agency as reported by the US census normalized by the number of sworn officers reported by the FBI
Persons per Household	The average number of persons per household of the population served by the agency as reported by the US Census
Persons per Square Mile	Population density of the population served by the agency as reported by the US Census
Median Age	Median age of the population served by the agency as reported by the US Census

Because of the number of factors under consideration and the size of the dataset, there were instances where individual metrics were missing for some respondents. As one example, because of the novel mapping between respondents and census subdivisions, there were instances where it was impossible to acquire the 2010 population of shifting census subdivisions, and it was thus impossible to determine the population delta between 2010 and 2020 for a reporting agency's jurisdiction. As another, certain reporting periods occurred during periods of transition for Flock Safety's internal reporting of platform use and device sharing. In such instances where a data point was missing only an internal metric or an external metric, either the mean or median value for the metric was used as an imputed value as statistically appropriate. Instances where multiple internal or multiple external metrics were unavailable or both an internal metric and an external metric were unavailable were excluded from the analysis.

This left a final total of 123 values under consideration; the next section details how we subsequently pared down the factors described in this section to an appropriate number of independent variables for this sample size. The agencies included in the data represented a wide range of agency types and jurisdictions served. Below are some details on the demographics of the agencies included in the analysis.

Table 1

Distribution of Agency by Size

Sworn Officers	# of Agencies
1-25	15
26-50	24
51-75	14
76-100	15
101-250	36
251-500	9
501-1,000	6
>1,000	3

Table 2

Distribution of Agencies by Population Served

Population	# of Agencies
<25,000	33
25,001 – 50,000	17
50,001 – 100,000	18
100,001 – 250,000	25
250,001 – 500,000	15
500,001 – 750,000	4
750,000 – 1,000,000	2
>1,000,000	8

Table 3

Distribution of Agencies by Population Median Income

Median	# of Agencies
<$40,000	7
$40,001 - $50,000	17
$50,001 – $60,000	18
$60,001 – $70,000	28
$70,001 – $80,000	14
$80,001 – $90,000	10
$90,001 – $100,000	12
>$100,000	16

Part two: Regression Analysis

With a refined dataset of ALPR-centric factors and agency demographic factors, we sought to determine which set of factors were most associated with agency clearance rates. We pursued several methods of regression analysis to determine the best independent variables.

Single Regression Analysis

First, to determine the individual variables that had the greatest correlation with ALPR-assisted clearance rate, we began our analysis by running individual linear regressions with the

percentage of crime cleared with ALPR cameras as the dependent variable for each independent factor described above. This was performed as an intermediary step toward our desired holistic model by identifying the most significant individual variables before working to understand how those variables interrelate.

Broadly and unsurprisingly, the ALPR-centric factors had greater correlations with crime cleared via ALPR cameras than demographic or jurisdictional factors. Notable exceptions were population density and persons per sworn officer. These factors were correlated with ALPR-assisted clearance rate more strongly than external factors more intuitively relevant to ALPR cameras–particularly the number of traffic intersections within jurisdiction–as well as hardware device performance metrics surrounding cloud upload latency and percentage of days with service issues.

We speculate these external factors were especially predictive because of how fundamental and multifarious they are. Population density is a proxy for, among other things, urbanization, economic conditions, and modes of transportation within an area. Persons per sworn officer is a measure not only of the relative resources of the agencies themselves but also the cultural and economic factors that lead an agency to have greater or fewer resources. Regarding the lack of explanatory power for cloud upload latency and days with service issues, it is worth noting that the datasets surrounding these metrics had relatively low cardinality, perhaps creating outsized noise relative to the diversity of the reported clearance rates.

Multivariable Regression Analysis and Optimization

Pruning the low-correlation independent variables, we iterated through a multivariable regression of every permutation of remaining variables to identify the model that best explained the variance amongst clearance rates while keeping to two constraints: that only six factors be

chosen, and that the factors be as conceptually distinct as possible. The former was done out of necessity based on the size of our dataset. There were simply too many potential factors to model holistically without generating an over-fitted model for our multilinear regression, as best practices of only including a feature for roughly every twenty inputs for this type of model would restrict us to six features.

Towards the latter, we partitioned the remaining individual Flock-internal factors into four categories (with two of our six dependent variables devoted to population density and population per sworn officer): Flock Safety software adoption rate, the density of Flock Safety hardware products in jurisdiction, Flock Safety camera network sharing participation rate, and Flock Safety market maturity. Running through the permutations, the most significant variables for each category were the peak number of cameras owned during the reporting period per sworn officer, the adoption of the Flock Safety hotlist tool throughout the reporting period,[2] the number of Flock Safety cameras owned by other law enforcement agencies and private entities shared with the jurisdiction during the reporting period, and the number of Flock Safety customers within 50 kilometers of the reporting jurisdiction.[3]

[2] This portion of the Flock Safety platform automatically collates ALPR reads with official databases of plates associated with criminal activity, as well as an agency's custom lists of plates with known investigative relevance, to deliver real-time alerts for when suspect vehicles pass an ALPR camera.

That this was the single portion of the Flock Safety platform whose adoption correlated most strongly with increased ALPR-assisted clearance rates is continuous with Zmud et al 2021, 3, where "linking the ALPR system to the State's crime information computer" and "having close coordination with the external steward of the hot lists" are two of the four recommendations by ALPR-equipped law enforcement personnel for success with ALPR technology.

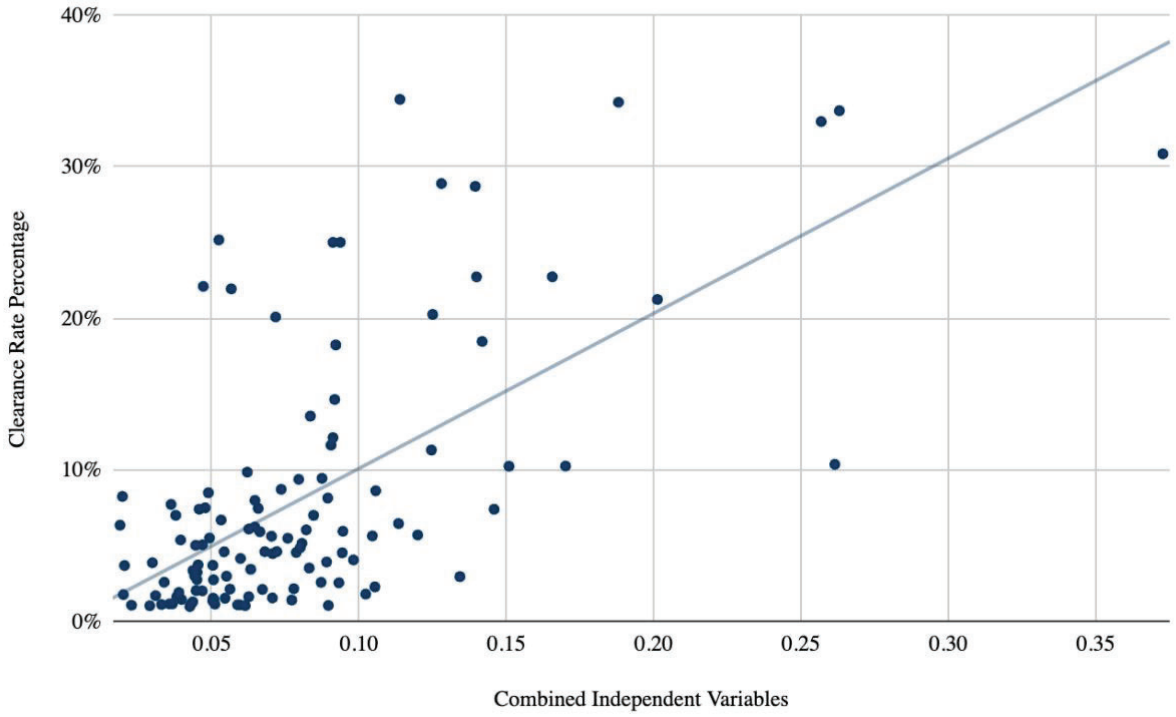
[3] One assumption of this model grounded in empirical reality rather than pure statistics should be noted. Because a theoretical jurisdiction not only with no ALPR camera use, no ALPR camera-related software use, and no other nearby ALPR customers, but also no law enforcement officers and no population for those zero officers to serve would not only solve no crime with ALPR cameras, but have no crime at all–because it would not exist–we enforced that our multilinear regression model pass through the origin, with a confluence of zero for all the independent variables reasonably translating to a zero ALPR-assisted crime clearance rate. We note as well the dismissal of one exceptional submission–an agency that still appeared to clear nearly 80% of the crime in its jurisdiction with ALPR assistance after all further scrutiny–from the final data set due to the model otherwise overfitting to it.

In addition to considering different independent variables, we also considered different regression techniques. In each permutation of variables, we analyzed the data using a Multivariate Ordinary Least Squares (OLS) regression, Least Angle Regression (LARS), Ridge Regression, and Random Forest Regressor. With our constraints in mind, we selected the independent variables and modeling technique that had the highest correlation coefficient to our dataset.

Results and Findings

We found that a multivariate OLS regression had the highest correlation to our data set with an R-squared of 0.69. The six independent variables were Flock Devices per Sworn Officer, Agency Monthly Hotlist Adoption, Shared Flock Devices per Sworn, Number of Nearby Flock Customers, Persons per Square Mile, and Persons per Sworn Officer. Summing all of the independent variables and their coefficients, we can plot the relationship between these six factors and agency clearance rate based on the data submitted by agencies.

Multilinear Regression



$$Clearance\ Rate\ \% = 9.1 \times Flock\ Devices\ per\ Sworn + 5.3 \times Agency\ Monthly\ Hotlist\ Adoption + 0.0083 \times Shared\ Flock\ Devices\ per\ Sworn + 0.050 \times Number\ of\ Nearby\ Flock\ Customers + 0.00013 \times Persons\ per\ Sworn - .00025 \times Persons\ per\ Square\ Mile$$

This analysis shows a clear relationship between how an agency uses Flock technology and the results they achieve. There are four themes that emerge.

Access to Evidence

Intuitively, both Flock Devices per Sworn and Shared Flock Devices per Sworn have positive coefficients with clearance rate. This indicates that an agency of a given size can increase their likelihood of solving crime with access to additional devices that capture evidence, whether that be by purchasing additional devices or requesting access to additional devices owned by other agencies and private entities.

We can explain the Shared Devices per Sworn coefficient being relatively low via the fact that a typical agency that works with Flock will have access to more than 200 times the number of cameras that they own via sharing. Simply, it takes significantly more cameras being shared with the agency to have the same impact as the agency owning more cameras. Quantifying the impact of the latter using this framework, a typical agency that acquires an additional owned Flock Device per Sworn Officer may expect a 9.1% increase in ALPR-assisted clearance rate.

Agency Behavior

While some agencies constrain access to ALPR technology to select officers, the positive coefficient between Flock hotlist software use and crime clearance suggests that an agency that provides access more broadly to ALPR-related software will be more successful in solving crime. Much of an agency's success in locating and apprehending suspects is done by officers in the field, and Flock's software is accessible to field officers via a mobile data terminal (MDT) or the Flock mobile app. We believe widespread agency use of Flock should be paired with a high degree of control over user-level permissions and auditing to ensure proper use, both of which are a core piece of Flock's technology.

Collaboration with Other Flock Users

There appears to be an additional positive correlation at the local level for collaboration between Flock customers beyond what is explained by the nationwide ability for customers to share with each other. The median number of cameras granted access to in a given camera-sharing interaction is ten, and the median sworn officer count amongst respondents was 34, meaning that an agency will need to gain access to roughly 3.5 additional typical Flock customers' cameras to drive their Flock-assisted clearance rate up by .0083%.

This is markedly lower than the additional .05% increase in clearance an agency can expect simply for having another Flock customer–regardless of market segment–within 50 kilometers of them. Considering the coefficient for Nearby Customers, if 20 additional customers begin working with Flock in a community, Law Enforcement can expect a 1% higher Flock-assisted clearance rate.

Data Collection for Large Agencies Remains a Challenge

It is striking that the model predicts a higher clearance rate for agencies with fewer sworn officers relative to the size of their population as well as for agencies that have a population distributed over a larger area. These findings may make sense when considering how ALPR technology can augment the effectiveness of Law Enforcement human efforts. An agency that is tasked with protecting a large area with fewer resources will be more likely to rely on Flock devices that are active 24/7, regardless of when officers are on patrol.

It is also possible that these findings are a product of agencies from very large jurisdictions disproportionately being filtered out due to data quality issues. It may be the case that our model biases towards smaller jurisdictions with more persons per sworn officer not because large agencies solve less crime with ALPR cameras, but because it is much more

difficult for large agencies to track their results comprehensively. This gap in our model invites subsequent research targeted at larger agencies.

Avenues for further research

This study was intended as an initial exploration into a gap in our current understanding of ALPR technology's use by and efficacy for law enforcement. By using an unprecedentedly broad survey of ALPR-equipped law enforcement practitioners that clearly attributes crime clearances to ALPR devices, we have identified general potential root causes associated with higher rates of ALPR-assisted crime clearances. As a general survey of crime clearances post-installation, there are several future studies that suggest themselves immediately.

For one, it would be worthwhile to measure the relative effectiveness of ALPRs in solving different types of crime. It makes intuitive sense that ALPR cameras would likely be more effective at solving crimes directly related to motor vehicles or where motor vehicles are disproportionately likely to be involved. The most obvious category would be motor vehicle theft itself.

However, delving into individual crime types requires methodological considerations particular to the type of crime considered. A study on motor vehicle theft and ALPR-assisted law enforcement outcomes would need to be attentive to the exceptionally low clearance rate for motor vehicle thefts owing to the fact that a motor vehicle theft is only considered cleared for ORI reporting purposes if an arrest is made–a criterion that is inattentive to the common scenario in which a stolen vehicle is spotted on an ALPR camera and then recovered unattended shortly afterward.

There is also a significant underlying causal inference to be tested in light of our findings: having established how much crime has been solved with the assistance of ALPR devices at

these agencies, it must be established that these are crimes that otherwise would have remained unsolved in the first place. Given the state of data collection on this issue, it is unlikely to be solved at scale via quantitative analysis. A mixed-methods study that considers both the qualitative change in practice, workflow, and results at a handful of agencies known to have adopted ALPR technologies and the quantitative, before-and-after impacts of those changes would better capture the day-to-day efficacy of this technology not reflected in the top level metrics considered here. Such a study is presently underway as part of a joint research project by Texas Christian University and the University of Texas at Tyler.

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