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Integrating Land Use and Water Resources: Planning to Support Water Supply Diversification

Project #4623A

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Integrating Land Use and Water Resources: Planning to Support Water Supply Diversification

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FOREWORD

One Water management recognizes the value of every drop of water. It seeks ways to maximize water resources and services, while protecting our communities and environment. One Water is breaking down traditional silos between water, wastewater, stormwater, and reuse within the water sector. It is also forging new partnerships between the water sector and other sectors.

The Water Environment & Reuse Foundation (WE&RF), Water Research Foundation (WRF), and Water Research Australia co-funded a study, *Institutional Issues for Integrated 'One Water' Management* (SIWM12T12; WRF project #4487), published in 2015, which identified key barriers and strategies to push for more integrated systems with lower costs and better resiliency. The study laid out a framework and actions to transition to a One Water approach, as well as case studies on utilities working towards these goals.

Since then, additional resources have been developed to help communities move towards a One Water approach, including: *Pathways to One Water* (WE&RF, 2015); *One Water Roadmap,* (US Water Alliance, 2016); and *Blueprint for One Water* (WRF, 2017). Cities are developing their own One Water plans, focused on the key elements of One Water applicable to their local context. At the heart of this lies an opportunity to engage with other sectors in order to achieve One Water goals. In fact, the *Institutional Issues* study identified a specific need for greater collaboration between water managers and urban planners on water issues.

To that end, WE&RF and WRF funded research efforts exploring current and future efforts to integrate planning and water. WE&RF, WRF, and the research teams worked together to leverage resources, conduct a joint utility survey, and coordinate projects with recent research from the American Planning Association (APA). While the projects complement one another's work, they each provide different insight into the broad topic of integrating efforts between the sectors.

Joining Up Water Management with Urban Planning (WE&RF Project No. SIWM5R13) takes a broader approach and investigates the key inhibiting and enabling factors to coordinating efforts across a range of water issues. The research team maps out connections between the sectors, analyzes best practices for integration, and developed a self-assessment tool – *Bridges-Barriers Matrix* – to improve future coordination. Case studies focus on specific instances of successful and unsuccessful coordination efforts within each community.

Integrating Land Use and Water Resources: Planning to Support Water Supply Diversification (WRF project #4623) dives deeper into coordination efforts around alternative water supplies and demand management. The research team looks at different scales of alternative water supplies, drivers/benefits of integration across sectors, and how to overcome the practical barriers to coordinated efforts. The *Coordinated Planning Guide* serves as a key resource that helps users put the project's findings into use. Case studies focus on integration solutions for specific alternative supplies in a given community.

Together, these projects unravel the challenges of and opportunities for better coordination between water and planning. They build off previous research, as well as one another, providing key actions utilities can take to work with planners and promote One Water cities.

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EXECUTIVE SUMMARY

KEY FINDINGS

- While coordinated planning between water and land use planners does occur, coordinated planning for alternative supply development is less common.
- Benefits of coordinated planning include resolving conflicts among planning efforts, and improving water and community sustainability.
- Institutionalized coordination between water and land use planners is a key solution. It will look different in each community.
- The Coordinated Planning Guide identifies specific opportunities in the water and land use planning process where better integration can occur, and it has a specific focus on alternative water supplies.

OBJECTIVES

This research project was part of the Water Research Foundation's Integrated Water Management: Planning for Future Water Supplies Focus Area program. The project aimed to evaluate water supply diversification efforts through an integrated water management approach, breaking down the barriers that traditionally separate water, wastewater, stormwater, and reuse, while also extending the conversation beyond water resources to identify opportunities and challenges for better collaboration between water and land use planning. To this end, there were three specific objectives of the research project:

- To communicate the current state of water supply diversification. Through a literature review and collaboration with a diverse group of stakeholders, this research documents the alternative water supply techniques currently being used by communities, what new approaches are on the horizon, and where opportunities for multi-purpose projects (e.g., rainwater harvesting for supply and stormwater management) are being implemented.
- To identify and highlight key opportunities and challenges for integrated water resource and land use planning. With the use of case studies, this research outlines the approaches and techniques available to support supply diversification and continue to improve the integration of water resource and land use planning.
- To develop user-friendly resources that can help advance the integration of water resource and land use planning. As a companion to this report, a Coordinated Planning Guide has been developed for use by the water utility, land use, and development communities to translate the research findings for their own communities, projects, and programs, and support the advancement of better integration and collaboration amongst water and land use professionals.

BACKGROUND

Water stress is increasing in many parts of the United States due to water supply shortages, population growth, water quality problems, and competing demands. In the U.S., several of the fastest growing states are also some of the most freshwater stressed—Nevada, Arizona, Georgia,

and Florida to name a few (U.S. Census Bureau, 2013). As a result, more communities are looking to augment their current supplies with alternative water supplies.

There are many alternative supply methods available, each with a unique set of criteria determining the appropriate conditions for use—no single alternative water supply method is appropriate for every situation. The following list defines each of the alternative water supply types considered in this project, ordered based on the degree to which each option may be used by water utilities in the future as a diversification strategy (Paulson et al., 2015).

- Potable reuse treats wastewater, improving it to meet drinking water quality standards, with the intent of either direct or indirect reuse. Direct reuse systems send the treated wastewater directly into the water distribution system. Indirect systems introduce treated wastewater into a natural groundwater or surface water source and then reclaim and put it through a second drinking water treatment process before adding it to the distribution system.
- Conservation is the act of reducing water consumption through activities, such as efficiency improvements/equipment upgrades and end user behavior change, and eliminating system leaks and other transmission inefficiencies. Conservation can be achieved directly by the utility as well as by customers.
- Non-potable reuse treats wastewater for reuse but limits the use of the treated water to applications other than drinking, such as industrial uses, agriculture, or landscape irrigation, thereby reducing the level of treatment required.
- Stormwater capture collects the runoff from rainfall events once water has made contact with the ground and makes the water available for beneficial uses instead of allowing it to run off into surface waterbodies. Captured stormwater can be used directly or go through a treatment process prior to use.
- Rainwater capture is the collection of rainwater before it contacts the ground, most often collected from roof top down spouts or directly.
- Aquifer storage and recovery (ASR) uses groundwater aquifers as underground storage reservoirs with the intent of future recovery and reuse. Storing the water underground reduces losses from evaporation and may even provide some treatment, depending on the method of storage, while also providing some operational flexibility by storing water during wet times for use during future dry times. Water is introduced to the aquifer either through surface infiltration or direct injection.
- Desalination treats either seawater or brackish groundwater to remove salts and other constituents, typically through an ultra-filtration (rather than conventional treatment) process. With enough treatment, the water may be used as a potable water supply.
- Water sharing programs facilitate the transfer of water from regions or users that have an abundance to those that are facing a lack of water.
- Greywater is a specific category of wastewater, typically described as residential/non-industrial wastewater coming from appliances such as showers and tubs, clothes washers, and bathroom sinks. The key to greywater is that it excludes water contaminated with fecal matter and limits the level of organics, greatly improving the quality compared to traditional wastewater and making it suitable for non-potable reuse with limited treatment.

Because alternative water supplies help to diversify a community's water portfolio and can be a critical part of a sustainable and resilient water future, the need for collaboration extends beyond water utilities. Some alternative supplies, like rainwater capture and greywater, happen on site and are installed and managed by owners and occupants rather than water providers. Achieving the greatest success in developing alternative supplies as part of a community's water supply portfolio will require improved and deeper collaboration between land use and community planners.

For example, water providers often engage in the development review process long after much of the project design has been determined. Also, land use planners do not often have a seat at the table in water supply planning and are not able to align water provider decision-making with broader community objectives and priorities. This lack of coordination can lead to missed opportunities and misalignment between community planning and a municipality's water resource management objectives. Because water stress can result in unexpected community costs to pay for new water supply or water quality protection measures, there is a clear benefit to taking a proactive approach to integrated water and land use planning.

However, though there are many benefits, the pathway for better integration between water management and land use planning is not always clear, leading to a few key questions that this research initiative aims to answer:

- What are the key drivers and benefits of alternative water supply at various scales?
- What are the drivers and benefits of integrated water/land use planning?
- What practical barriers exist to integration and diversification?

APPROACH

To answer the questions above, it was important to identify the key players and the scales at which decisions are made for water and land use planning. Research was divided into three specific phases and included a literature review as well as various forms of stakeholder engagement (survey, interviews, and focus groups).

The literature review (Fedak et al., 2016) includes the review and synthesis of over 50 documents and is organized into three sections: first assessing the current state of water use/alternative water supply and integrated water/land use planning, then identifying the key barriers to better integration of diversified water supplies into land use planning, and finally outlining specific strategies for more effective integration.

An online survey on water utility and land use planning collaboration was sponsored by the Water Research Foundation and the Water Environment & Reuse Foundation (WE&RF), in cooperation with the American Planning Association (APA), and administered with the intent on engaging a large group of water utility and land use planning professionals. The survey identified issues on which land use planners and water professionals need greater collaboration, the barriers to increased collaboration, the most effective techniques to increase that collaboration, and case studies of water/land use planning integration. It also queried potential end users about the most helpful research products. The survey was distributed to over 5,000 individuals, and a total of 454 usable responses were obtained.

A series of interviews was conducted with 12 communities and stakeholders to gain an in-depth perspective of how alternative water supply and land use decisions are made in concert with one another. The research team sought communities with exemplary programs and processes that might provide useful models for other communities, while also targeting locations that specifically

focus on alternative water supplies. Brief case studies were developed for each of the interviewed communities.

To supplement the individual community interviews, four focus group discussions were conducted via teleconference. Each focus group keyed in on one of the following topics to help fill identified gaps in the research findings: (1) integrating water supply into integrated planning, (2) geographic considerations, (3) the development community, and (4) the role of third party conveners.

RESULTS/CONCLUSIONS

Alternative water supplies reduce strain on traditional water supplies; however, they require greater coordination between water providers and land use planners for benefits to be fully realized. General research findings and conclusions suggest that this research can be directly applied to the water resources industry, as well as the larger land use planning and development community. To support this research report, a Coordinated Planning Guide was developed as an easy-to-use resource for identifying the role of alternative water supplies in the land use planning process from long-range planning to codes and regulations to the development review process. Specific conclusions follow.

Water and Land Use Planners Are Coordinating, but There Is Room and Desire for Improvement

The survey results indicate that coordination between water and land use planners is happening in general, and more often in urban and suburban areas, as opposed to rural areas. However, the extent to which coordination is happening varies widely among communities, and it does not necessarily occur specifically for alternative water supply development. The literature review, survey results, and interviews all showed there were significantly fewer examples of coordinated planning related specifically to alternative supply development, as opposed to just general water and land use planning. This is likely a reflection of the fact that alternative water supplies are less common in general; the potential applications for each method vary; and the benefits of, and pathways for, coordinating planning efforts are less well known.

The Benefits of Coordination Tend to Outweigh the Challenges/Costs

The interviews conducted with communities across the Unites States revealed clear drivers for, and benefits of, both supply diversification and coordinated planning. The drivers for diversifying water supply vary by geographic region and include: population growth (San Francisco, CA), improving reliability and resiliency (Sarasota, FL), and environmental protection (Boulder, CO). Benefits of, and drivers for, integrated planning include resolving conflicts between various planning efforts (Sterling Ranch, CO), enabling pursuit of additional community priorities (Pima County/Tucson, AZ), and improving water management planning and supply sustainability (Kansas City, MO), among others.

The challenges of integrated planning are, of course, important to acknowledge as well. The main challenge of deeper coordination identified in the interviews is the additional time required to align work products with more people when time is a common constraint. Additionally, water and land use professionals many times have different end objectives, which can make the idea of integration less intuitive.

Considering the pros and cons, the research interviews conducted all indicated a net benefit from better coordination, despite any challenges encountered (Aurora, CO). The quantitative costs and benefits of coordinating have not been well defined, and are areas that could benefit from additional evaluation and research.

The Scale at Which Alternative Water Supplies Are Developed Implies Different Land Use Planning Coordination

The scale of water planning has a bearing on how it can be integrated into land use planning, as demonstrated in both the literature review and interviews. Utility scale alternative water development projects—like desalination and aquifer storage and recovery—are often best addressed in long-range planning efforts, aligning the water and land use priorities for a community/region from the start. Coordination on site scale alternative water supplies—like greywater and stormwater capture—which are typically installed and managed by owners and occupants rather than water providers, can be addressed at virtually all planning stages, particularly in the codes and regulations, and in the development review process.

Institutionalized Coordination between Water and Land Use Planners Is a Key Solution to a Primary Barrier

The survey results indicated that lack of time was a primary barrier to better collaboration, along with several other organizational/institutional topics, including lack of directive, lack of specified duties/roles, and challenging jurisdictional issues. While finding more time is always a challenge, this report and the Coordinated Planning Guide may help provide a shortcut to achieving more coordination.

According to the interviews, communities that are collaborating in water and land use planning cited institutionalized coordination as a primary integration technique, though achieving institutionalized collaboration will look a bit different in each community. For example, the ability of a water utility to coordinate with a local governmental planning agency is very different if it is a municipal water utility, guided by the same policies and decision-making body, versus an independent (private or enterprise) utility.

Strong leadership is key in ensuring coordination happens, and clearly defined roles of staff will help enable it to continue. The focus group interviews underscored the fact that third party entities have also played strong roles in convening stakeholders.

There Is Significant Potential and Desire to Better Integrate Alternative Water Supplies into the Land Use Planning Process

The survey indicated a strong desire to improve integration of water (including, but not limited to, alternative water supply) and land use planning. Land use planners are uniquely positioned to integrate alternative water resources into their plans, codes, regulations, and development review processes. Water providers can proactively promote their alternative water supply plans and programs through these channels, helping other stakeholders navigate the technical details to identify the most appropriate applications for each supply option. Educating developers, planners, and the public on water supply diversification can help in getting initiatives passed and advancing innovation.

While the survey also showed strong support for having land use planners more involved in water planning efforts, there seemed to be a clear pathway for water providers to be integrated more into the land use planning process. Land use planners are accustomed to engaging, and many times seek out, multiple stakeholders in their decision-making processes and are also well positioned for connecting decisions around alternative water supplies with other community priorities. Decisions regarding long-range water planning and utility scale alternative water supplies should be integrated into long-range planning efforts. Site scale alternative water supplies can be integrated into virtually all forms of land use planning, in particular codes and regulations, and development review processes. The Coordinated Planning Guide, the companion document to this research report, should be reviewed for a detailed look at how this can be achieved.

APPLICATIONS/RECOMMENDATIONS

The integration and coordination of alternative water supply development and land use planning can be achieved in several ways. In many communities, there is some degree of coordination already—this a foundational step in building the relationships and channels of communication needed to become more coordinated. Ensuring effective and deeper coordination usually needs to be supported by leadership in both the water and land use departments. To examine where more collaboration is needed to advance alternative water supplies, and how to do it, we recommend the following for communities interested in advancing the development of alternative water supplies.

Coordinate Long-Range Plans

- Conduct Research: Identify the alternative water supply types in use or available in your community and establish a baseline of information about them. Also review state/local water and health laws for any pertinent requirements. Use this information and research to inform all next steps, taking into account which land use planning activities are best suited to the alternative water supplies of interest.
- Review Plans: Review your community's comprehensive plan and water management plans to see if/how alternative water supplies are addressed. Additional research may be necessary to inform potential alternative supply approaches. Introduce or explore ways to integrate alternative water supply opportunities in capital improvement planning.
- Align Projections: Check on the sources for the land use planning population projections; compare against the population projections/sources used by water utilities. Population can be a first step to more in-depth discussions about projections of the future, considering additional topics such as climate change and the economy, commercial/industrial/institutional customer trends, etc.

Coordinate Codes and Regulations

- Evaluate Regulations: Evaluate your community's zoning, subdivision, and development regulations; growth management strategies; and state laws and regulations to see where there may be unintended barriers or opportunities to implement alternative water supply projects.

- Review Fees and Incentives: Review fee structures and code requirements to see if there are any opportunities to incentivize or promote alternative water supply projects.
- Integrate Ordinances: Review any separately adopted water sustainability ordinances and see if there are ways to integrate them with zoning, subdivision, and/or development regulations.

Coordinate Development Review Processes

- Build Teams: Invite your water utility or community planner counterparts to a meeting to get to know them and explore opportunities for enhanced collaboration on alternative water supplies. If such a relationship already exists, expand your efforts to establish a multi-disciplinary team of water and land use planning professionals and set up a mechanism for routine coordination.
- Clarify Review Processes: Examine the steps in the development review process to see where/how water utilities can or should be more engaged. Formalize those opportunities for collaboration via steps or sub-steps in your development review process.
- Inform Decision Makers: Provide training or information to elected and appointed officials (especially those involved in land use approvals) about alternative supply types, methods, options, and/or challenges in your community.
- Revisit Inspection Procedures: Review your community's inspection procedures and staffing assignments to ensure that inspections are happening at the right time(s) and that staff has sufficient training.

Based on the research findings, a more extensive review of the following areas should be explored through future research:

- The triple bottom line (economic, social, environmental) costs and benefits of improved collaboration
- Funding mechanisms—such as alternative funding sources, pilot projects, and improved financial planning and budget priorities—to support alternative supply development and integration efforts
- The costs and benefits of specific alternative water supply options to help in prioritization and decision-making
- The development of tools and techniques to standardize how water resource impacts are calculated in new development and redevelopment projects
- Geographic differences of alternative water supply uptake and technologies
- The most effective models/examples of institutionalized collaboration

MULTIMEDIA

Findings from the literature review and interview stages of the research were compiled into a Microsoft Excel database. This resource includes all the details of these efforts, allowing the user to search and filter results and explore the specific findings of individual resources in more detail. The database is available on the #4623 project page of the WRF website.

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- Sarasota County, FL
- Soquel Creek Water District, CA
- Sterling Ranch, CO
- Westminster, CO

RELATED WRF RESEARCH

- Blueprint for One Water, project #4660
- Institutional Issues of Integrated Water Management, project #4487
- Source Water Protection Vision and Roadmap, project #4176
- Urban Landscape Water Use Research, project #4633

CHAPTER 1
INTRODUCTION AND BACKGROUND

Water supply in the United States is still supplied predominantly through fresh surface water and groundwater sources, though there are numerous factors driving the need for supply diversification, from water shortages to population growth and environmental protection. Alternative water supplies present an underdeveloped, sustainable source for augmenting water supply.

This research project was part of the Water Research Foundation's Integrated Water Management: Planning for Future Water Supplies Focus Area program. The project aims to evaluate water supply diversification efforts through an integrated water management approach, breaking down the barriers that traditionally separate water, wastewater, stormwater, and reuse while also extending the conversation beyond water resources to identify opportunities and challenges for better collaboration between water and land use planning. To this end, there are three specific objectives of the research project:

- To communicate the current state of water supply diversification. Through a literature review and collaboration with a diverse group of stakeholders, this research documents what alternative water supply techniques are currently being used by communities, what new approaches are on the horizon, and where opportunities for multi-purpose projects (e.g., rainwater harvesting for supply and stormwater management) are being implemented.
- To identify and highlight key opportunities and challenges for integrated water resource and land use planning. With the use of case studies, this research outlines the approaches and techniques are available to support supply diversification and continue to improve the integration of water resource and land use planning.
- To develop user-friendly resources that can help advance the integration of water resource and land use planning. As a companion to this Research Summary Report, a Coordinated Planning Guide has been developed for use by the water utility, land use, and development communities to translate the research findings for their own communities, projects, and programs, and support the advancement of better integration and collaboration amongst water and land use professionals.

ALTERNATIVE WATER SUPPLIES

Alternative water supplies, sometimes called auxiliary or augmentation supplies, are used to supplement and diversify a water provider's more traditional surface and groundwater supplies. For the purposes of this research, the alternative supply options included are listed below and are ordered based on the degree to which each option is expected to be used by water utilities in the future as a diversification strategy (Paulson et al., 2015):

- Potable reuse treats wastewater, improving it to meet drinking water quality standards, with the intent of either direct or indirect reuse. Direct reuse systems send the treated wastewater directly into the water distribution system while indirect systems introduce treated wastewater into a natural groundwater or surface water source and then reclaim

and put through a second drinking water treatment process before adding to the distribution system.

- Conservation is the act of reducing water consumption through activities, such as efficiency improvements/equipment upgrades and end user behavior change, and eliminating system leaks and other transmission inefficiencies. Conservation can be achieved directly by the utility as well as by customers.
- Non-potable reuse treats wastewater for reuse but limits the use of the treated water to applications other than drinking, such as industrial uses, agriculture, or landscape irrigation, thereby reducing the level of treatment required.
- Stormwater capture collects the runoff from rainfall events once water has made contact with the ground and makes the water available for beneficial uses instead of allowing it to run off into surface waterbodies. Captured stormwater can be used directly or go through a treatment process prior to use.
- Rainwater capture is the collection of rainwater before it contacts the ground, most often collected from roof top down spouts or directly
- Aquifer storage and recovery (ASR) uses groundwater aquifers as underground storage reservoirs with the intent of future recovery and reuse. Storing the water underground reduces losses from evaporation and may even provide some treatment, depending on the method of storage, while also providing some operational flexibility by storing water during wet times for use during future dry times. Water is introduced to the aquifer either through surface infiltration or direct injection.
- Desalination treats either seawater or brackish groundwater to remove salts and other constituents, typically through an ultra-filtration (rather than conventional treatment) process. With enough treatment, the water may be used as a potable water supply.
- Water sharing programs facilitate the transfer of water from regions or users that have an abundance to those who are facing a lack of water.
- Greywater is a specific category of wastewater, typically described as residential/non-industrial wastewaters coming from appliances such as showers and tubs, clothes washers, and bathroom sinks. The key to greywater is that it excludes water contaminated with fecal matter and limits the level of organics, greatly improving the quality compared to traditional wastewater and making it suitable for non-potable reuse with limited treatment.

It is important to recognize that no single alternative water supply method is appropriate for every situation. The alternative water supply methods examined in this study vary in many ways, including their applicable scale, the demands they can be used to meet, and the planning activities associated with each method. For example, if a community wanted to implement greywater, while it is typically applicable at the site scale, there are opportunities in all three planning activity categories (e.g., by supporting the development of alternative supplies in a comprehensive plan, by having the right plumbing and health codes and regulations in place, and by supporting a development proposal that features greywater with coordinated reviews and possibly even incentives). ASR and desalination, on the other hand, are typically developed at the utility or regional scale and can primarily be supported by inclusion in a community's comprehensive planning documents. For more information and details on the various alternative water supply options as well as successful application examples, see the full literature review for this research effort (Fedak et al., 2016).

THE IMPORTANCE OF INTEGRATED PLANNING

A growing population and expanding economy are often welcomed signs of community vitality. However, increased development can strain increasingly limited natural resources like water if growth is not matched by thoughtful and sustainable planning initiatives. In the U.S., several of the fastest growing states are also some of the most fresh-water stressed – Nevada, Arizona, Georgia, and Florida to name a few (U.S. Census Bureau, 2013). In addition to potential water shortages, protecting water quality is also a critical concern for many communities.

The footprint of residential and commercial development can have a profound impact on local water resources and water utilities. As population increases, water demands for indoor uses, process water (e.g., industrial uses), and outdoor landscaping also increases. To augment traditional water sources, such as reservoir storage, there is an emerging effort to develop alternative water supplies. Greywater, stormwater capture, and ASR are a few examples of alternative water supplies that can more sustainably supplement the water needs of both existing development and new demands because of growth. Neighborhoods that are incorporating these alternatives to build "water smart from the start" are achieving water reductions of 40 percent or more compared to more traditional developments in the same communities (Western Resource Advocates, 2009).

To capitalize on these opportunities, water providers, community planners, and other stakeholders like the development community must collaborate. However, there is significant opportunity to improve and deepen collaboration among land use and water planners. For example, water providers often engage in the land use review process long after much of the project design has been determined. Also, land use planners do not often have a seat at the table in water supply planning and are not able to align water provider decision making with broader community objectives and priorities. This lack of coordination can lead to missed opportunities and misalignment between community planning and a municipality's water demand, supply, and water quality objectives. Because water stress can result in unexpected community costs to pay for new water supply or water quality protection measures, there is a clear benefit to taking a proactive approach to integrated planning.

However, the pathway for better integration between water management and land use planning is not always clear and this disconnect is at the heart of the challenge to promote more sustainable alternative water supplies. This leads to a few key questions that this research initiative aims to answer:

- What are the key drivers and benefits of alternative water supply at various scales?
- What are the drivers and benefits of integrated water/land use planning?
- What practical barriers exist to integration and diversification?

ORGANIZATION OF REPORT

This research summary report is organized into four chapters: Introduction and Background, Research Approach, Analysis and Results, and Conclusions and Recommendations. While this report synthesizes all the research findings, it is supported by a Coordinating Planning Guide, which is a higher-level resource intended for use by water providers and community planners looking for opportunities to improve integration and collaboration. Readers looking for even more detail on the research findings and deliverables can find them in the appendices to this document.

CHAPTER 2
RESEARCH APPROACH

This chapter is organized into three sections, aligning with the three research phases: literature review, stakeholder engagement, and integrated planning resources. Within each section the research methods are summarized, followed by a summary of the analysis and results for each research phase. More detailed research findings and deliverables are included as appendices to this document.

LITERATURE REVIEW

The first step in the research process was a literature review to document the current state of (1) water supply diversification examples, including enabling statutes and other relevant enabling conditions; and (2) water supply planning integration across the country. Specifically, the focus was on identifying the challenges and barriers to diversifying water supplies and integrating planning, and the best practices used to overcome them. Through the review and synthesis of over 50 documents, the literature review research phase helped identify exemplary communities for potential profiling in the case studies portion of the research while also highlighting common themes and demonstrations of successful integrated planning. The documents reviewed included government reports, municipal planning documents, scientific research, news articles, conference presentations, and more. Their geographic scope was worldwide with information from numerous countries. Within the United States, much of the literature covered issues from the Rocky Mountains west but other regions were included as well.

The literature review for this research effort (Fedak et al., 2016) is organized into three sections: first assessing the current state of water use/alternative water supply and integrated water/land use planning, then identifying the key barriers to better integration of diversified water supplies into land use planning, and finally outlining specific strategies for more effective integration.

STAKEHOLDER ENGAGEMENT

Survey

The research team engaged a large group of water utility and land use planning professionals in an on-line survey to identify issues on which land use planners and water professionals need greater collaboration, the barriers to increased collaboration, the most effective techniques to increase that collaboration, case studies of water/land use integration, and also to query potential end users about the most helpful research products.

The Survey on Water Utility and Land Use Planning Collaboration was sponsored by the Water Research Foundation and the Water Environment & Reuse Foundation (WE&RF) in cooperation with the American Planning Association, and was administered by the University of Arizona, Western Resource Advocates, and the Brendle Group. See Appendix A for a copy of the survey instrument that was crafted to answer research questions of interest to both the WRF and WE&RF research teams. Survey results are summarized as part of the Analysis and Results chapter later, with the more detailed results included in Appendix B.

Qualtrics online survey software was used to distribute the survey via email to over 5,000 individuals, including WRF and WE&RF members and American Planning Association (APA) members. The survey was available online from July 11 to August 8, 2016, and a total of 454 usable responses were obtained. General questions were asked to quantify the geographic and professional coverage achieved by the survey. The two most common locations were California and Colorado, but the top 10 states from which responses were received was not restricted to western states alone. There was a good distribution of survey respondents from across the U.S. and Canada. The professional perspectives of the survey respondents also were broad, although professionals from combined utility/agencies make up the largest share of survey respondents, followed by private firms and wastewater agencies.

The Water Environment & Reuse Foundation's "Joining-Up Urban Water Management with Urban Planning and Design" contains important details on the process, pitfalls, and solutions to better integrating water and land use planning. The Project describes results from a national survey about top issues in need of greater water and land use collaboration, includes suggestions for how to identify coordination issues in a community, lists common barriers to improving coordination, and provides tactics to overcome those barriers.

Interviews

A series of interviews was conducted with 12 communities and stakeholders to gain an in-depth perspective of how alternative water supply and land use decisions are made in concert with one another. The research team sought communities with exemplary programs and processes that might provide a useful model for other communities, while also targeting locations with a specific focus on alternative water supplies, which limited to some degree the geographic reach of the interview candidates.

In many cases both a water planning professional and land use planning professional were interviewed together for each community unless it was not possible to coordinate their schedules. The interview template can be found in Appendix C, and a summary of each of the interview case studies can be found in Appendix D. There are also many brief examples from the interviews included throughout this report. Unless otherwise cited, all community examples and call-outs are a product of the interviews conducted as part of this research effort.

Focus Groups

Focus group discussions were conducted via teleconference to help fill gaps in the research after the initial round of community interviews were completed. The four focus topics and questions of interest are summarized here, with the series of questions asked of each group found in Appendix E.

- Integrating Water Supply into Integrated Planning – The examples of integrated planning focused on water supply are limited. Are there other examples out there that should be highlighted? Why are there not more examples?
- Geographic Considerations – How can the geographic diversity of case studies be expanded and address regional differences to develop a comprehensive framework?

- The Development Community – How to ensure the voice of developers is included in the final research findings and resources?
- The Role of Third Party Conveners – Leadership has been identified as a key need in successful integration and a lack of leadership as a barrier to current integration. What is the role of third parties in this convening role and who can best fill this role?

The following chapter includes key findings from the four focus group discussions, with a more detailed summary of each focus group included in Appendix F.

CHAPTER 3
ANALYSIS AND RESULTS

WHY COLLABORATE – DRIVERS AND BENEFITS

To understand the drivers of collaboration, it is helpful to first understand the drivers of alternative water supplies. Across the United States, achieving sustainable water supplies for current and growing populations is becoming increasingly difficult. To maintain water reliability, significant choices will need to be made about acquiring new, traditional water supplies (e.g., via dams, pipelines, and/or groundwater wells); focusing on using existing supplies more efficiently; or developing a suite of locally-available alternative water supplies. These choices will have varying impacts and should be weighed against each other in a relevant forum such that a community can make the best, collective decision for itself to attain long-term water reliability.

City of Aurora, Colorado
Solution: Institutionalized Collaboration

In the City of Aurora, Colorado, integration between land and water planners occurs at multiple planning stages. Land-use and water planners have developed joint population and water infrastructure projection tools to inform both long term planning processes. And the land-use and water impacts of proposed new developments are evaluated at the pre-application stage, which helps the City identify issues quickly. These efforts have resulted in more efficient services, better informed customers, and a higher quality of development within the city.

City of Chandler, Arizona
Solution: Policy and Regulatory Changes

The City of Chandler adopted a Sustainable Water Allocation Regulation that requires new, high-volume commercial/industrial users above a base amount to purchase water from a willing seller to meet their demand. “The last thing we wanted to do is use 100 percent of our water and find out we only have 90 percent of our land built,” said one of Chandler’s water managers about the reasons for enacting the new policy (Toy, 2015).

Geographic location is a significant factor in alternative water supply development. In many coastal regions, salt water intrusion into groundwater aquifers is a notable problem because it reduces the quality of groundwater drinking supplies. In several communities in Sarasota County, FL for example, non-potable reuse water has become a significant water supply for irrigation water to reduce reliance on groundwater. In the arid west, drought and scarcity of water coupled with rapidly growing populations have been drivers of investments in alternative water supplies like stormwater and rainwater catchment and greywater systems. In other regions all over the U.S., protecting water quality is a high priority, so reusing wastewater rather than returning it to a stream or river can prevent further degradation of the water quality. And, as climate change continues to influence the cycles of drought and flooding that communities experience, it is likely that more investment in alternative water supplies will continue to augment traditional supplies and increase the resiliency of communities’ water supplies.

Gillette Stadium, Foxborough, Massachusetts
Solution: New Technology and Innovation

In 1991 the Gillette Stadium, home to the NFL's New England Patriots football team and other events, was projected to require more water and wastewater treatment capacity than the small town of Foxborough had. To resolve this issue, an on-site wastewater reuse system was installed that helped to address both issues. The stadium has a closed-loop, membrane bioreactor treatment plant that generates water suitable for up to 250,000 gallons of reuse per day with a 500,000-gallon elevated storage tank for storing the treated water. In addition, the stadium can store 700,000 gallons of untreated wastewater for future treatment, which can be generated during a busy weekend. The system returns high-quality treated wastewater both to the stadium and the adjacent Patriot Place, a 1.3-million-square-feet shopping destination with shops, restaurants, and hotel lodging. The recycled water is used for toilets, facilities cooling, and other purposes (Shandas, 2010).

Sarasota County, Florida
Solution: New Technology and Innovation

Sarasota County had a need and a desire to expand its reclaimed water usage. In the 1980s the Environmental Protection Agency (EPA) changed the standards regarding nutrient pollution of treated wastewater that gets discharged into waterways. That, coupled with drought, led to treated wastewater being applied to irrigated areas where the low levels of nutrients were actually a benefit to the grass and plants. To date, reclaimed water is used on irrigated spaces in residential areas, as well as large, irrigated spaces such as parks and golf courses.

Some of the basic mechanics of integrated planning are already practiced in many communities. For example, it is common for water providers to review the water specifications of new, proposed developments. While the degree and extent of this coordination varies widely, the perceived need for doing so is strong (see survey results questions 13 and 14, Appendix A). While integrated planning for alternative water supplies specifically is less common, any existing coordination activities can help to lay the foundation for more regular and involved coordination among community planners and water providers.

The benefits that can be realized from integrated planning range from site level planning to long-range planning. Benefits identified in the literature review, survey, and interviews conducted include the following:

- Increasing water supply sustainability at reduced costs
- Resolving conflict between various land use plans, economic development plans, and regional/statewide water plans
- Reducing competition for limited water supplies
- Facilitating protection of natural resources and cultural heritage
- Improving water management plans, data development, and data sharing
- Identifying early warnings of legal and other water vulnerability uncertainties
- Addressing urban flooding by integrating low-impact development into land planning
- Providing better information for the public

- Increasing predictability of the development process

Recognizing these benefits and many others, strengthening the partnerships between land use and water planners is increasingly being called for by agencies and organizations across the U.S. As just one prominent example, in 2015 the APA completed a Water Task Force report emphasizing the new paradigm of "One Water" that incorporates water into all aspects of the built environment and emphasizes integrated, regional water planning and partnerships between water resource managers and community planners. This report led to a new APA Policy Guide on water, adopted in 2016 (Campbell et al., 2016).

Furthermore, a survey conducted as part of this research and in collaboration with WE&RF Project SIWM5R13, "Joining-Up Urban Water Management with Urban Planning and Design," indicates that the overwhelming majority of community planners and water providers think they should be more involved in each other's decision-making, and that doing so via planning processes is one of the most effective ways to achieve results (Stoker et al., forthcoming). Generally, the research survey results suggest that there is more support from land use planners to have water planners engaged in their decision-making as opposed to the other way around, though there is broad support from both groups. This makes sense considering that land use planners are more accustomed to (and seek out) engaging multiple stakeholders in their decision-making processes. Additionally, according to the survey results, there is more support from planners to engage water professionals in community planning than vice versa. In water supply, wastewater, and combined utilities about half the people feel planners are already sufficiently involved in water utility decisions.

Integrating water into a community's comprehensive plan affords important benefits. Because water planning and its related infrastructure investments are long-term processes, there is a good reason to consider these issues within the context of long-range land use planning. And because land use planning processes explicitly embrace public values beyond a single resource use (unlike water management), this promotes discussion of water issues in a broader, forward-looking environment that promotes community conversation and affirms value of the resource.

San José, California
Solution: Public Education and Stakeholder Engagement

Extensive public outreach with residents in San José, California during the four-year development of the Envision San José 2040 General Plan highlighted environmental issues, especially water, as one of the most key issues to the community (City of San Jose, CA, 2011). Envision San José contains robust goals and policies within the Water Supply, Conservation, Recycling, and Quality section of its Environmental Leadership Chapter with objectives on increasing water use efficiency and the use of recycled water supplies.

Discussing water in long-range planning efforts similarly affords the opportunity to think at large geographic scales. Because water resources – either above or below ground – rarely conform to political boundaries and water service area boundaries do not always neatly align with land use jurisdictions, coordinating on a regional scale can offer important benefits. Aquifer storage and recovery projects and desalination projects often require cooperation between multiple agencies and levels of government. Building trust and relationships with regional stakeholders and

decision-makers can make implementing these types of projects easier in a quest to balance long-term water supply and demand.

Mid-America Regional Council and Kansas City, Missouri
Solution: Institutional Collaboration

The Mid-America Regional Council, a metropolitan planning organization for the bi-state Kansas City region, has engaged in regional planning efforts on stormwater best management practices, developing stream buffers, and protecting natural resources, with some work on water recycling projects with local water providers.

Kansas City, Missouri is leading a collaborative project in the Twin Creeks area of the city that will utilize a series of linear parks to reduce stormwater runoff to demonstrate a new style of development pattern for the community (City of Kansas City, MO, 2016). Park land is a critical piece of a community's infrastructure that not only provides a location for recreational opportunities, but also supports natural habitats, facilitates multiple modes of transportation, helps manage stormwater to reduce flood risks, and increases property values.

Integrating water into land use regulations (e.g., zoning ordinances, subdivision codes, and landscape ordinances) can increase a community's water supply sustainability by locking in good water use patterns for decades. Encouraging water efficiency and alternative water supply options at the time of land entitlement and construction is more cost-effective than implementing these actions after construction, because retrofitting existing buildings later is expensive and difficult.

Regulations and incentives that encourage more compact growth and infill save on infrastructure costs, and help preserve open space for recreational and watershed health purposes. Designing and building water conservation features into new development is also a buffer against drought, as developments with a smaller water footprint, drought tolerant landscaping, and reduced reliance on potable water for irrigation put less strain on water systems with the potential to save delivery, treatment, water acquisition, and energy costs.

WHEN TO COLLABORATE

Survey respondents were asked to prioritize 20 topics of potential collaboration, which were grouped into several categories, including Planning, Conservation, Regulations and [water supply] Alternatives (the full list of categories can be found in Appendix B). The highest priority topics – presented in Table 3.1 - were rated "very important" and tended to fall into the Planning category, whereas the lowest priority topics were rated "moderately important" and tended to fall in the Alternatives category. The ratings of all 20 topics fell into these 2 middle level ratings, even though the rating choices also included "extremely important" and "slightly important." This indicates that all 20 topics have some relevance to integrated planning, and that there is not a singular need that stood out above the rest according to the survey respondents. Interestingly however, priorities 2 and 4 of the most important topics for collaboration (Table 3.1) are inherently tied to water supply and thereby alternative water supply planning. One possible reason for the lower rating for Alternative water supplies is that they are simply less common, and lack of experience and/or relevance may have led to the perception that integrated planning is less useful in their development and implementation. Additionally, and/or alternatively, many of the lower ranked topics such as small-scale systems and greywater reuse are more narrow, technical

solutions (tactics) as opposed to broader approaches like planning water supply/wastewater service capacity and comprehensive planning (strategy), potentially providing an opportunity to build awareness and set the direction for implementing technical solutions through long-range planning. Appendix B contains the full details and results from this survey.

Table 3.1
Topics of potential collaboration, highest and lowest priorities

Most Important for Collaboration (in order of priority)	Least Important for Collaboration (in order of priority)
1. Preserving/restoring watersheds, wetlands, or other features 2. Planning water supply and wastewater service capacity 3. Master, general, or comprehensive planning 4. Population growth, urban growth, or service demand forecasting	1. Desalination 2. Transferring or sharing agriculture water for urban use 3. Small-scale water and wastewater systems for office blocks 4. Greywater for irrigation, indoor use, or heat recovery

Unlike the survey, the interviews conducted underscored the importance of integrated planning in alternative water supply development and implementation, though those interviews focused on communities in which these activities already exist. One of the important outcomes from the interviews was the recommendation that community planners play an integral role in facilitating deeper coordination with water providers. This is because community planners are accustomed to coordinating with a wide variety of other essential community services, such as transportation, police, fire and parks and recreation, and have a natural platform for deeper engagement.

As a result, the Coordinated Planning Guide - the companion document to this research report - is structured by planning activities, and illustrates the ways in which better coordination can be achieved. Planning activities fall into three main categories: plans, regulations, and processes. They include the following:

Coordinated Plans

- Comprehensive/General Plan: is an official policy document adopted by a local government that establishes the community's long-range vision for the future and provides a roadmap for achieving that future by guiding growth management strategies, land use regulations, capital investments, and development decisions. A water element can be a substantial part, emphasizing conservation or alternative supplies as part of the community's vision for the future.
- Integrated Water Plan: establishes policy-level direction for water managers in planning activities often at the scale of 30 years or longer, considering multiple aspects of water management including water supply, wastewater, stormwater, water quality, and water efficiency.

Coordinated Regulations

- Zoning codes form the blueprint for future development by dividing land into zones, and prescribing the type of land uses and intensity of development allowed within each zone. Zoning can also be used to designate the amount and location of undeveloped land, or open space. Lands can also be rezoned, overriding the original zoning, subject to certain conditions.
- Subdivision regulations guide how a segment of raw land is divided into lots for individual sale and development. Land subdivision is designed to ensure lots have adequate streets and utilities, and avoid sensitive lands such as floodplains and steep slopes. Subdivision regulations address the quality of new development, such as neighborhood design and layout of the site.
- Development codes regulate development activities. In some communities, unified development codes integrate zoning and subdivision regulations with other development specifications; in others, they are separate documents. Development codes or adopted policies typically specify development standards, including site, building, landscaping, and related design and land use specifications to ensure new development is properly planned and built.
- Water sustainability ordinances are incorporated into various municipal and county code sections. These types of ordinances support more sustainable water supplies by reducing indoor and outdoor water demand and requiring alternative water supplies to reduce potable use. Indoor conservation ordinances are generally found in plumbing codes. Outdoor water conservation codes may address irrigation efficiency, water features, golf courses, large landscaped areas, and also contain requirements to use alternative water supplies for irrigation purposes.

Coordinated Review Processes

- Pre-Application Meeting – A common first step for new development concepts or proposals that provides an important opportunity for the developer and the water provider to engage early in the development design process.
- Development Plan Application and Review - Development plans are submitted to the local governing authority by the developer and include detailed drawings and descriptions. The local government reviews the plans to ensure that the proposals adhere to all zoning, subdivision, and other development standards.
- Development Agreements and Fees - Contracts that stipulate the standards and conditions that will apply to the development of the property.
- Permit Review and Inspections - Building-level systems (plumbing, mechanical, electrical, etc.) are reviewed to ensure they conform with all applicable building and health codes.
- Post-Occupancy Considerations - Building owners or occupants are typically responsible for the operations and maintenance of any alternative water supply systems, but the local governing body can take action to help ensure the successful performance of these systems.

The Coordinated Planning Guide provides significantly more detail on when and how alternative water supplies and land use can be integrated, with supporting case study examples throughout.

BARRIERS AND SOLUTIONS TO INTEGRATION

While coordination is already happening in many communities, the full potential is still often unrealized despite the fact that a higher degree of collaboration is of great interest to both water providers and community planners. Therefore, is it important to understand the barriers and pathways to achieving greater collaboration. The literature review, survey, and interviews helped uncover several common barriers and many of the solutions that have been found for overcoming them.

Survey participants were asked about potential barriers to collaboration (organized into groupings of Political, Institutional/Organizational, Economic/Financial, Process/Management, and Behavioral/Cultural) as well as tools and techniques for overcoming these barriers (organized into groupings of Process, Legal/Regulatory, Professional Development, and Analytical).

Survey respondents confirmed that they are generally clear about who they need to work with but integration is generally not prioritized so it doesn't get the attention it may deserve. Lack of time was the primary barrier identified in the survey, as well as lack of mandates or incentives, and a weak appreciation for the benefits of collaboration. Institutional barriers include jurisdictional differences, such as whether or not a water utility is municipal (and therefore a part of the municipal government and more easily linked to land use planning) or independent (private or enterprise), and therefore operating independently from local government.

Survey respondents' preferred integration solutions included more intentional alignment and coordination (not consolidation or mergers) on virtually all stages of planning, from joint scenario planning to development project evaluation to data management. Interestingly, "institutionalized collaboration" was the integration solution most frequently found through the interviews.

Combining the survey responses with findings from the research literature review resulted in four key barriers to better integration: inadequate economic justification, lack of coordination and/or control, lack of public and political support, and gaps in current knowledge. A summary of these barriers and solutions are included in Table 3.2.

"Joining-Up Urban Water Management with Urban Planning and Design" (Stoker et al., forthcoming) identified more specific coordination devices, organized into four functional groups (Process, Professional or Organizational Development, Legal/Regulatory, and Analytical/Informational). These devices are included in Table 3.2.

Table 3.2 is color coded by functional group and assigned to an integration solution. The WE&RF project also includes a Barriers-Bridges Matrix as a helpful resource for identifying the most appropriate coordination devices for a range of identified barriers.

Table 3.2
Barriers and solutions to diversified water supplies and better integration

Barrier	Integration Solutions	Coordination Devices* (Stoker et al., forthcoming)
Inadequate Economic Justification	 **Funding solutions,** such as alternative funding sources, pilot projects, and improved financial planning and budget priorities, can help to address the significant capital outlay required for many water supply projects.	5. Joint grant writing for shared endeavors
	 **Cost-benefit tools** help make the financial case for integration and highlight the benefits of collaboration.	
Lack of Coordination and/or Control	 **Institutionalized collaboration** through interagency and interdisciplinary approaches that define clear roles and responsibilities can help in prioritizing water from planning to implementation.	1. Appointing internal coordination leaders or facilitators 6. Retaining external, neutral coordination facilitators 7. Permanent cross-paradigm coordinating groups, councils, or commissions 4. Mandatory consistency between water and land use decisions 5. State and/or federal mandates for collaboration or consistency on specific activities (for example, planning or demand forecasting) 2. Consolidation or merger of the departments or agencies 4. Developing an official memo of understanding or cooperation between organizations 6. Joint organizational strategic planning
	 **Planning at the right scale** and knowing when it is important to expand the reach to a larger geographic scale (e.g., from municipal to regional or watershed) will help to ensure the right stakeholders are at the table for decision making and building trust and relationships.	3. Creating or strengthening regional governance

(continued)

Table 3.2 Continued

Lack of Public and Political Support		**Public education and stakeholder engagement** through early communication, education and branding, and consistent messaging enable greater public buy-in.	8. State or regional assistance with guidance or facilitation 9. University or extension service assistance with guidance or facilitation 10. Water and planning units working together on shared citizen involvement activities 2. Conducting joint education programs for citizens and/or elected officials
		Informing decision makers to enact **policy and regulatory changes** can also go a long way towards creating the appropriate mandates and/or incentives for increased collaboration (e.g., requiring a comprehensive plan water element).	1. Collaboration to update or reform building and development codes 2. Coordination on land development project evaluation 3. Coordination on other permit processes
Gaps in Current Knowledge		**Data collection and sharing** can help to better link water provider and community planning processes while also filling knowledge gaps and getting all stakeholders aligned.	1. Agreeing on appropriate indicators for performance metrics 3. Improving or creating common or consistent data sets 6. Joint tours, training events, field trips, or workshops 2. Coordinating planning processes 3. Joint future scenarios planning, visioning, or goal setting 4. Knowledge networks (or learning alliances) that help participants see the connections between their roles and the benefits of working with others to solve problems 5. Professional expert forums where scientific, technical, or economic information on water and planning is discussed 1. Collaborative capacity audits to identify impediments to collaboration or missed opportunities 7. Joint professional development or training or certification in areas of common concern
		**New technology and innovation** will continue to increase the performance of alternative water supply technologies, making them more cost effective, and thereby encouraging greater adoption.	4. Joint demonstration projects 5. Joint research or white papers

*Coordination device font colors correspond to the four functional groups: Process, Professional or Organizational Development, Legal/Regulatory, and Analytical/Informational

THE ROLE OF OTHER STAKEHOLDERS

Key to making better long-term plans, regulations, and processes that integrate water and land use and better maximize the use of alternative supplies is making sure the right people are in the room. A cross-section of individuals involved in both land use and water planning are obviously needed, but so are local decision-makers, as well as stakeholder groups within the community. Important additional stakeholders to consider in any coordinated process include real estate representatives, builders and developers, landscape architects, health agencies, regional organizations, and consultants.

As an organizing structure, communities may consider bringing together a mix of community planners, water planners, and additional stakeholders into a multi-disciplinary integration team. This team would benefit from the involvement of departments—local and regional—charged with water supplies, water conservation, wastewater treatment, infrastructure development, stormwater management, and transportation, especially if organizations with these responsibilities are not all housed within one governmental entity.

City of Tucson and Pima County, Arizona
Solution: Institutional Collaboration & Public Education and Stakeholder Engagement

Development of the City of Tucson and Pima County, Arizona's Water and Wastewater Infrastructure Supply and Planning study required engagement from a wide variety of city and county staff as well as members of the public to make the study a success (Pima County, 2008). Staff participated from city water, county wastewater, city and county public works, city and county planning, city and county managers' offices, city development services, city and county sustainable development departments, city parks and recreation, county office of science and conservation, county development services department, and regional flood control district. In addition, residents from an existing water and wastewater advisory committee and other members of the public were similarly engaged.

A first step for the integration team could be to review the alternative water supply options that can be feasibly implemented in the community through evaluation of the community's current alternative water supply and conservation plans, and then to assess the disconnect between these documents and the community's comprehensive plan, land use and other development codes (e.g., zoning, site plan, subdivision, building, plumbing), and other regulations and initiatives (e.g., incentives, development agreements, and post-occupancy enforcement measures). This review and assessment will make the benefits of cooperation clearer as land use and water planners learn more about each other and the scope of services that each provides.

The importance of public participation, engagement, outreach, and education should not be underestimated in development of plans, regulations, and processes to better integrate water and land use, as lack of public support can slow the public process and have great influence over elected decision-makers.

Involving consultants and others that have specific technical expertise may also be critical. For example, it may be necessary to conduct local modeling and data collection to demonstrate the effectiveness of low-impact development techniques before flood control departments and water quality agencies will change their policies allowing for water providers and developers to invest in new projects.

Two stakeholder groups that were explored further as part of this research effort, using focus groups, were third parties and developers. Findings from this work are summarized in the sections below.

Third-Party Facilitators/Coordinators

The research team explored the role of external or third parties as an integration solution, either in a guiding or facilitation role. The survey results seemed to indicate that outside help was not a key ingredient to enabling better collaboration, but the case study interviews seemed to indicate the opposite. Through input from the focus group, it was confirmed that third parties many times will act as conveners, facilitators, drivers of decision making, data and resource providers, and/or consultants to solve a problem (for ultimate adoption by a decision-making body). Importantly, there are a variety of types of third-party entities: quasi-governmental, non-profit, academic, and private companies. Third party entities can act as neutral facilitators and thereby incorporate a broad range of stakeholder interests, which is particularly useful for contentious and complex issues. This has a distinct advantage over entities that have vested interests in a particular outcome. A disadvantage of third parties may be that they can add another layer of process or government to the decision-making process. Also, there are situations that are appropriate for a third-party convener – such as issues that are divisive, will take a lot of time, and will generate a lot of input. And there are situations in which a third-party convener is not necessary, such as when a decision/program does not affect many people. So, careful consideration should be given to whether engaging one would be helpful or not.

Developers

Because developers are critical to the successful implementation of many alternative water supply projects, their input on challenges and barriers as well as potential incentives and/or best practices was collected via a focus group.

When it comes to challenges and barriers, the public health community (which involves planning review activities) generally errs on the side on being safe and conservative to protect consumer health in terms of water supply purposes (e.g., generally not favorable to approaches that could put consumers at risk). In converse, the water supply community errs on the side of having multiple alternatives and system redundancies, which drives the need/interest in multiple supplies. The different priorities between these groups create barriers to implementing alternative water supply approaches, and exploration of more common/middle ground is needed. Current development requirements generally do not allow flexibility for the development community to propose a creative approach that could use less water and/or an alternative supply. Most regulations still require a set amount of water regardless of alternative supply techniques and/or aggressive conservation measures. Differing approval authorities for land use versus water providers can create complications and increase opportunities for misalignment or conflict.

Expedited application processing and flexible water requirements for different design approaches were identified as potential incentives by the developer focus group. When everyone sits at the table together (including planners, water utilities, and the environmental community), the outcomes tend to be better than when processes and conversations are separated. Interestingly, developers see the environmental community as an ally in having conversations with utilities and planners about alternative water supply projects and reducing water demand and think it can be valuable to include them in the process to advocate for more sustainable outcomes. A lot of

developments have a design review committee/architectural committee in place to enforce neighborhood covenants and restriction ordinances. In general, the water community is not very connected to this type of control but there is significant opportunity to leverage such groups to enforce things like water use and landscape design.

CASE STUDIES OF INTEGRATION AT WORK

There are multiple examples of communities, regions, and/or projects that have successfully overcome barriers by leveraging a variety of integration solutions. A series of interviews was conducted with 12 communities and stakeholders (Appendix D) to gain an in-depth perspective of how alternative water supply and land use decisions are made in concert with one another in some of these communities.

Table 3.3
Community case studies

Community	Alternative Supplies	Integration Solutions
Aurora, CO	• Conservation • Potable Reuse (indirect)	• Institutionalized Collaboration • Public Education and Stakeholder Engagement • Policy & Regulatory Changes • Data Collection & Sharing • New Technology & Innovation
Boulder, CO	• Conservation • Stormwater Capture	• Funding Solutions • Planning at the Right Scale • Policy & Regulatory Changes
Fort Collins, CO	• Conservation • ASR (Considered) • Water Sharing	• Funding Solutions • Cost-benefit Tools • Planning at the Right Scale
Kansas City, MO	• Stormwater Capture • Non-Potable Reuse (Proposed)	• Institutionalized Collaboration • Planning at the Right Scale • Public Education & Stakeholder Engagement
Manatee County, FL	• Conservation • Desalination (Considered) • Water Sharing	• Institutionalized Collaboration • Planning at the Right Scale • Policy & Regulatory Changes

(continued)

Table 3.3 Continued

Community	Alternative Supplies	Integration Solutions
Pima County/Tucson, AZ	• Conservation • Non-Potable Reuse • Stormwater Capture • Rainwater Capture • ASR • Greywater	• Institutionalized Collaboration • Planning at the Right Scale • Public Education & Stakeholder Engagement • Policy & Regulatory Changes • New Technology & Innovation
San Francisco, CA	• Potable Reuse (Considered) • Conservation • Non-Potable Reuse • Stormwater Capture • Rainwater Capture • Desalination (Considered) • Water Sharing • Greywater	• Planning at the Right Scale • Policy & Regulatory Changes • Data Collection and Sharing • New Technology & Innovation
San José, CA	• Conservation • Non-Potable Reuse • Stormwater Capture	• Institutionalized Collaboration • Public Education & Stakeholder Engagement
Sarasota County, FL	• Non-Potable Reuse • ASR	• Institutionalized Collaboration • Data Collection and Sharing • New Technology & Innovation
Soquel Creek Water District, CA	• Conservation • Stormwater Capture (Considered) • Potable Reuse (Indirect Considered) • Desalination (Considered) • Water Sharing (Considered)	• Institutionalized Collaboration • Public Education & Stakeholder Engagement • Policy & Regulatory Changes • New Technology & Innovation
Sterling Ranch, CO	• Conservation • Stormwater Capture • Rainwater Capture	• Planning at the Right Scale • Policy & Regulatory Changes • Data Collection and Sharing • Public Education & Stakeholder Engagement • New Technology & Innovation
Westminster, CO	• Conservation • Non-Potable Reuse	• Institutionalized Collaboration • Policy & Regulatory Changes • Data Collection and Sharing

Each case study identifies the relevant alternative water supplies considered in the community as well as which integration solutions were used to help overcome the traditional barriers to water and land use collaboration identified as part of the literature review phase of this research.

Virtually all the communities interviewed have some level of institutionalized collaboration between water and land use planning departments, as well as a water element integrated into their comprehensive plan. In contrast, there are limited examples of how communities have addressed the financial/economic barriers to more effective collaboration. This research finding highlights a potential area for further exploration. Though the financial cost of collaboration itself has not been identified as a significant barrier, the capital outlay required for many alternative water supply projects is an identified barrier. Additionally, the survey results also indicate concern over a weak appreciation for the benefits of collaboration, indicating the need for more resources and tools that can help stakeholders develop the necessary economic justifications for both alternative supply projects and collaboration to help with buy-in.

INTEGRATED PLANNING RESOURCES

Literature Review and Case Study Database

Findings from the literature review and interview stages of the research were compiled into a Microsoft Excel® database. This resource includes all the details of these efforts, allowing the user to search and filter results and explore the specific findings of individual resources in more detail. The final version of this database is available for download from the Water Research Foundation website.

Coordinated Planning Guide

The Coordinated Planning Guide is intended to provide an overview for water providers and community planners to better understand the who, what, where, why, when, and how of improving coordination and integration of alternative water supply projects. Organized into chapters by planning activity (Plans, Regulations, and Processes), the guide steps a user through the typical planning workflow or tasks and helps water utilities navigate to where they can engage in these activities based on the intended breadth/scale of their water supply planning efforts (site, neighborhood, utility, and regional). The guide also includes key takeaways from case studies included in this research report.

The intent is that this guide is to act as a decision support tool giving communities the legal, technical, and process resources and methodologies that enable them to diversify their water supplies and reduce demand through the land use process. Additionally, the guide helps identify applicable regulatory authorities and governance considerations, related land use processes and considerations, staging of the water planning and supply process, and other pertinent information.

CHAPTER 4
CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Alternative water supplies reduce strain on traditional water supplies, however, they require greater coordination between water providers and land use planners for benefits to be fully realized. General research findings and conclusions suggest that this research can be directly applied to the water resources industry as well as to the larger land use planning and development community. Specific conclusions follow:

Water and Land Use Planners Are Coordinating, but There Is Room and Desire for Improvement

The survey results indicated that coordination between water and land use planners is happening, in general, and more often in urban and suburban areas, as opposed to rural areas. However, the extent to which coordination is happening varies widely among communities, and it does not necessarily occur specifically for alternative water supply development. The literature review, survey results and interviews all showed there were significantly fewer examples of coordinated planning related specifically to alternative supply development, as opposed to just general water and land use planning. This is likely a reflection of the fact that alternative water supplies are less common in general, the potential applications for each method vary, and the benefits and pathways for coordinating planning efforts are less well known.

The Benefits of Coordination Tend to Outweigh the Challenges/Costs

The interviews conducted with communities across the Unites States revealed clear drivers and benefits of both supply diversification and coordinated planning. The drivers for diversifying water supply vary by geographic region and included: population growth (San Francisco, CA), improving reliability and resiliency (Sarasota, FL), and environmental protection (Boulder, CO). Benefits and drivers of integrated planning include resolving conflicts between various planning efforts (Sterling Ranch, CO), enabling pursuit of additional community priorities (Pima County/Tucson, AZ), and improving water management planning and supply sustainability (Kansas City, MO), among others.

The challenges of integrated planning are, of course, important to acknowledge as well. The main challenge of deeper coordination identified in the interviews is the additional time required to align work products with more people when time is a common constraint. Additionally, water and land use professionals many times have different end objectives which can make the idea of integration less intuitive.

Considering the pros and cons, the research interviews conducted all indicated a net benefit from better coordination, despite any challenges encountered (Aurora, CO). The quantitative costs and benefits of coordinating have not been well defined, and is an area that could benefit from additional evaluation and research.

The Scale at Which Alternative Water Supplies Are Developed Implies Different Land Use Planning Coordination

The scale of water planning has a bearing on how it can be integrated into land use planning, demonstrated in both the literature review and interviews. Utility scale alternative water development projects – like desalination and aquifer storage and recovery – are often best addressed in long-range planning efforts, aligning the water and land use priorities for a community/region from the start. Coordination on site scale alternative water supplies – like greywater and stormwater capture – which are typically installed and managed by owners and occupants rather than water providers, can be addressed at a virtually all planning stages, particularly in the codes and regulations, and in the development review processes.

Institutionalized Coordination between Water and Land Use Planners Is a Key Solution to a Primary Barrier

The survey results indicated that lack of time was a primary barrier to better collaboration, along with several other organizational/institutional topics, including lack of directive, lack of specified duties/roles, and challenging jurisdictional issues. While finding more time is always a challenge, this report and companion Guide may help provide a shortcut to achieving more coordination.

According to the interviews, communities that are collaborating in water and land planning cited institutionalized coordination as a primary integration technique, though achieving institutionalized collaboration will look a bit different in each community. For example, the ability of a water utility to coordinate with a local governmental planning agency is very different if they are a municipal water utility, guided by the same policies and decision-making body, versus an independent (private or enterprise) utility.

Strong leadership is key in ensuring coordination happens, and clearly defined roles of staff will help enable it to continue. The focus group interviews underscored the fact that third party entities have also played a strong role in convening stakeholders.

There Is Significant Potential and Desire to Better Integrate Alternative Water Supplies into the Land Use Planning Process

The survey indicated a strong desire to improve integration of water (including, but not limited to, alternative water supply) and land use planning further. Land use planners are uniquely positioned to integrate alternative water resources into their plans, codes and regulations, and development review processes. Water providers can proactively promote their alternative water supply plans and programs through these channels, helping other stakeholders navigate the technical details to identify the most appropriate applications for each supply option. Educating developers, planners, and the public on water supply diversification can help in getting initiatives passed and advancing innovation.

While the survey also showed strong support to have land use planners more involved in water planning efforts, there seemed to be a clear pathway for water providers to be integrated more into the land use planning process. Land use planners are accustomed to, and many times seek out, engaging multiple stakeholders in their decision-making processes and are also well positioned for connecting decisions around alternative water supplies with other community priorities. Decisions regarding long-range water planning and utility-scale alternative water

supplies should be integrated into long-range planning efforts. Site scale alternative water supplies can be integrated into virtually all forms of land use planning, in particular codes and regulations, and development review processes. The Coordinated Planning Guide, the companion document to this research report, should be reviewed for a detailed look at how this can be achieved.

RECOMMENDATIONS

The integration and coordination of alternative water supply development and the land use planning process can be achieved in several ways. In many communities, there is some degree of coordination already – this a foundational step in building the relationships and channels of communication needed to become more coordinated. Ensuring effective and deeper coordination usually needs to be supported by leadership in both the water and land use departments. To examine where more collaboration is needed to advance alternative water supplies, and how to do it, we recommend the following for communities interested in advancing the development of alternative water supplies.

Coordinate Long-Range Plans

- Conduct Research: Identify the alternative water supply types in use or available in your community and establish a baseline of information about them. Also review state/local water and health laws for any pertinent requirements. Use this information and research to inform all next steps taking into account which land use planning activities are best suited to the alternative water supplies of interest.
- Review Plans: Review your community's comprehensive plan and water management plans to see if/how alternative water supplies are addressed. Additional research may be necessary to inform potential alternative supply approaches. Introduce or explore ways to integrate alternative water supply opportunities in capital improvements planning.
- Align Projections: Check on the sources for the land use planning population projections; compare against the population projections/sources used by water utilities. Population can be a first step to more in-depth discussions about projections of the future, considering additional topics such as climate change and the economy, commercial/industrial/institutional customer trends, etc.

Coordinate Codes and Regulations

- Evaluate Regulations: Evaluate your community's zoning, subdivision, and development regulations, growth management strategies, as well as state laws and regulations, to see where there may be unintended barriers or opportunities to implement alternative water supply projects.
- Review Fees and Incentives: Review fee structures and code requirements to see if there are any opportunities to incentivize or promote alternative water supply projects.
- Integrate Ordinances: Review any separately adopted water sustainability ordinances and see if there are ways to integrate them with zoning, subdivision and/or development regulations.

Coordinate Development Review Processes

- Build Teams: Invite your water utility or community planner counterpart to a meeting to get to know them and explore opportunities for enhanced collaboration on alternative water supplies. If such a relationship already exists, expand your efforts to establish a multi-disciplinary team of water and land use planning professionals and set up a mechanism for routine coordination.
- Clarify Review Processes: Examine the steps in the development review process to see where/how water utilities can or should be more engaged. Formalize those opportunities for collaboration via steps or sub-steps in your development review process.
- Inform Decision Makers: Provide training or information to elected and appointed officials (especially those involved in land use approvals) about alternative supply types, methods, options, and/or challenges in your community.
- Revisit Inspection Procedures: Review your community's inspection procedures and staffing assignments to ensure that inspections are happening at the right time(s) and that staff has sufficient training.

Based on the research findings a more extensive review of the following areas should be explored through future research.

- The triple bottom line (economic, social, environmental) costs and benefits of improved collaboration.
- Funding mechanisms – such as alternative funding sources, pilot projects, and improved financial planning and budget priorities – to support alternative supply development and integration efforts.
- The costs and benefits of specific alternative water supply options to help in prioritization and decision making.
- The development of tools and techniques to standardize how water resource impacts are calculated in new development and redevelopment projects.
- Geographic differences of alternative water supply uptake and technologies.
- The most effective models/examples of institutionalized collaboration.

APPENDIX A
SURVEY ON WATER UTILITY AND LAND USE PLANNING COLLABORATION, SURVEY INSTRUMENT

Q1 Water, wastewater, and stormwater professionals are being asked to work more collaboratively with urban planners. In this survey, we want to know about your experiences in water and land use planning processes, and your opinions on the best ways to improve the state of collaboration between these two sectors. The survey should take 20-30 minutes to complete (you may stop and continue at any time). Your participation is completely voluntary, and your responses are confidential. Upon completion, you may enter your name in a drawing to win an iPad. First please tell us a bit about your background.

Q2 In which city, state, and county is your organization located?

City (if applicable):
State:
County:

Q3 Which category best describes the organization where you work on water issues? (Please check one):

- ❍ Water supply utility, agency, or department (1)
- ❍ Wastewater utility, agency, or department (2)
- ❍ Stormwater utility, agency, or department (3)
- ❍ Combined utility, agency, or department (for example, water and wastewater) (4)
- ❍ Public planning department in a township, city, or county (5)
- ❍ Non-profit, non-governmental organization (6)
- ❍ Private firm or consultancy (7)
- ❍ Public board member or commissioner or other appointed official (8)
- ❍ Elected official (9)
- ❍ Regional water or planning agency (10)
- ❍ Other (please specify) (11) _____

SKIP LOGIC: if Private firm or consultancy Is Selected, Then Skip To What is the name of the organization ...If Public board member or commissioner... Is Selected, Then Skip To What is the name of the organization ...If Elected official Is Selected, Then Skip To What is the name of the organization ...If Regional water or planning ... Is Selected, Then Skip To What is the name of the organization ...If Other (please specify) Is Selected, Then Skip To What is the name of the organization ...If Public planning department ... Is Selected, Then Skip To What is the name of the organization ...If Non-profit, non-governmental... Is Selected, Then Skip To What is the name of the organization ...

Q4 What best describes your current function? (Please check all that apply):

- ❑ Operations, maintenance, or other technical staff (1)
- ❑ Manager/Director (2)
- ❑ Customer service (3)
- ❑ Business operations (e.g., finance or billing) (4)
- ❑ Other (please specify): (6) _____

Q5 What best describes your organization? (Please check one):

- ❍ A special purpose district or independent authority (1)
- ❍ Part of a general purpose government (2)
- ❍ Other (please specify): (3) _____

Q6 What is the name of the organization where you are employed, appointed, elected, or volunteer to work on water management (if multiple, please enter the one where you spend the most time)?

DISPLAY LOGIC: Only display Q7 if Q3 Answer is Public planning department in a township, city, or county

Q7 What best describes your current function? (Please check one):

- ❍ Comprehensive or long-range planning (1)
- ❍ Current planning or development review (2)
- ❍ Open space or natural resource planning (3)
- ❍ Multi-functional (for example, comprehensive planning and project reviews, etc.) (4)
- ❍ Other (Please specify): (5) _____

DISPLAY LOGIC Only Display Q8 if Q3 Answer is Non-profit, non-governmental organization

Q8 What best describes your organization? (Please check one):

- ❍ Environmental or conservation group (1)
- ❍ Business or economic development group (2)
- ❍ Other (please specify): (3) _____

Q9 How large is the community or region that is served by your organization? (May check more than one)

- ❑ Less than 20,000 (1)
- ❑ 20,000-49,999 (2)
- ❑ 50,000-249,999 (3)
- ❑ 250,000-499,999 (4)
- ❑ 500,000-999,999 (5)
- ❑ Greater than 1 million (city or region) (6)
- ❑ I work for an organization with state-, multi-state, or national-level responsibilities (7)
- ❑ I work for a firm or consultancy that serves various communities (for example from cities to state-level projects) (8)

Q10 Which of the following landscapes comprise at least one-quarter of the geography served by your organization? If you serve multiple communities (for example as a consultant or statewide official) please describe the range of settings in which you work. (Please check all that apply):

- ❑ Urban (1)
- ❑ Suburban (2)
- ❑ Rural village or town (3)
- ❑ Rural countryside (4)

Q11 Collaboration in your community We are interested in learning how important you think it is for local water professionals and managers to collaborate with municipal or county planners to resolve or better manage water issues or services. Please note: Local water professionals and managers are utility officials or consultants who plan and manage water supplies, wastewater, or stormwater systems. Municipal or county planners are typically public employees or consultants who work on comprehensive planning, neighborhood plans, open space plans, zoning, subdivisions, or other land use regulations, or review development projects for zoning/master planning consistency.

Q12 How much collaboration happens between water utilities or departments and municipal/county planning departments in the community or communities where you work? Please rank on a scale from we "never" collaborate to "always."

- ❍ Never (1)
- ❍ Sometimes (2)
- ❍ About half the time (3)
- ❍ Most of the time (4)
- ❍ Always (5)

Q13 Do you think the role Municipal or County Planners currently play with respect to decisions by water utilities (water supply, wastewater, or stormwater) is:

- ❍ Just about right (1)
- ❍ Not involved enough (2)
- ❍ Too involved (3)
- ❍ I don't know (4)

Q14 Do you think the role water utilities (water supply, wastewater, or stormwater) play with respect to decisions by municipal or county planning agencies is:

- ❍ Just about right (1)
- ❍ Not involved enough (2)
- ❍ Too involved (3)
- ❍ I don't know (4)

Q15 For each of the following, please rate the importance of collaboration between the local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)	Unsure (6)
Conservation:						
1. Preserving/ restoring watersheds, wetlands, or other features or areas	❍	❍	❍	❍	❍	❍
2. Potable water conservation	❍	❍	❍	❍	❍	❍
3. Ordinances, zoning, or codes at the building or development level	❍	❍	❍	❍	❍	❍
Education or Outreach:						
1. For the public on some particular water topic(s)	❍	❍	❍	❍	❍	❍
2. For elected officials on some particular water topic(s)	❍	❍	❍	❍	❍	❍
3. With one another (i.e., between water and planning agencies)	❍	❍	❍	❍	❍	❍
Emergency Planning or Management:						
1. Climate change adaptation	❍	❍	❍	❍	❍	❍
2. Drought	❍	❍	❍	❍	❍	❍
3. Floods or storms	❍	❍	❍	❍	❍	❍
4. Other service disruptions (please specify):	❍	❍	❍	❍	❍	❍

Q16 For each of the following, please rate the importance of collaboration between the local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)	Unsure (6)
Infrastructure:						
1. Multi-year capital improvement programming	❍	❍	❍	❍	❍	❍
2. Expanding facility capacities to meet demands of growth	❍	❍	❍	❍	❍	❍
3. Adding public amenities to infrastructure projects or using infrastructure as public amenities (e.g., recreation facilities in retention basins)	❍	❍	❍	❍	❍	❍
4. Maintenance (e.g., maintaining plants in green infrastructure projects)	❍	❍	❍	❍	❍	❍
5. Specific project planning and/or design	❍	❍	❍	❍	❍	❍
6. Service area planning	❍	❍	❍	❍	❍	❍

Q17 For each of the following, please rate the importance of collaboration between the local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)	Unsure (6)
Alternative or Emerging Systems: 1. Desalination	❍	❍	❍	❍	❍	❍
2. Water recycling (reclamation, reuse, etc., including potable or non-potable)	❍	❍	❍	❍	❍	❍
3. Green infrastructure or low impact development	❍	❍	❍	❍	❍	❍
4. Rainwater collection and use	❍	❍	❍	❍	❍	❍
5. Greywater for irrigation, indoor use, or heat recovery	❍	❍	❍	❍	❍	❍
6. Transferring or sharing agriculture water for urban use	❍	❍	❍	❍	❍	❍
7. Small scale water and wastewater systems for office blocks, neighborhoods, or households	❍	❍	❍	❍	❍	❍

Q18 For each of the following, please rate the importance of collaboration between the local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)	Unsure (6)
Planning:						
1. Guiding land development patterns or densities	❍	❍	❍	❍	❍	❍
2. Data collection or analysis on water related issues	❍	❍	❍	❍	❍	❍
3. Master, general, or comprehensive planning	❍	❍	❍	❍	❍	❍
4. Population growth, urban growth, or service demand forecasting	❍	❍	❍	❍	❍	❍
5. Planning water supply and waste water service capacity	❍	❍	❍	❍	❍	❍
6. Utility master planning	❍	❍	❍	❍	❍	❍
Regulation:						
1. Land development project reviews and permitting	❍	❍	❍	❍	❍	❍
2. Septic system, discharge, diversion, or water withdrawal permits	❍	❍	❍	❍	❍	❍
3. Updating zoning, subdivision, or other regulations	❍	❍	❍	❍	❍	❍
4. Combined Sewer Overflow, Total Maximum Daily Load, or other water quality regulations or mandates	❍	❍	❍	❍	❍	❍

Q19 If there are other areas where you think it's important for local water professionals and managers to work with the municipal or county planners, please list them here:

Q20 **Examples of working together (or not)** We want to conduct case studies of planners and water professionals working well together to resolve or better manage water issues or services, and cases where improved interaction could produce better outcomes. Do you know of cases that we should study? If so, please briefly describe them below, including the purpose or activity and where it occurred with sufficient detail so we can follow up. Please include the city/county and state, and a contact if you know one. Case(s) of working well together:

Q21 Case(s) where better interaction could have produced better outcomes:

Q22 Barriers to Collaboration: Please indicate your level of agreement as to whether or not the following are currently major barriers to collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work. Please rate from "strongly agree" it is a major barrier to collaboration, to "strongly disagree" it is a major barrier to collaboration.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)	I don't know/not applicable (6)
<u>Political factors:</u> 1. Resistance from external stakeholders (elected, state, community, business)	❍	❍	❍	❍	❍	❍
2. Fear of being linked to another agency's failures	❍	❍	❍	❍	❍	❍
3. Concerns over losing organizational power, resources, or status	❍	❍	❍	❍	❍	❍

Q23 Barriers to Collaboration: Please indicate your level of agreement as to whether or not the following are currently major barriers to collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)	I don't know/not applicable (6)
Institutional/Organizational factors:						
1. General opinions that it is unnecessary to collaborate because each organization's activities do not significantly affect the other's work	❍	❍	❍	❍	❍	❍
2. Differing agency legal mandates or regulations (local, state, or federal)	❍	❍	❍	❍	❍	❍
3. Lack of time - too many other priorities to deal with	❍	❍	❍	❍	❍	❍
4. Lack of a central authority over both the planners and water professionals	❍	❍	❍	❍	❍	❍
5. No one responsible for coordinating	❍	❍	❍	❍	❍	❍
6. No mandates or incentives to work together	❍	❍	❍	❍	❍	❍

Q24 Barriers to Collaboration: Please indicate your level of agreement as to whether or not the following are currently major barriers to collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)	I don't know/not applicable (6)
<u>Economic/Financial factors:</u> 1. The financial costs of collaboration seem to outweigh the benefits	❍	❍	❍	❍	❍	❍
2. Different cycles in planning budgets or resource uncertainty	❍	❍	❍	❍	❍	❍
3. Concern over losing financial resources	❍	❍	❍	❍	❍	❍
4. Insufficient financial resources to support collaboration	❍	❍	❍	❍	❍	❍
5. Weak appreciation of the benefits of collaborating (e.g., how green infrastructure helps housing values or how recreational spaces improve health)	❍	❍	❍	❍	❍	❍

Q25 Barriers to Collaboration: Please indicate your level of agreement as to whether or not the following are currently major barriers to collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)	I don't know/not applicable (6)
<u>Processes and Management:</u> 1. Concerns that cooperation could delay implementing needed solutions or projects	❍	❍	❍	❍	❍	❍
2.Geographic distance between units	❍	❍	❍	❍	❍	❍
3. Inadequate cross-organizational data or modeling capacities (e.g., apples to oranges data sets)	❍	❍	❍	❍	❍	❍
4. Lack of mechanisms for organizing or managing collaboration	❍	❍	❍	❍	❍	❍
5. It is unclear who to work with	❍	❍	❍	❍	❍	❍

Q26 Barriers to Collaboration: Please indicate your level of agreement as to whether or not the following are currently major barriers to collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)	I don't know/not applicable (6)
Behavioral, Cultural, Personal:						
1. Negative attitudes toward the other profession or organization	❍	❍	❍	❍	❍	❍
2. Conflicting professional cultures or priorities between urban planners and water utility professionals	❍	❍	❍	❍	❍	❍
3. Insufficient knowledge about each other's professions	❍	❍	❍	❍	❍	❍
4. Lack of staff interest	❍	❍	❍	❍	❍	❍
5. Poor historical relations or mistrust of the other organization or personnel	❍	❍	❍	❍	❍	❍

Q27 Tools and Activities for Collaboration Please rate how effective you think the following are or could be for fostering collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely effective (1)	Very effective (2)	Moderately effective (3)	Slightly effective (4)	Not effective at all (5)	I don't know/not applicable (6)
Process:						
1. Appointing internal coordination leaders or facilitators	❍	❍	❍	❍	❍	❍
2. Coordinating planning processes	❍	❍	❍	❍	❍	❍
3. Joint future scenarios planning, visioning, or goal setting	❍	❍	❍	❍	❍	❍
4. Knowledge networks (or learning alliances) that help participants see the connections between their roles and the benefits of working with others to solve problems	❍	❍	❍	❍	❍	❍
5. Professional expert forums where scientific, technical, or economic information on water and planning is discussed	❍	❍	❍	❍	❍	❍

…continued on next page…

	Extremely effective (1)	Very effective (2)	Moderately effective (3)	Slightly effective (4)	Not effective at all (5)	I don't know/not applicable (6)
6. Retaining external, neutral coordination facilitators	❍	❍	❍	❍	❍	❍
7. Permanent cross-paradigm coordinating groups, councils, or commissions	❍	❍	❍	❍	❍	❍
8. State or regional assistance with guidance or facilitation	❍	❍	❍	❍	❍	❍
9. University or extension service assistance with guidance or facilitation	❍	❍	❍	❍	❍	❍
10. Water and planning units working together on shared citizen involvement activities	❍	❍	❍	❍	❍	❍

Q28 Tools and Activities for Collaboration Please rate how effective you think the following are or could be for fostering collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely effective (1)	Very effective (2)	Moderately effective (3)	Slightly effective (4)	Not effective at all (5)	I don't know/not applicable (6)
<u>Legal/Regulatory:</u> 1. Collaboration to update or reform building and development codes	❍	❍	❍	❍	❍	❍
2. Coordination on land development project evaluation	❍	❍	❍	❍	❍	❍
3. Coordination on other permit processes (please specify):	❍	❍	❍	❍	❍	❍
4. Mandatory consistency between water and land use decisions	❍	❍	❍	❍	❍	❍
5. State and/or federal mandates for collaboration or consistency on specific activities (for example, planning or demand forecasting)	❍	❍	❍	❍	❍	❍

Q29 Tools and Activities for Collaboration Please rate how effective you think the following are or could be for fostering collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely effective (1)	Very effective (2)	Moderately effective (3)	Slightly effective (4)	Not effective at all (5)	I don't know/not applicable (6)
Professional or Organizational Development						
1. Collaborative capacity audits to identify impediments to collaboration or missed opportunities	❍	❍	❍	❍	❍	❍
2. Consolidation or merger of the departments or agencies	❍	❍	❍	❍	❍	❍
3. Creating or strengthening regional governance	❍	❍	❍	❍	❍	❍
4. Developing an official memo of understanding or cooperation between organizations	❍	❍	❍	❍	❍	❍
5. Joint grant writing for shared endeavors	❍	❍	❍	❍	❍	❍
6. Joint organizational strategic planning	❍	❍	❍	❍	❍	❍
7. Joint professional development or training or certification in areas of common concern	❍	❍	❍	❍	❍	❍

Q30 Tools and Activities for Collaboration Please rate how effective you think the following are or could be for fostering collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work.

	Extremely effective (1)	Very effective (2)	Moderately effective (3)	Slightly effective (4)	Not effective at all (5)	I don't know/not applicable (6)
Analytical/Informational: 1. Agreeing on appropriate indicators for performance metrics	❍	❍	❍	❍	❍	❍
2. Conducting joint education programs for citizens and/or elected officials	❍	❍	❍	❍	❍	❍
3. Improving or creating common or consistent data sets	❍	❍	❍	❍	❍	❍
4. Joint demonstration projects	❍	❍	❍	❍	❍	❍
5. Joint research or white papers	❍	❍	❍	❍	❍	❍
6. Joint tours, training events, field trips, or workshops	❍	❍	❍	❍	❍	❍

Q31 If you think there is something else that would be most helpful for fostering collaboration between local water professionals and managers and the municipal or county planners, please list them here:

Q32 Are there other professions, organizations, or agencies that should be involved in the collaborations between local water professionals and managers and the municipal or county planners?

Q33 If you are willing to be contacted for follow-up questions, please provide your contact information:

Name:
Email address:
Your phone:

Q34 If you would like to be entered into a drawing to win an iPad, please give your name and email here (information will only be used for the drawing and to notify the winner; the winner may donate the prize to charity if preferred or required by ethics rules):

Name:
Email address:

APPENDIX B
SURVEY ON WATER UTILITY AND LAND USE PLANNING COLLABORATION, SURVEY SUMMARY

SUMMARY OF SURVEY RESULTS
Task 4 Deliverable
Integrating Water Management with Urban Planning and Design (SIWM5R13)

Prepared by Gary Pivo and Philip Stoker
School of Landscape Architecture and Urban Planning
University of Arizona

September 21, 2016

HIGHLIGHTS

- The survey was conducted from July 11-August 8, 2016 and distributed via email lists, e-newsletter postings and websites provided by the Water Environment & Reuse Foundation, the Water Environment Foundation, the Water Research Foundation (WRF), and the American Planning Association. 454 responses were collected from urban planners and water professionals. Our goal was to better understand the views and experiences of US urban planners and water professionals related to collaboration between the professions.
- We found no evidence of nonresponse bias but the reliance on certain organizations for our sampling means the findings may not fully reflect the views of professionals who are not associated with the sponsoring organizations.
- In most communities, professionals see collaboration occurring sometimes or most of the time. Those from nonprofits or rural places differ from others in their view on this question; they see less collaboration.
- There is more support in communities for greater engagement by water professionals in urban planning than vice versa. In water supply, wastewater, and combined utilities about half the people feel planners are already sufficiently involved in water utility decisions. This suggests there will be some resistance to increasing the role of involvement by planners in utility decisions.
- When asked about the importance of coordination between planners and water professionals for specific functions, it is viewed to be very important for 85% of the functions. Individual functions given the highest priority for coordination are flood and stormwater management, preserving watersheds, wetlands and other features, education or outreach with one another, and planning for water supply and wastewater service capacity. Coordination for the functions grouped under Alternative or Emerging Systems (e.g., greywater systems) is seen as only moderately important, rather than very important. There were only a few functions where views differed by respondent background (e.g., those working for wastewater agencies see coordination around water recycling as more important than others).

- When asked about current barriers to coordination, “lack of time” stood out as most important and most agreed upon. The most common rating for all barriers was “neither agree nor disagree,” suggesting a lack of strong professional opinion on which barriers are most critical. Institutional/Organization barriers, as a group, (e.g., time, mandates) represented four of the five most important barriers, suggesting that mandates and/or authorities are critical barriers. The only difference in responses among sub-groups is for respondents from rural places which say insufficient financial resources are a higher barrier than do respondents from suburban or urban places.
- When asked about the effectiveness of collaboration tools, we found about half the tools are viewed as very effective and only consolidation/merger of departments is considered just “slightly” effective. Also, as a group, the tools under Professional or Organizational Development are considered less effective than other categories such as Legal/Regulatory reforms.

PURPOSE OF THE SURVEY

In order to better understand the prospects for collaboration between planners and water professionals around sustainable water solutions, we undertook a national survey on behalf of the Water Environment and Reuse Foundation in collaboration with a parallel project being conducted by Brendle Group and Western Resource Advocates for the Water Research Foundation. Our purpose was to determine how much collaboration occurs in communities throughout the county, whether professionals feel there’s a need for more collaboration, the functions where they think coordination is needed most, the barriers to coordination, and the tools or practices that are thought to be most effective in fostering coordination. This information will be combined with the results of case studies to help develop integration strategies worthy of discussion in our upcoming symposium and final report.

LOGISTICS

The survey was written by University of Arizona faculty with input from project advisors and collaborators working on a related project sponsored by the Water Research Foundation. Qualtrics online survey software was used to distribute the survey via email to three different groups: 1) 419 contacts who previously watched webcasts, attended workshops, or downloaded reports by WRF; 2) 4,418 contacts from the WE&RF members database; and 3) 226 contacts that had previously completed a related survey conducted by the American Planning Association and had indicated they were willing to be contacted in the future. The survey was available online from July 11 – August 8, 2016. All three groups received three email reminders to fill out the survey. They were also encouraged to send the survey to others who might wish to participate.

In addition to email invitations, a link and invitation to complete the survey was distributed in three July 2016 e-newsletters: *Laterals* (by the WE&RF), *What’s Happening* (by the Water Environment Foundation), and *Water Current* (by the Water Research Foundation). The link was also posted as a “Latest News” item on the WE&RF Sustainable Integrated Water Management research area webpage.

Altogether, 250 individuals completed the survey via the anonymous link, and 204 individuals completed the survey via email invitation.

THE SAMPLE

The survey produced 454 useable responses. The population whose views we wished to obtain were practicing urban planning and water management professionals in the USA. However, survey sampling bias can occur when a sample is collected in a way where some members of the intended population are less likely to be included than others. The result can be findings that are influenced by the sampling method and do not fully reflect the population under study

In the present sample, there were two types of potential sample bias. The first type, known as selection bias, can occur when all the members of the population do not have an equal chance of being sampled (or invited to participate). This is normally avoided by randomly selecting from a complete list of the population. In our survey, the list of possible invitees that we could obtain did not include all planners and water professionals, but rather a list of contacts provided by WE&RF and the APA, readers of certain newsletters, and those that may have been sent the survey by others who saw or received the invitations. This subgroup of all professionals may or may not have views that differ from other planners and water professionals.

A second type of sample bias come from the fact that the survey was voluntary and people could choose whether or not to respond to the survey. This is known as "non-response" bias, where those who choose to participate may have views that differ from those that do not. This bias can be checked by doing a special study of non-respondents or by checking to see if there is a difference between the views reported by early and late respondents, assuming that late responders are somewhat like non-respondents. We did the later and found no evidence of non-response bias.

Selection bias can be mitigated by weighting some respondents more than others when computing the summary statistics. That was not possible in our sample, however, because without more complete information on the full population of planners and water professionals, we were unable to determine their distribution on "auxiliary variables," such as state location, that may affect responses and could therefore be useful for weighting. In the results below, we do show that some views are correlated with the type of organization or setting where respondents work, however those results could not be used to weight the sample because we do not know the distribution of all planners and water professionals in the nation on such auxiliary variables.

Because of this unresolved potential for sample bias, the results reported are best viewed as hypotheses about the whole target population. That said, although the views of those in our sample may or may not represent the whole population of planners and water professionals, the results are a valid depiction of the respondents' opinions, their opinions deserve serious consideration, and they may well be similar to those typical of all other planners and water professionals.

The following charts characterize the respondent population in three ways – by state location, by type of agency, and by level of urbanization. Here again, the reader should be cautious in drawing conclusions about the results based on over or under representation in these categories. For example, while the sample does include a disproportionate share of respondents from urban organizations, this may or may not matter if urbanization has no effect on professionals' views and indeed we find that it does not for all but a few questions, which are discussed below.

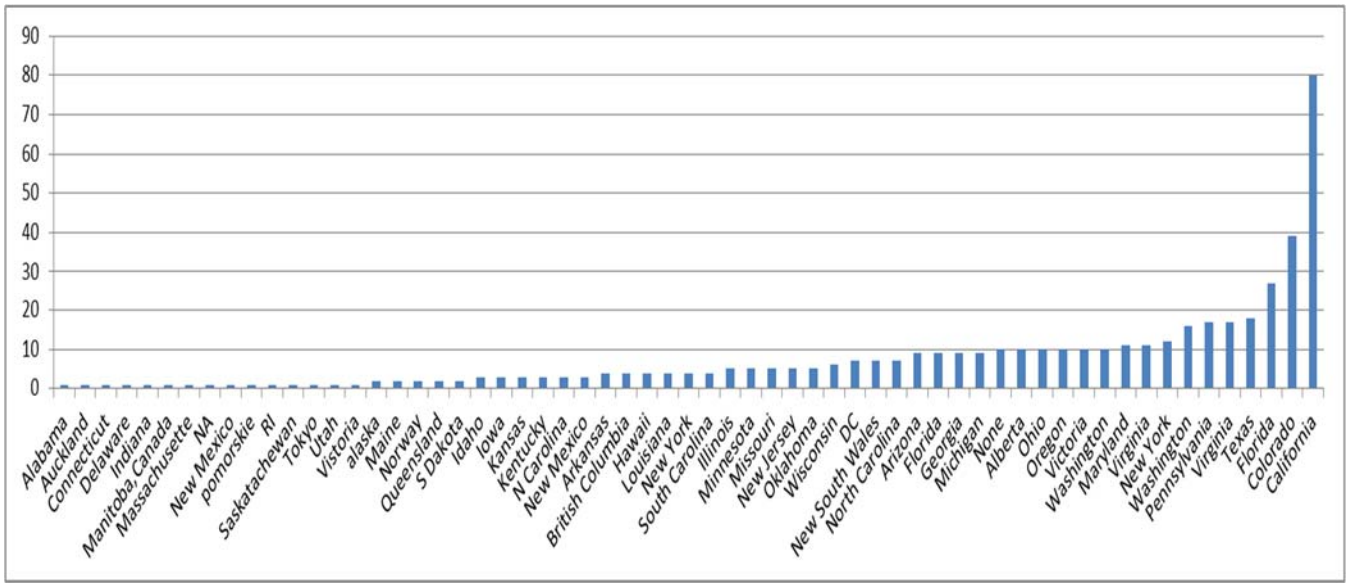

Figure B.1 Sample by state

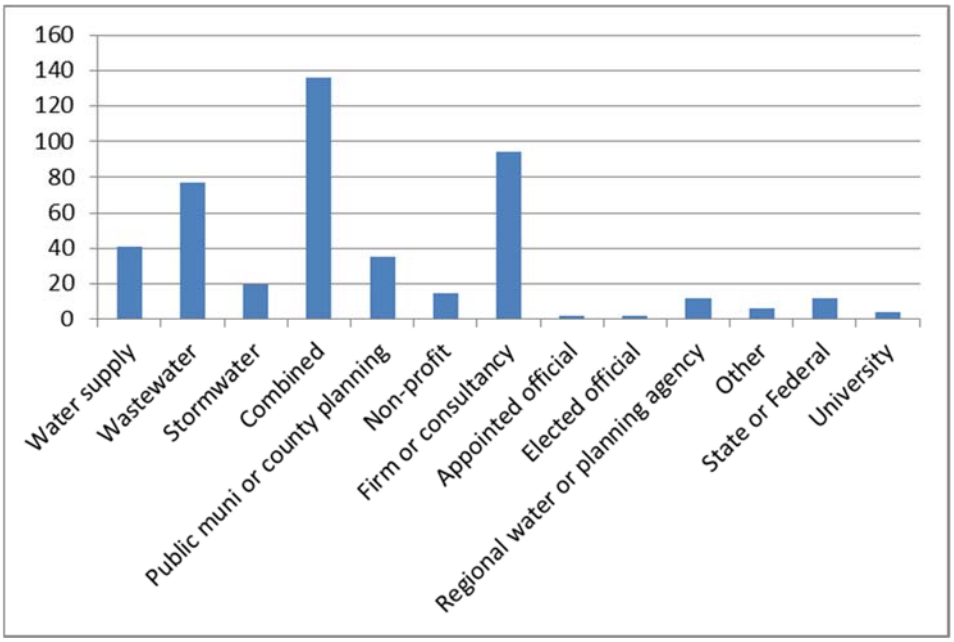

Figure B.2 Sample by type of organization

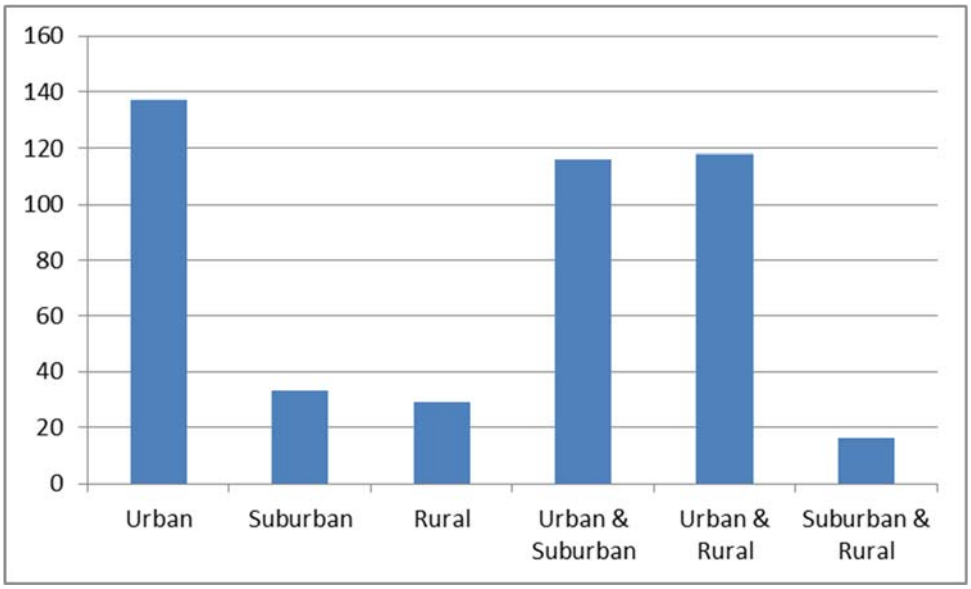

Figure B.3 Sample by type of setting

HOW MUCH COLLABORATION OCCURS?

Our first question was aimed at determining how much collaboration occurs in US communities. We asked, "How much collaboration happens between water utilities or departments and municipal/county planning departments in the community or communities where you work?" Figure B.4 gives the frequency distribution of our results. The solid bars represent the percent of respondents who chose each response. The error bars give the range within which we would expect the results to fall for the true population being studied. The error bars are given because our survey covers a sample of the true population we are studying, which is all US water and urban planning professionals. If we were to repeat the survey with a different sample of the population, the results would be somewhat different. However, we would expect the results for each response to fall within the error bars in 95% of all possible samples.

In our sample, the responses fall into a bi-modal distribution. Most respondents indicated that collaboration occurs either "sometimes" or "most of the time" in the community or communities where they work.

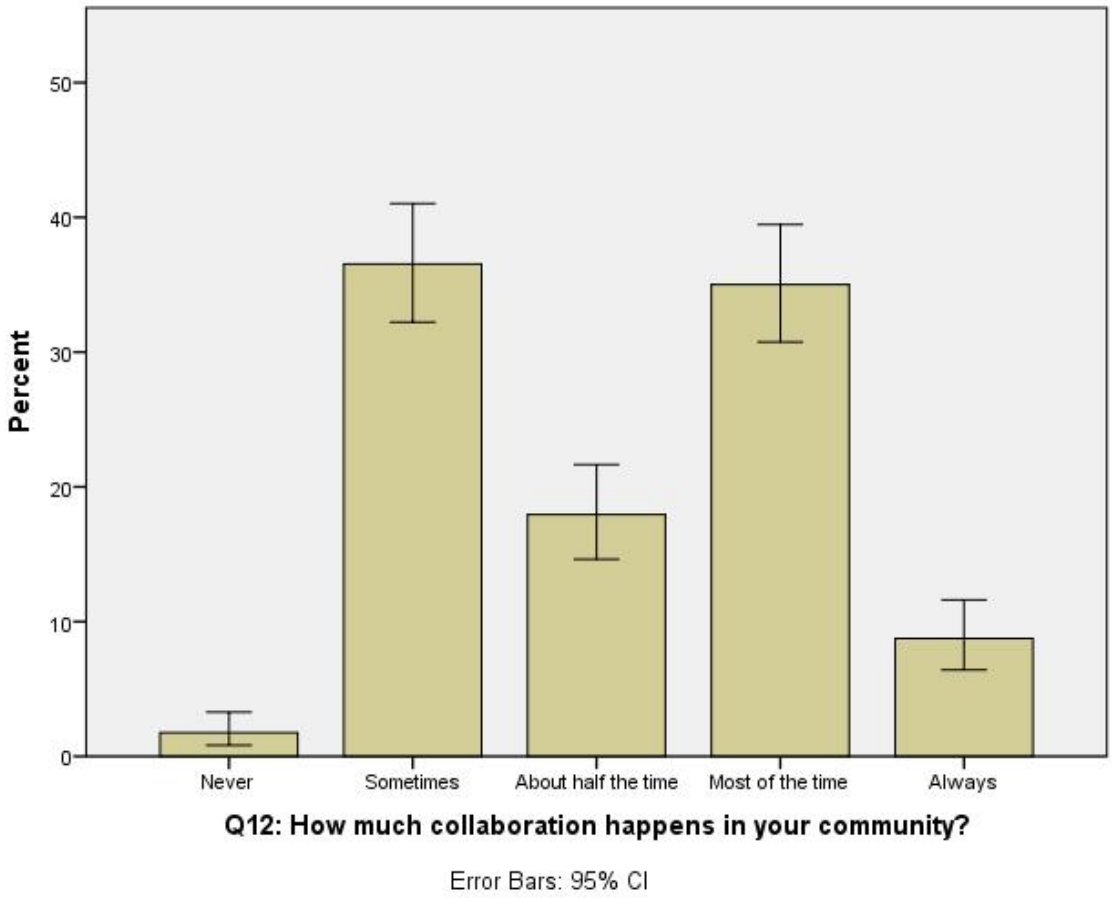

Figure B.4 How much collaboration is happening

The answers varied by certain respondent characteristics. The following "means plot" (Figure B.5) shows the average response broken down by the respondent's type of organization. On the vertical axis 2.0 and 3.0 represent "sometimes" and "about half the time," respectively. An average of 2.5 should therefore be interpreted as "halfway between sometimes and about half the time." The means plot shows that the average response for all of the groups but one tended to be "about half the time." Moreover, the differences between those groups are statistically insignificant, meaning there is a 95% chance that there is no difference between them in the true population. The one group that does break out of this pattern is the non-profits, who think collaboration occurs "sometimes." However, their response is only different in a statistically significant way from the water supply, wastewater, and combined water utility groups. About 60 percent of the nonprofits self-report as environmental or conservation groups, so we suspect that people in those groups tend to observe less coordination than those working for water management agencies.

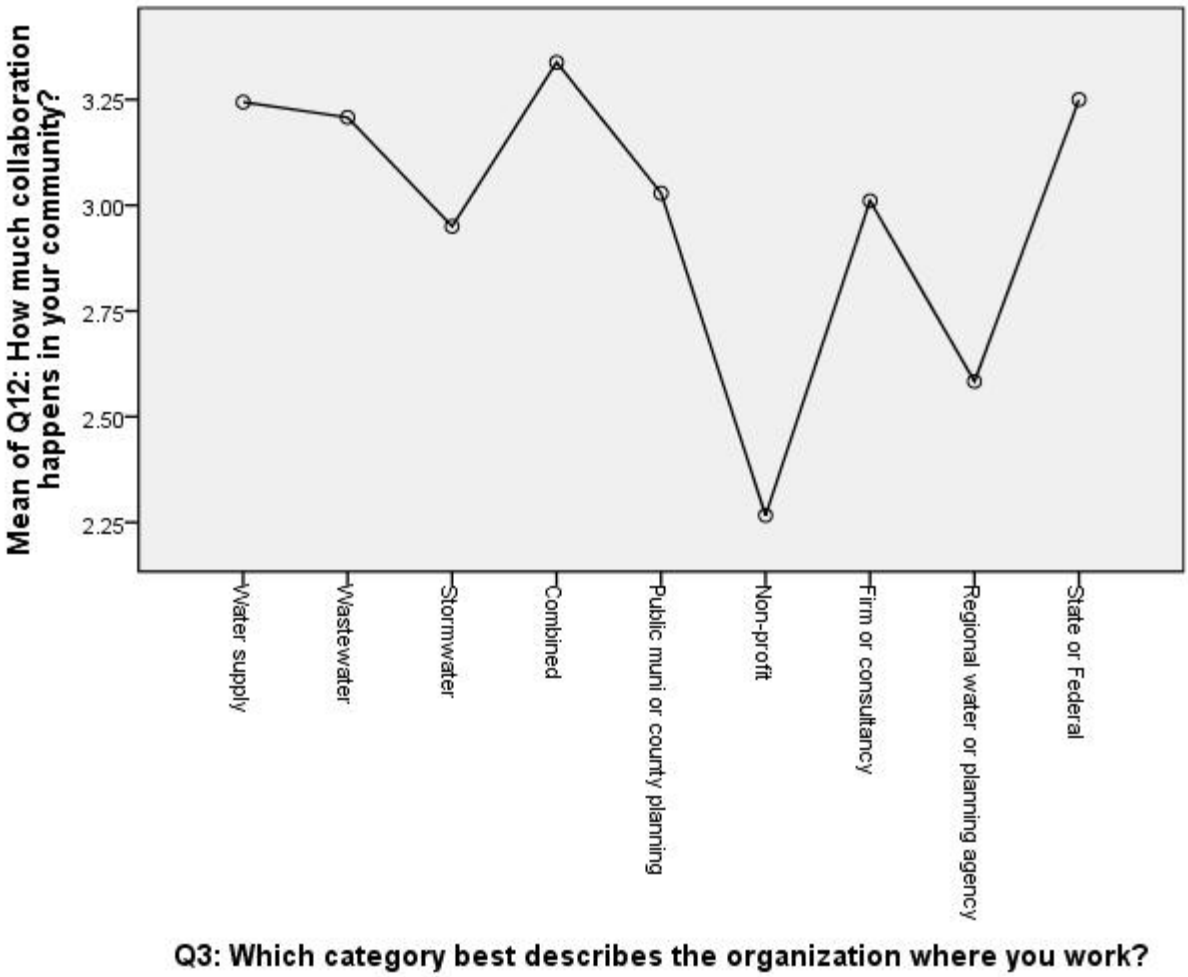

Figure B.5 Means plot of how much collaboration by type of organization

We should be careful with our interpretations of the means plot, however, because it hides the bimodal nature of the responses found within the groups. Table B.1 shows those distributions. It indicates that a bimodal distribution is found in the responses from every organizational group. It would therefore be misleading to only report "average" responses for the groups, and more descriptive to say that collaboration is commonly reported as occurring either "sometimes" or "most of the time."

Table B.1
Breakdown of how much collaboration by type of organization

				Count	Column N %
Q3: Which category best describes the organization where you work?	Water supply	Q12: How much collaboration happens in your community?	Never	0	0.0%
			Sometimes	16	39.0%
			About half the time	4	9.8%
			Most of the time	16	39.0%
			Always	5	12.2%
	Wastewater	Q12: How much collaboration happens in your community?	Never	1	1.3%
			Sometimes	29	37.7%
			About half the time	11	14.3%
			Most of the time	25	32.5%
			Always	11	14.3%
	Stormwater	Q12: How much collaboration happens in your community?	Never	0	0.0%
			Sometimes	10	50.0%
			About half the time	2	10.0%
			Most of the time	7	35.0%
			Always	1	5.0%
	Combined	Q12: How much collaboration happens in your community?	Never	0	0.0%
			Sometimes	39	28.7%
			About half the time	26	19.1%
			Most of the time	57	41.9%
			Always	14	10.3%

(continued)

Table B.1 Continued

			Count	Column N %
Public muni or county planning	Q12: How much collaboration happens in your community?	Never	2	5.7%
		Sometimes	10	28.6%
		About half the time	11	31.4%
		Most of the time	9	25.7%
		Always	3	8.6%
Non-profit	Q12: How much collaboration happens in your community?	Never	1	6.7%
		Sometimes	11	73.3%
		About half the time	1	6.7%
		Most of the time	2	13.3%
		Always	0	0.0%
Firm or consultancy	Q12: How much collaboration happens in your community?	Never	3	3.2%
		Sometimes	34	36.2%
		About half the time	20	21.3%
		Most of the time	33	35.1%
		Always	4	4.3%
Regional water or planning agency	Q12: How much collaboration happens in your community?	Never	1	8.3%
		Sometimes	6	50.0%
		About half the time	2	16.7%
		Most of the time	3	25.0%
		Always	0	0.0%
State or Federal	Q12: How much collaboration happens in your community?	Never	0	0.0%
		Sometimes	5	41.7%
		About half the time	1	8.3%
		Most of the time	4	33.3%
		Always	2	16.7%

We also compared responses by level or urbanization. The following means plot (Figure B.6) shows there are differences in collaboration by level of urbanization, though the only difference that is statistically significant is between urban and rural places. There is less collaboration in rural than urban places, although even the rural places tend to report that collaboration occurs somewhere between “sometimes” and “about half the time.” We found

similar results when answers were broken down by community population, though those results were not statistically significant. In the sample, those serving communities with less than 20,000 persons reported less collaboration. The most collaboration occurs in urban communities, where respondents reported it occurring somewhere between "about half" and "most of the time." In general, there appears to be a declining "collaboration gradient" as one moves from urban to rural places, though it is not particularly steep. Here again, however, we also found bimodal distributions within the groups, except for the rural case where 55% of the respondents gave the opinion that collaboration occurs "sometimes."

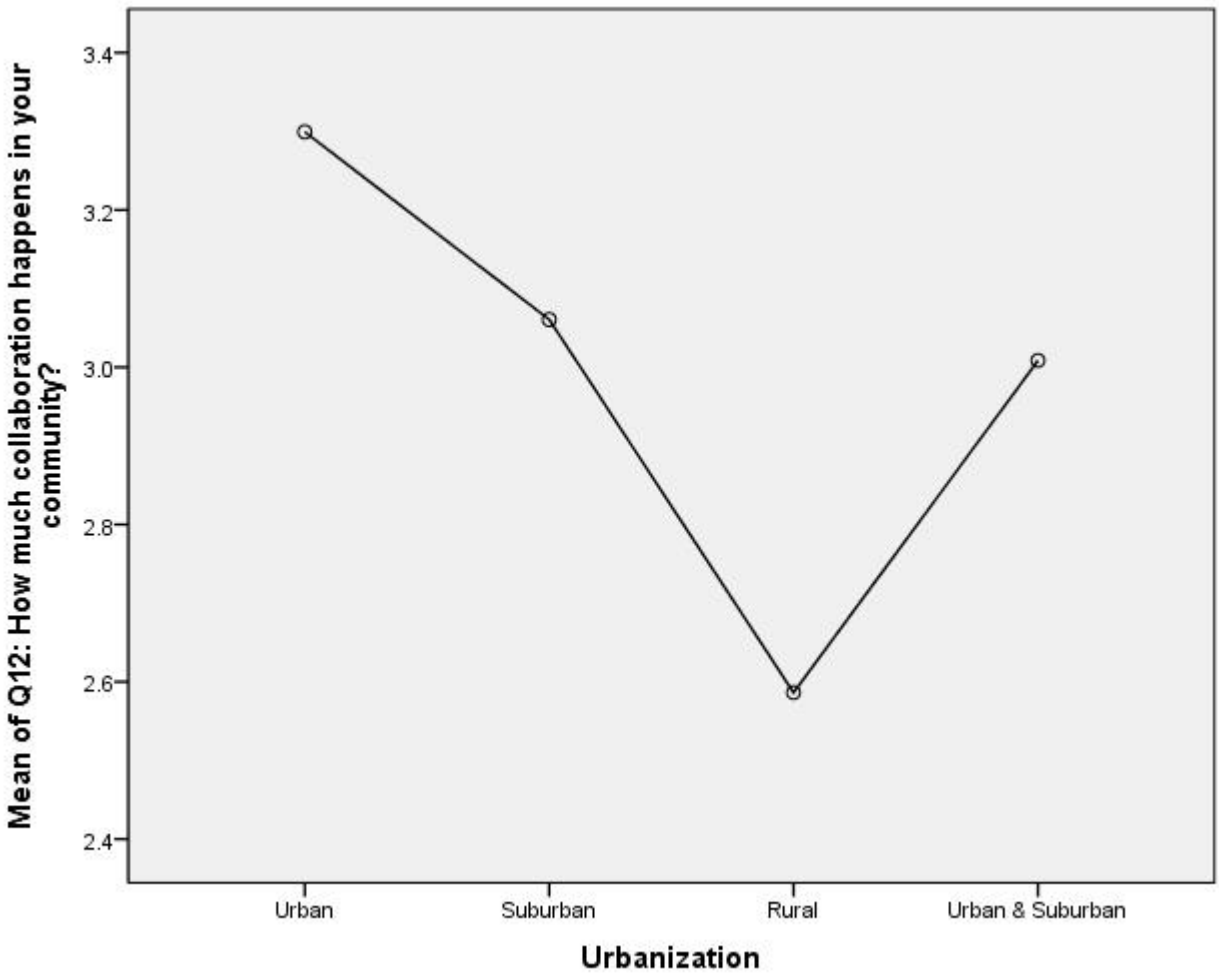

Figure B.6 Means plot of how much collaboration by setting

Table B.2
Breakdown of how much collaboration by setting

				Count	Column N %
Urbanization	Urban	Q12: How much collaboration happens in your community?	Never	1	0.7%
			Sometimes	45	32.8%
			About half the time	20	14.6%
			Most of the time	54	39.4%
			Always	17	12.4%
	Suburban	Q12: How much collaboration happens in your community?	Never	1	3.0%
			Sometimes	12	36.4%
			About half the time	7	21.2%
			Most of the time	10	30.3%
			Always	3	9.1%
	Rural	Q12: How much collaboration happens in your community?	Never	1	3.4%
			Sometimes	16	55.2%
			About half the time	6	20.7%
			Most of the time	6	20.7%
			Always	0	0.0%
	Urban & Suburban	Q12: How much collaboration happens in your community?	Never	2	1.7%
			Sometimes	49	42.2%
			About half the time	18	15.5%
			Most of the time	40	34.5%
			Always	7	6.0%

IS THERE ENOUGH COLLABORATION?

To gauge whether respondents felt there should be more collaboration we asked, “Do you think the role Municipal or County Planners currently play with respect to decisions by water utilities (water supply, wastewater, or stormwater) is just about right, not involved enough, too involved, (or don’t know)?” Then we turned it around and asked, “Do you think the role water utilities (water supply, wastewater, or stormwater) play with respect to decisions by municipal or county planning agencies is just about right, not involved enough, too involved, (or don’t know)?”

The first of these questions was also asked in the *2016 American Planning Association Water Survey* and we merged those results for this report giving us a total sample size of 1,385 for this question only.

Figure B.7 shows the results for how people viewed the role of municipal or county planners in water utility decisions, broken down by type of organization. Our respondents from water supply, wastewater, and combined water agencies were mostly split between those who think the level of involvement is just about the right level or not enough. Meanwhile, most respondents from stormwater agencies, planning departments, consulting firms and elsewhere feel planners are not involved enough. Analyses confirmed these differences are statistically significant at the .95 level, meaning there is a 95% probability that similar differences occur among those who did not take the survey. This suggests that in water supply, wastewater, and combined utilities there is a split between people who do and do not feel planners are sufficiently involved in water utility decisions. There appears to be a stronger consensus that they should be more involved among people in stormwater agencies, planning departments, and other types of organizations. Breakdowns of these results by level of urbanization and size of area served did not reveal other significant differences.

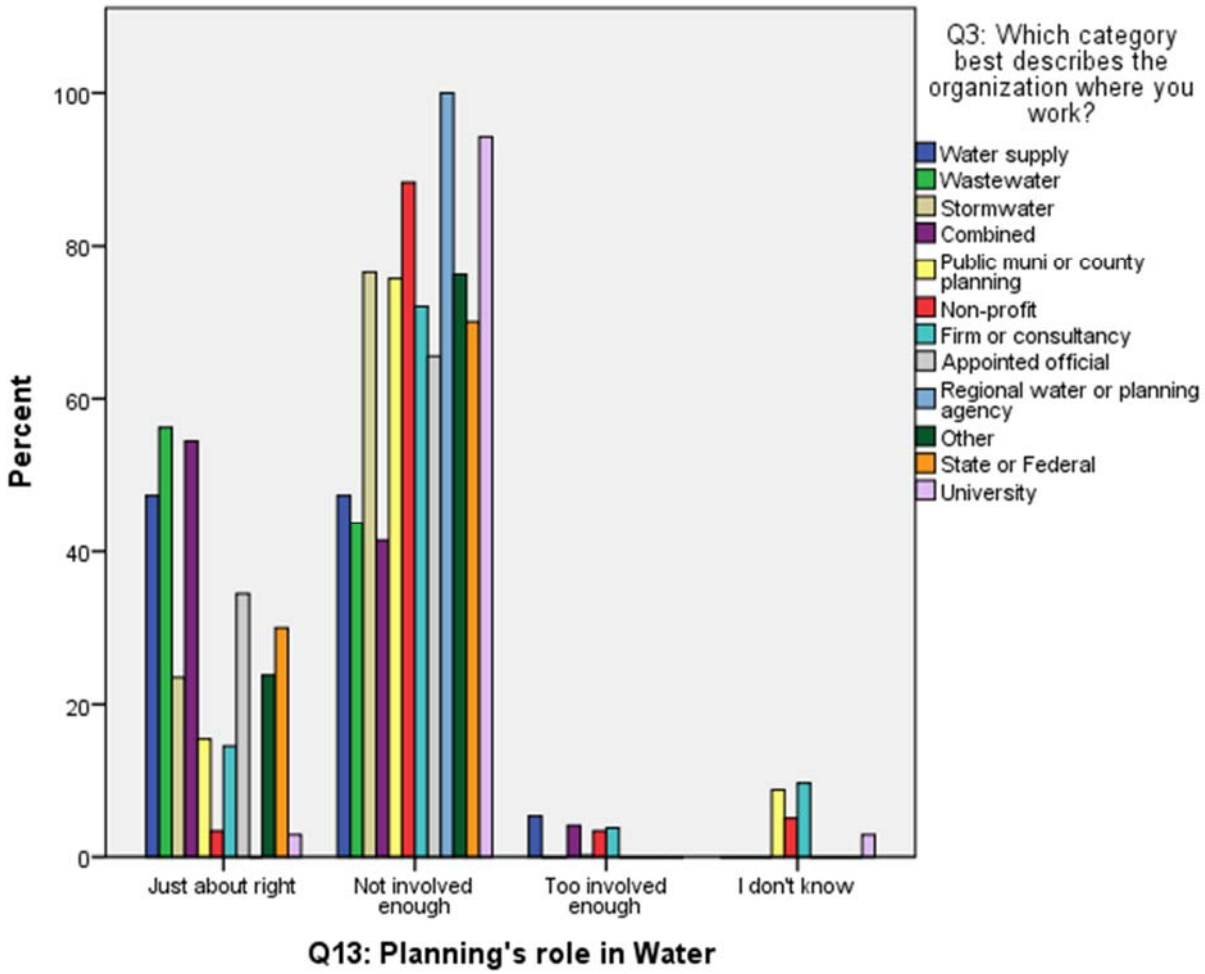

Figure B.7 Role of urban planners in water utility decisions

When we asked the opposite question – that is, how people felt about the role of water utilities in municipal and county planning decisions, those in water supply agencies became more

like those in other organizations, but the wastewater and combined water agencies remained more divided. As before, people working for stormwater agencies, the urban planners, and people from non-profits, private firms, and regional agencies were mostly of the view that water professional should be more involved in municipal and county planning decisions. Overall, these findings suggest we would find more support in communities for greater engagement by water professionals in urban planning than vice versa. Still, about half the water professionals we surveyed do think planners should be more involved in water agency decisions, even if the other half think their involvement is "just about right." As before, breakdowns of these results by level of urbanization and size of area served did not reveal any significant findings.

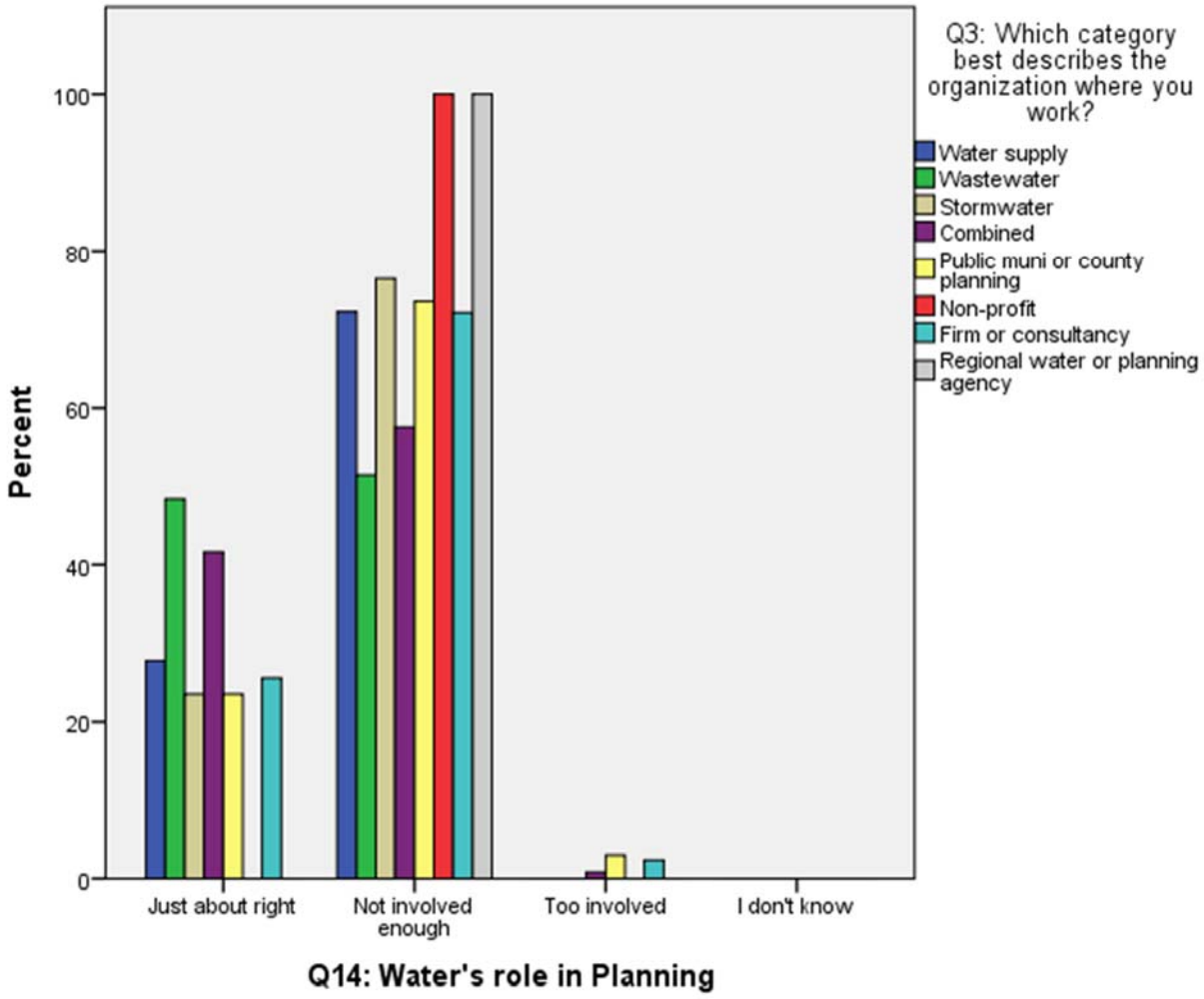

Figure B.8 Role of water professionals in urban planning

PRIORITIES FOR COLLABORATION

To determine the functions or activities where collaboration is thought to be most important, we asked the respondents to "please rate the importance of collaboration between the local water professionals and managers and the municipal or county planners in the community or communities where you work." This was done for 33 different functions grouped into 7 categories

including Conservation, Education or Outreach, Emergency Planning or Management, Infrastructure, Alternative or Emerging Systems, Planning, and Regulation. The response options were extremely important, very important, moderately important, slightly important, not at all important, and unsure.

Table B.3 summarizes the results. Column 1 lists the functions as they were described in the survey and Column 8 gives the categories in which they were presented. The functions are sorted from lowest to highest mean score with the lowest score representing the most important functions. Columns 4-6 give the confidence interval and bounds for the 95% confidence interval. They describe the range in which we would expect the mean response for 95% of all samples of the true study population to fall. Column 7 gives the standard deviation for the responses. It represents the variation or dispersion of the responses and the lower the standard deviation, the more agreement there was among the respondents. Column means are given at the bottom on the table so the statistics for each item can be benchmarked across all others.

A few general patterns are worth underscoring. First, consider the mean scores in relation to their meaning. The means range from 1.79 (for floods and storms) to 3.67 (for desalination), which round from 2 or "very important" to 4 or "slightly important. No function or activity received an average score that rounds to "extremely important" or "not at all important." Second, 28 (85%) of the 33 functions received a mean score that rounds to 2 or "very important", suggesting that coordination tends to be seen as a very important overall. Third, the standard deviations for the top ranked functions are lower than for the bottom ranked ones, indicating there is more agreement around what is most important than around what is least important. And fourth, as shown by Table B.4, there is not much difference between the grand mean for each category of functions, except for the Alternative or Emerging Systems, which were ranked at or near the bottom of the list, although the grand mean for the Alternative or Emerging Systems group rounds to 3 or "moderately important". It is notable, however, that the grand mean for all the other functional categories round to 2 or "very important". The Alternative or Emerging Systems category include items commonly included as part of One Water movement. We cannot be sure of whether the low grand mean for Alternative or Emerging Systems means they are viewed as less important by the typical respondent or viewed as requiring less coordination, which is what our question was meant to ask. We suspect, however, that some respondents may have been thinking that these functions are both less important for or less applicable to their own community or communities, so any coordination work that is done to foster them may also need to involve work that explains their utility and raises their salience.

We used ANOVA to search for statistically significant differences between the mean scores given by respondents working for different types of organizations or in different types of settings. Only a few differences were large enough to conclude that they were unlikely to be an artifact of the sampling and likely to be true in the population represented by the sample. First, respondents working for stormwater, wastewater, and municipal or county planning agencies tend to see collaboration around multi-year capital improvement programming as very important, as compared to those working for water suppliers who tend to see it as moderately important. Second, those working for wastewater agencies tend to see coordination around water recycling as very important compared to those working for combined water agencies and municipal or county planning agencies who tend to see it as moderately important. And third, those working for wastewater agencies tend to see collaboration around desalination as moderately important, as compared to those working for combined water or municipal/county planning agencies who tend to see it as slightly important.

After asking respondents to rank the importance of collaboration in the 33 specific functional areas, we asked them to list any other areas where they think it is for local water professionals and managers to work with the municipal or county planners. The most common responses were source water protection (6), stormwater (6), septic systems (4), emergency planning (4), and groundwater protection (3).

Table B.3
Priorities for collaboration

(1) Importance of collaboration to…	(2) N	(3) **Mean Score** 1=extremely 2=very 3=moderately 4=slightly	(4) lower bounds 95% CI	(5) upper bounds 95% CI	(6) 95% CI	(7) Standard Deviation	(8) Category
Floods or storms	447	1.79	1.72	1.87	0.15	0.79	Emergencies
Preserving/restoring watersheds, wetlands, or other features	449	1.80	1.72	1.87	0.16	0.85	Conservation
Education or outreach with one another (i.e., between water and planning agencies)	447	1.80	1.73	1.86	0.13	0.70	Education/Outreach
Planning water supply and waste water service capacity	449	1.80	1.72	1.88	0.16	0.85	Planning
Population growth, urban growth, or service demand forecasting	449	1.85	1.77	1.92	0.15	0.83	Planning
Master, general, or comprehensive planning	445	1.85	1.77	1.92	0.15	0.79	Planning
Service area planning	437	1.94	1.86	2.02	0.16	0.84	Infrastructure
Education or outreach for elected officials on some particular water topic(s)	446	1.95	1.87	2.03	0.17	0.89	Education/Outreach
Utility master planning	438	1.97	1.89	2.06	0.17	0.90	Planning

(1) Importance of collaboration to…	(2) N	(3) **Mean Score** 1=extremely 2=very 3=moderately 4=slightly	(4) lower bounds 95% CI	(5) upper bounds 95% CI	(6) 95% CI	(7) Standard Deviation	(8) Category
Expanding facility capacities to meet demands of growth	447	1.98	1.89	2.07	0.18	0.97	Infrastructure
Ordinances, zoning, or codes at the building or development level	445	2.00	1.91	2.08	0.16	0.87	Conservation
Other service disruptions[1]	178	2.00	1.87	2.13	0.26	0.88	Emergencies
Guiding land development patterns or densities	446	2.02	1.94	2.11	0.17	0.92	Planning
Potable water conservation	449	2.08	1.99	2.18	0.19	1.03	Conservation
Multi-year capital improvement programming	443	2.09	2.00	2.19	0.18	0.97	Infrastructure
Land development project reviews and permitting	448	2.10	2.02	2.19	0.17	0.90	Regulation
Education or outreach for the public on some particular water topic(s)	447	2.12	2.03	2.21	0.17	0.94	Education/Outreach
Drought	446	2.13	2.04	2.23	0.19	1.03	Emergencies
Combined sewer overflow, total maximum daily load, or other water quality regulations	438	2.15	2.05	2.26	0.21	1.10	Regulation
Data collection or analysis on water related issues	445	2.17	2.08	2.25	0.17	0.91	Planning

[1] Respondents were asked to specify what "Other Service Disruptions" that thought were important. The responses and frequencies were: system malfunctions/bursts/leaks/outages (30), earthquakes/natural disasters (22), miscellaneous non-service disruptions (11), contamination/health issues (11), wildfires (10), extreme weather (6), water levels (3), terrorism (2), and sanitary systems (2).

(1) Importance of collaboration to…	(2) N	(3) **Mean Score** 1=extremely 2=very 3=moderately 4=slightly	(4) lower bounds 95% CI	(5) upper bounds 95% CI	(6) 95% CI	(7) Standard Deviation	(8) Category
Green infrastructure or low impact development	447	2.18	2.09	2.28	0.18	0.99	Alternatives
Climate change adaptation	450	2.25	2.16	2.35	0.19	1.04	Emergencies
Updating zoning, subdivision, or other regulations	447	2.27	2.18	2.36	0.18	0.98	Regulation
Specific project planning and/or design	439	2.33	2.25	2.42	0.17	0.92	Infrastructure
Adding public amenities to infrastructure projects or using infrastructure as public amenities	444	2.38	2.29	2.47	0.19	1.00	Alternatives
Septic system, discharge, diversion, or water withdrawal permits	443	2.41	2.31	2.52	0.21	1.12	Regulation
Water recycling (reclamation, reuse, etc., including potable or non-potable)	439	2.42	2.30	2.53	0.23	1.23	Alternatives
Maintenance (e.g., maintaining plants in green infrastructure projects)	445	2.48	2.38	2.58	0.20	1.07	Infrastructure
Rainwater collection and use	441	2.68	2.57	2.78	0.22	1.16	Alternatives
Greywater for irrigation, indoor use, or heat recovery	437	2.88	2.77	3.00	0.24	1.26	Alternatives
Small scale water and wastewater systems for office	424	3.03	2.90	3.16	0.26	1.35	Alternatives

(1) Importance of collaboration to…	(2) N	(3) **Mean Score** 1=extremely 2=very 3=moderately 4=slightly	(4) lower bounds 95% CI	(5) upper bounds 95% CI	(6) 95% CI	(7) Standard Deviation	(8) Category
blocks, neighborhoods, or households							
Transferring or sharing agriculture water for urban use	413	3.24	3.11	3.38	0.27	1.41	Alternatives
Desalination	407	3.67	3.53	3.80	0.27	1.38	Alternatives
Column Mean	434	2.24	2.14	2.33	0.19	1.00	

Table B.4
Priorities for collaboration by category

Functional Category	Grand Mean	Interpretation
Planning	1.94	Very important
Education & Outreach	1.96	Very important
Conservation	1.96	Very important
Emergencies	2.05	Very important
Infrastructure	2.17	Very important
Regulations	2.23	Very important
Alternatives	2.81	Moderately important

BARRIERS TO COLLABORATION

We then asked respondents to "indicate your level of agreement as to whether or not the following are currently major barriers to collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work." This was done for 24 possible barriers grouped into 4 categories including 1) Behavioral, Cultural, or Personal, 2) Economic/Financial, 3) Institutional/Organizational, 4) Processes and Management and 5) Political. The responses options were strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree or don't know/not applicable.

Tables B.5 and B.6 summarize the results using the same column headings and sort order described in the previous section. We found four notable patterns in the data. First, the barrier with the lowest mean (meaning most agreement) was "Lack of time – too many other priorities to deal with" and in this case its mean score was notably lower than the second ranked barrier. The same can be said of its standard deviation. These suggest that the lack of time stands above all other barriers as the most important and agreed upon barrier. Second, the mean scores range from 2.16 to 3.35, which round to 2 to 3 or somewhat agree to neither agree nor disagree and 16 (two-thirds) of the 24 barriers have a mean that rounds to 3 (neither agree nor disagree). In addition, the standard deviations are rather high relative to the means. These facts suggest there is not much certainty or agreement around barriers. Professional water and urban planning professionals probably spend little time thinking about barriers to collaboration and their academic counterparts have little related research that informs the professions, so it is unsurprising though notable that we find little conviction in the results. More discussion and research is needed to fully understand barriers to collaboration and the results of this or other opinion surveys should not be interpreted as pointing with confidence to the most or least important barriers. Third, we note that the grand means for the categories of barriers indicate that Institutional/Organizational barriers stand above the others. This can also be seen in the fact that four of the top five barriers are in this category. This would suggest that collaboration is more of an institutional/organizational problem caused by legal governance structures than a political, behavioral, economic, or management process problem. What may be needed is a new wave of legislation that strengthens or requires concurrency, consistency, and coordination. Finally, we find notable that barriers having to do with mandates or authorities are highly ranked. "No mandates…," "No one responsible…," "Differing legal mandates…" and "Lack of a central authority…" are all part of the institutional/organizational category and as a group suggest that mandates and/or authorities are critical barriers, though not to the exclusion of other highly ranked barriers.

As before, we used ANOVA to check for statistically significant differences in the scores given by respondents working in different types of organizations or places. There were few overall and none among the highly rated tools. The only one we found that seems notable is that respondents in rural communities see "Insufficient financial resources to support collaboration" as a higher barrier than those from urban and suburban places.

Table B.5
Current barriers to collaboration

	N	Mean Score 2=somewhat agree 3=neither agree nor disagree 4=somewhat disagree	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
Lack of time - too many other priorities to deal with	401	2.16	2.06	2.26	0.20	1.02	Institutional/Organizational
No mandates or incentives to work together	402	2.28	2.16	2.40	0.24	1.25	Institutional/Organizational
No one responsible for coordinating	403	2.28	2.16	2.40	0.24	1.24	Institutional/Organizational
Concerns over losing organizational power, resources, or status	394	2.28	2.17	2.40	0.23	1.17	Political
Differing agency legal mandates or regulations (local, state, or federal)	397	2.34	2.22	2.45	0.22	1.12	Institutional/Organizational
Weak appreciation of the benefits of	401	2.34	2.22	2.46	0.24	1.24	Economic/Financial

	N	Mean Score 2=somewhat agree 3=neither agree nor disagree 4=somewhat disagree	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
collaborating (e.g., how green infrastructure helps housing values or how recreational spaces improve health)							
Lack of mechanisms for organizing or managing collaboration	398	2.38	2.27	2.49	0.23	1.15	Processes and Management
Lack of a central authority over both the planners and water professionals	398	2.44	2.32	2.57	0.25	1.26	Institutional/Organizational
Conflicting professional cultures or priorities between urban planners and water utility professionals	397	2.50	2.38	2.62	0.24	1.19	Behavioral, Cultural, Personal

	N	Mean Score 2=somewhat agree 3=neither agree nor disagree 4=somewhat disagree	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
Concerns that cooperation could delay implementing needed solutions or projects	397	2.51	2.40	2.63	0.22	1.13	Processes and Management
Insufficient knowledge about each other's professions	394	2.52	2.41	2.64	0.23	1.16	Behavioral, Cultural, Personal
Insufficient financial resources to support collaboration	398	2.53	2.42	2.64	0.23	1.15	Economic/Financial
Inadequate cross-organizational data or modeling capacities	388	2.61	2.51	2.71	0.20	1.02	Processes and Management
Resistance from external stakeholders (elected, state, community, business)	414	2.71	2.58	2.85	0.27	1.39	Political
Poor historical relations or mistrust of the other organization or personnel	385	2.72	2.59	2.84	0.25	1.24	Behavioral, Cultural, Personal

	N	Mean Score 2=somewhat agree 3=neither agree nor disagree 4=somewhat disagree	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
Different cycles in planning budgets or resource uncertainty	389	2.79	2.68	2.90	0.23	1.13	Economic/Financial
Concern over losing financial resources	387	2.81	2.70	2.93	0.23	1.14	Economic/Financial
Lack of staff interest	395	2.86	2.74	2.97	0.23	1.18	Behavioral, Cultural, Personal
General opinions that it is unnecessary to collaborate because each organization's activities do not affect the other's	402	2.87	2.74	2.99	0.26	1.31	Institutional/Organizational
It is unclear who to work with	399	2.87	2.75	2.99	0.24	1.23	Processes and Management
Negative attitudes toward the other profession or organization	395	2.91	2.79	3.03	0.25	1.24	Behavioral, Cultural, Personal
Fear of being linked to another agency's failures	381	2.97	2.85	3.08	0.23	1.12	Political

	N	Mean Score 2=somewhat agree 3=neither agree nor disagree 4=somewhat disagree	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
The financial costs of collaboration seem to outweigh the benefits	392	3.28	3.16	3.40	0.23	1.18	Economic/Financial
Geographic distance between units	392	3.35	3.24	3.46	0.22	1.12	Processes and Management
Column Mean	395	2.64	2.52	2.75	0.23	1.18	

Table B.6
Barriers to collaboration by category

Category	Grand Mean	Interpretation
Institutional/Organizational	2.30	somewhat
Behavioral, Cultural, Personal	2.70	neither
Processes and Management	2.75	neither
Economic/Financial	2.75	neither
Political	2.65	neither

TOOLS FOR COLLABORATION

Finally, we asked respondents to "Please rate how effective you think the following are or could be for fostering collaboration between local water professionals and managers and the municipal or county planners in the community or communities where you work." This was done for 24 different tools grouped into 4 categories including Process, Legal/Regulatory, Analytical/Informational, and Professional or Organizational Development. The response options were extremely effective, very effective, moderately effective, slightly effective, not at all effective, or don't know/not applicable.

Tables B.7 and B.8 summarize the results following the same format used in the two prior questions. We would underscore the following observations. First, the mean scores ranged from 2.22 to 3.52, which round to 2 to 4, or very effective to slightly effective. About half of the scores round to 2 or very effective and all but one of the rest round to 3 or moderately effective. Only 1 – consolidation or merger of departments or agencies – had a score that rounds to slightly effective. It's interesting that this received the lowest score because organizational barriers were the most important category of barriers, although respondents may be saying that simple consolidation is less effective than mandatory consistency and coordination and similar more direct organizational strategies. Indeed, mandating consistency between water and land use decisions has the 5th highest mean effectiveness score. Second, the standard deviations for the top ranked tools are lower than for other tools, indicating greater agreement among the raters on their scoring for these most highly rated tools. Third, none of the tool categories dominated the more highly rated subset, however Professional or Organizational Development as a group did dominate those found at the bottom of the rankings, even though their grand mean rounds to 3 or moderately effective. Still, it does appear that respondents are less optimistic about the effectiveness of tools that would reorganize governance through greater regionalization or consolidation, as compared to those that focus more on changing processes, regulations, information.

ANOVA tests revealed no meaningful statistically significant differences in the scores given by respondents working in different types of organizations or places.

Table B.7
Effectiveness of tools for collaboration

	N	Mean Score 2=very effective 3=moderately effective 4=slightly effective	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
Joint future scenarios planning, visioning, or goal setting	386	2.22	2.12	2.31	0.19	0.93	Process
Coordination on land development project evaluation	381	2.27	2.17	2.36	0.18	0.89	Legal/Regulatory
Improving or creating common or consistent data sets	385	2.31	2.22	2.41	0.18	0.92	Analytical/Informational
Coordinating planning processes	389	2.32	2.24	2.41	0.17	0.84	Process
Mandatory consistency between water and land use decisions	365	2.36	2.25	2.47	0.22	1.07	Legal/Regulatory
Knowledge networks (or learning alliances) that help participants see the connections between their roles and the benefits of working with others to solve problems	385	2.38	2.28	2.47	0.19	0.93	Process
Joint demonstration projects	381	2.38	2.28	2.48	0.19	0.97	Analytical/Informational
Appointing internal coordination leaders or facilitators	386	2.44	2.34	2.53	0.19	0.97	Process
Joint organizational strategic planning	376	2.44	2.34	2.54	0.20	0.99	Professional or Organizational Development
Coordination on other permit processes[2]	182	2.45	2.31	2.60	0.29	0.99	Legal/Regulatory

(continued)

[2] The most common "other" processes listed were land development platting and permitting (9) and MS4 programs for controlling polluted stormwater discharges (4).

Table B.7 Continued

	N	**Mean Score** 2=very effective 3=moderately effective 4=slightly effective	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
Professional expert forums where scientific, technical, or economic information on water and planning is discussed	390	2.48	2.38	2.57	0.19	0.94	Process
Collaboration to update or reform building and development codes	375	2.48	2.38	2.57	0.19	0.93	Legal/Regulatory
Water and planning units working together on shared citizen involvement activities	373	2.55	2.45	2.65	0.19	0.94	Process
Joint tours, training events, field trips, or workshops	385	2.55	2.45	2.65	0.20	0.98	Analytical/Informational
Agreeing on appropriate indicators for performance metrics	379	2.57	2.47	2.67	0.20	0.97	Analytical/Informational
State and/or federal mandates for collaboration or consistency on specific activities (for example, planning or demand forecasting)	364	2.60	2.48	2.72	0.24	1.17	Legal/Regulatory
Conducting joint education programs for citizens and/or elected officials	383	2.63	2.54	2.72	0.19	0.92	Analytical/Informational
Joint professional development or training or certification in areas of common concern	368	2.68	2.58	2.79	0.21	1.02	Professional or Organizational Development
Joint grant writing for shared endeavors	354	2.77	2.66	2.87	0.21	1.01	Professional or Organizational Development
Joint research or white papers	373	2.77	2.66	2.88	0.21	1.05	Analytical/Informational

(continued)

Table B.7 Continued

	N	**Mean Score** 2=very effective 3=moderately effective 4=slightly effective	lower bounds 95% CI	upper bounds 95% CI	95% CI	Standard Deviation	Category
Permanent cross-paradigm coordinating groups, councils, or commissions	365	2.81	2.71	2.92	0.21	1.01	Process
Developing an official memo of understanding or cooperation between organizations	379	2.86	2.75	2.97	0.21	1.06	Professional or Organizational Development
State or regional assistance with guidance or facilitation	371	2.96	2.84	3.07	0.22	1.10	Process
Creating or strengthening regional governance	354	3.00	2.88	3.11	0.23	1.08	Professional or Organizational Development
Retaining external, neutral coordination facilitators	369	3.01	2.90	3.12	0.21	1.05	Process
Collaborative capacity audits to identify impediments to collaboration or missed opportunities	346	3.03	2.93	3.14	0.22	1.03	Professional or Organizational Development
University or extension service assistance with guidance or facilitation	361	3.12	3.01	3.23	0.22	1.07	Process
Consolidation or merger of the departments or agencies	343	3.52	3.40	3.65	0.25	1.19	Professional or Organizational Development
Grand Mean		2.64	2.54	2.74	0.21	1.00	

Table B.8
Effectiveness of tools for collaboration by category

Legal/Regulatory		2.43	very
Analytical/Informational		2.54	moderately
Process		2.61	moderately
Professional or Organizational Development		2.90	moderately

After asking respondents to assess the specific list of tools for collaboration, we asked them to list any other tools they thought would be helpful. The most common responses were leadership (agency or political (9), education (5), and joint activities (i.e., committees, field trips, projects, planning) (5).

OTHER COLLABORATORS

Finally, we asked respondents: "Are there other professions, organizations, or agencies that should be involved in the collaborations between local water professionals and managers and the municipal or county planners?" Table B.9 tallies their responses grouped into common types.

Table B.9
Other groups to include in collaboration

Type of Group	Frequency
National Water Orgs - AWRA, AWWA, NACWA, ASDWA, ACWA, WEF	13
City agencies	10
Federal Agencies	9
Professional consultants (water, transportation)	9
Environmental Groups, Advocacy Groups	8
Utilities, Waste Management	7
Engineers, Scientists, Architects, Landscape Architects	7
State agencies	7
NGOs	6
Regional Agencies	6
Non-Profits	5
Local stakeholders (neighborhoods, schools, youths, tax payers, realtors)	5
Academia, Research Institutes	5
Developers	4
Legal/Lawyers	4
County Agencies	3
Health/Medical	3
Private sector leaders	2
Land Trusts	2
Tribes	1

APPENDIX C
CASE STUDY INTERVIEW TEMPLATE

Interviewer:
Date:
Interviewee:
Title:
Organization:

INTRODUCTION

Hi, thanks again for taking the time to meet with me today. Just a quick recap of what we are hoping to accomplish today.

- Get a summary of efforts in your community to improve integrated planning, with a specific focus on considerations for alternative water supply
- Better understand the key players and how they work together
- Summarize identified barriers and solutions for overcoming them
- Identify what worked well and what didn't
- Gather ideas for successful replication and scaling

Does that sound ok to you and do you have any questions before we begin?

QUESTIONS

- What is your role within this organization?
- Can you provide a summary of the programs taking place within your community that pertain to this integrated planning research in order to help fill any gaps in our current understanding of the situation? (review of matrix)
    - What alternative water supply approaches are being used in your community?
    - Did you consider multi-purpose projects as part of program selection?
    - Because this project is really focused on alternative water supply, are there (other) alternative supply options you considered or that could be applied in your community as part of this program? Any good resources we could explore to learn more?
    - What have you done to address integrated water and land use planning? Broadly, what barriers had you realized and what steps did you take to overcome them? (we'll get into details later)
    - If your efforts in integrated planning don't specifically pertain to alternative water supply, how can some of other integration efforts apply to water supply planning?
    - Are there areas where integration currently isn't happening as well as it should or where the current process could be improved by more aggressive integration (e.g., comp plan just compiling other planning efforts)
- Let’s confirm some basic facts about XYZ in your community.
    - Who were/are the key players (City departments, utilities, other agencies)?

    - What year was it implemented
    - At what scale (e.g., master planned community, city-wide, etc.)
    - Any other details of what exactly was implemented
    - What is the status of it now (e.g., how many XYZ installed, how well is it working, etc.)
    - How would you generally describe the evolution of the program over time? Why/how was the evolution accomplished?
- What was your role in the design/implementation of XYZ?
- What was the motivation behind doing this?
- In what ways did the stakeholders/players identified above work together to achieve a successful and integrated approach:
    - Of the players involved, who has jurisdiction and where?
    - Who initiated the development of this program and the idea of integration?
    - Is it a formal working relationship or informal?
    - If formal, are there policies, codes, MOUs etc.?
    - With what frequency did/do you meet?
    - What types of data/information were/are exchanged?
    - Other ways in which you collaborate?
    - What changes have there been over time in the way collaboration has taken place?
- What are the successes:
    - What about this collaborative process worked well?
    - What are the main benefits realized from integrated planning?
    - Any data available quantifying the benefits (e.g., water use)
- What challenges/barriers did you encounter and deal with through the process? What enabled you to overcome them? (financial, coordination, political, legislative, legal, public acceptance, local know-how, etc.)
- What elements of this process do you think should be replicated by other communities wanting to do the same? What would you advise against, if anything?
- Would your recommendations outlined in the questions above change any if this were to be implemented at a larger/smaller (choose) scale than what you did?
- Is there anything else we should know?
- Do you know of other communities/examples that might be good for us to know about? Who is a good contact person there?
    - What about the developer community? Any leaders we should be aware of and talking
- Do you have any suggestions for resources that would help with integration? We are starting to develop the framework for our final deliverables and are looking for input on what types of resources might be most helpful. Currently we are planning on developing targeted User Guides for utility, planning, and developer audiences as well as a supporting decision support and/or organizational assessment tool that would walk users through a project process and identify the best opportunities for integration and collaboration.

WRAP-UP

A few things we are asking for from each community to help as we try to pull all of these findings together include:

- A photo or photos of any of the projects or programs you mention above
- A quote from you about your program, the benefits of integrated planning, and/or anything else you think would be relevant to this research effort based on our conversation today
- Access to any other resources that may help our team continue to better understand your community and programs

Additionally, just a few logistics

- We will provide you an opportunity to review any research materials we develop from this conversation so you can provide feedback before they are published
- We may be reaching out again to folks later on in the research if we need to gather additional information, is that OK?
- If you have any questions or ideas that come to you after we have wrapped up today, please don't hesitate to contact me or to pass along any additional information you think would be helpful to this research effort.

APPENDIX D
CASE STUDY SUMMARIES

A series of interviews was conducted with 12 communities and stakeholders to gain an in-depth perspective of how alternative water supply and land use decisions are made in concert with one another. The research team sought communities with exemplary programs and processes that might provide a useful model for other communities, while also targeting locations with a specific focus on alternative water supply, which limited the geographic reach of the interview candidates. This appendix contains the summaries of those interviews and the following table synthesizes all the findings into a single matrix while the following pages provide brief case studies for each community example.

Table D.1
Summary matrix of case studies

Community/ Example	Alternative Water Solutions	Funding Solutions	Cost Benefit Tools	Institutionalized Collaboration	Planning at the Right Scale	Public Education & Engagement	Policy & Regulatory Changes	Data Collection & Sharing	New Technology & Innovation
Aurora, CO	-Conservation -Potable reuse			●		●	●	●	●
Boulder, CO	-Conservation -Stormwater capture	●			●		●		
Fort Collins, CO	-Conservation -ASR (considered) -Water sharing	●	●		●				
Kansas City, MO	-Stormwater capture -Non-potable reuse (proposed)			●	●	●			
Manatee County, FL	-Conservation -Desalination (considered) -Water sharing			●	●		●		

(continued)

Table D.1 Continued

Community/ Example	Alternative Water Solutions	Funding Solutions	Cost Benefit Tools	Institutionalized Collaboration	Planning at the Right Scale	Public Education & Engagement	Policy & Regulatory Changes	Data Collection & Sharing	New Technology & Innovation
Pima County, City of Tucson, & Pima Association of Governments, AZ	-Conservation -Non-potable reuse -Stormwater capture -Rainwater capture -ASR -Greywater		●	●	●	●	●	●	●
San Francisco, CA	-Potable reuse (considered) -Conservation -Non-potable reuse -Stormwater capture -Rainwater capture -Desalination (considered) -Water sharing -Greywater				●		●	●	●
San José, CA	-Conservation -Non-potable reuse -Stormwater capture			●		●			
Sarasota County, FL	-Non-potable reuse -ASR			●				●	●

(continued)

Table D.1 Continued

Community/ Example	Alternative Water Solutions								
Soquel Creek Water District, California	-Conservation -Stormwater capture (considered) -Non-potable reuse (considered) -Desalination (considered) - Water Sharing (considered)			●		●	●		●
Sterling Ranch, CO	-Conservation -Stormwater capture -Rainwater capture				●	●	●	●	●
Westminster, CO	-Conservation -Non-potable reuse			●			●	●	

AURORA, COLORADO

Aurora is Colorado's third largest city with a diverse population of more than 351,000. At 154 square miles, the city reaches into Arapahoe, Adams, and Douglas counties. More than 450 neighborhoods complete the fabric of the community – with 6 golf courses, 2 reservoirs, nearly 100 parks, and over 5,000 acres of open space and trails. Aurora faces water and land use challenges that include the following:

- Lack of land development code that encourages alternative supplies
- Less integration on alternative water projects (though new development is coordinated)
- Funding barriers to get alternative water supply integrated into code

Key Policy and Program Findings

The City of Aurora offers a no-cost pre-application meeting with potential developers that are attended by staff from multiple agencies. The incentive for developers to attend these meetings is to gain a better understanding of what is required before hiring architects or engineers. They also require an inspection of landscapes along with a landscape water management plan for large, irrigated areas before the issuance of a Certificate of Occupancy. Aurora has a joint task force comprised of representatives from the development community and city departments that discusses potential changes to code. Getting buy-in from this group makes it easier for the changes to pass through city council.

Alternative Supply Considerations

- Conservation is a consideration in all types of new developments and is incentivized through tap fees
- Indirect potable reuse is achieved through the City’s Prairie Waters Project

Integration Solutions

- Institutionalized collaboration across water and land use planning departments
- Stakeholder engagement with development community
- Data collection and sharing across departments
- Development of new technology and innovation for water treatment and integrated water/land use planning tool
- Policy and Regulatory Changes

Policy and Program Successes

- Connections between planning and water usually occur in landscaping or new development plans
- Early-stage development meetings between city staff and developers help achieve goals
- The Joint Task Force provides key input – and ultimately support – for proposed changes to codes

Opportunities for Replication

- Integrated planning has allowed the city to do more with less money
- The results are better informed customers and higher quality developments
- The City is beta testing a spatial planning tool that models the impacts that different planning zones will have on infrastructure needs, including water. It links planning zone types with water consumption rates on a square foot basis.

Interview Contact(s)

- Karen Hancock, Environmental Program Supervisor
- Lyle Whitney, Water Conservation Supervisor

BOULDER, COLORADO

Tucked into the valley below the Flatirons, Boulder hosts thriving tech and natural foods industries, supports a renowned entrepreneurial community, has some of the region's best restaurants, and is home to many federal research labs and a world-class university. It also has 107,000 people with more than 60 urban parks. Boulder has preserved more than 45,000 acres of open space, much of which surrounds the city and helps maintain its geographical boundaries. Water and land use challenges Boulder faces include the following:

- Protecting the quality of source water in areas impacted by development and fire
- Challenges for collaborating between planning and water due to limited resources
- Effectively managing stormwater quantity and quality through larger city collaboration

The City of Boulder works to ensure there is continued reliability of the existing water supply by protecting the watershed and maintaining infrastructure while also focusing on stormwater protection and flood mitigation.

Key Policy and Program Findings

Boulder has sufficient water supplies to meet projected build out demands at its water supply level of service. Boulder's growth potential primarily occurs through redevelopment and therefore integration that occurs between water supply and land use plans is focused less on development of alternative water supplies and more on sustainable management of water resources. The city participates in cross-departmental meetings, such as an Environmental Team, to discuss topics such as planning, water quality and services, recreation, open space and energy, with an objective of sharing current projects, goals, best practices and ideas to gain a more comprehensive understanding of city environmental/ ecosystem activities and identify potential opportunities for collaboration and/or streamlining projects. Having this cross departmental group helps build relationships needed for projects such as stormwater quality and quantity planning (e.g., flood mitigation).

Alternative Supply Considerations

- Water Conservation programs for city customers
- Green infrastructure for stormwater management

Integration Solutions

- Land acquisition is used to protect and manage resources
- An urban service boundary is used to manage locations for provision of services and thus keep urban development contained within a defined area
- Stormwater management solutions considered at various scales
- Policy and regulatory changes are consistently applied to achieve land and water management objectives

Policy and Program Successes

- Greenbelt purchases (open space) around the city have, in part, protected resources and been a way to manage a distinct, compact community with predictable growth patterns
- The city developed a regional Source Water Protection Plan for the St. Vrain and Boulder Creek watersheds
- The city is in the process of developing a Green Infrastructure Strategic Plan
- The city is considering how climate change may impact natural areas, building energy requirements, water demands by city customers and the municipal water supply
- Code changes that set water conservation-minded land use policies and incentives help save water

Opportunities for Replication

- Purchase land for open spaces to preserve the scenic, natural environment, agricultural and buffer values of the community
- Establish an urban service area or "blue line" beyond or above which water service is not provided

Interview Contact(s):

- MaryAnn Nason, Water Conservation and Outreach Coordinator
- Lesli Ellis, Comprehensive Planning Manger
- Kim Hutton, Water Resources Engineer

FORT COLLINS, COLORADO

Fort Collins is nestled against the foothills of the Rocky Mountains and alongside the banks of the Cache La Poudre River. Fort Collins encompasses approximately 60 square miles with a population of 160,000 residents in 2015. The City maintains more than 600 acres of parks, 40,000 acres of natural areas, 20 miles of off-street hike/ bike trails, and a variety of recreational facilities.

There are three main water providers serving the City of Fort Collins: Fort Collins Utilities (FCU), the East Larimer County Water District (ELCO), and the Fort Collins-Loveland Water District (FCLWD). FCU has older and more diverse water supplies that it can leverage to keep water supply costs down, but the Districts do not and the water supply costs are much higher and there is more uncertainty about supplies being available – thus they have much different raw water requirements than FCU. This has given concern to City Council about there being adequate and affordable water for the City's growth. Only FCU is directed by the City Council (which has many and diverse goals), while ELCO and FCLWD are single purpose water providers that have independent board of directors (not directed by City Council).

The city is rapidly urbanizing and faces water and land use challenges which include the following:

- Potentially not enough storage for the water to which Fort Collins Utilities has the rights
- Confusion for developers due to varying regional water policies and code requirements
- Difficult to coordinate between water suppliers at the regional level
- Varying standards and requirements for developers in ELCO and FCLWD service areas

Key Policy and Program Findings

Currently a lot of work is focused on changing raw water requirements for new developments within the FCU service area. The current raw water requirements are based on a study in the 1980s. Fort Collins Utilities currently allows developers to provide either water rights or cash-in-lieu. FCU requires more water than would actually be used on average by the development to account for variation in demands (e.g., more use in drought years), changes in yield of that water (e.g., less yield in drought years), and other factors that diminish the usefulness of those water rights. Differences in the price of water at different water districts drives differing development patterns within the region. FCU is considering moving to a cash only system that would allow it to focus on developing strong infrastructure first and then purchasing rights as they are needed. FCLWD is already a cash only system while ELCO does not accept cash at all.

Alternative Supply Considerations

- Conservation programs are offered for all utility customers
- Aquifer storage is in preliminary stages of exploration

Integration Solutions

- The City is participating in efforts to develop a water fund that will be used to protect supplies in the watershed
- Though not focused solely on water and land use planning, the City has a sustainability assessment tool that requires interdisciplinary evaluation of the sustainability impacts of

any project going before City Council and facilitates greater cross jurisdictional collaboration between all stakeholders

- Recently, a Regional Water Collaboration Committee was formed to discuss regional water issues within the City's growth management area, with a focus on coordinated water conservation and shortage response plans, improved water supply and drought planning, and development of additional water supplies. The Committee is comprised of City Council members, ELCO and FCLWD board members and key staff from FCU, ELCO and FCLWD.

Example of Watershed Collaboration: Coalition for the Poudre River Watershed

Another example of collaboration on water and land use issues by the City of Fort Collins is its partnership with the Coalition for the Poudre River Watershed, a 501(c)3 organization located in Fort Collins, Colorado which evolved from post-fire restoration needs in 2012. Its mission is to "improve and maintain the ecological health of the Poudre River watershed through community collaboration." The group work across jurisdictions to tackle issues like wildfire impacts on the ecological health of the Poudre River watershed. As a non-profit, the group doesn't have any direct control over water or land use, but facilitates stakeholder discussions and planning regarding watershed resilience & restoration.

Policy and Program Successes

- City Plan informs Water Supply and Demand Management Plans
- Developers are discussing using special districts to lower water costs
- Putting incentives in place allows developers to be more creative
- There is a strong ethos of interdisciplinary work that encourages collaboration
- There is a regional focus for comprehensive planning

Opportunities for Replication

- Encourage a regional focus on comprehensive planning
- Create opportunity for greater coordination at the regional level
- Highlight co-benefits and connecting water priorities with other city priorities and objectives (e.g., promotion of higher density reduces water use)

Interview Contact(s)

- Liesel Hans, Water Conservation Program Manger
- Renee Davis, Water Conservation Specialist
- Donnie Dustin, Water Resources Manager
- Cameron Gloss, Planning Manager

KANSAS CITY, MISSOURI

Kansas City, Missouri is located at the confluence of the Kansas River and Missouri River, which provide the city's drinking water. The population was 475,378 in 2015 and the city's boundaries cross 4 counties over an area of 319 square miles. Recent decades have seen steady growth in the population but the ready availability of water has limited supply concerns. Major water and land use challenges include the following:

- Upstream land use impacts on water quality
- Stormwater challenges, including a history of combined sewer overflows
- Water resource, water quality, and dredging concerns along the Missouri River
- Costs and climate impacts associated with pumping water (the largest user of electricity)

Key players involve Mid-America Regional Council (MARC) planning efforts, Kansas City Water Services (KCWS), municipalities (Kansas City), districts, counties (Johnson County), and federal organizations.

Key Policy and Program Findings

Regional planning has been used to address a number of concerns, including stormwater management, water quality, and combined sewer overflows. Thinking more broadly about watersheds instead of land areas has been helpful and major drivers, such as stormwater consent decrees from the Environmental Protection Agency (EPA), have helped drive that discussion regionally. Community involvement has helped push new concepts, such as green infrastructure, and shaped policy (e.g., combined sewer mitigation plan was a 5-year process with a large amount of community engagement). At a larger scale, regional stakeholder discussions attempt to mitigate land use impacts on stormwater and downstream water quality.

Example: Twin Creeks

Kansas City's Twin Creeks development offered a chance to show how planning could better consider water when it is being newly developed. City Council put $40 million into sewer infrastructure and stormwater management to enhance planning at the development. This included a 7-mile linear park that follows the Twin Creeks watershed. The project was designed to not only provide commercial and residential housing units but to enhance the community and to help mitigate stormwater runoff and flooding.

Alternative Supply Considerations

- Much of the collaboration in the regional revolves around stormwater management
- Wastewater reuse study currently underway

Integration Solutions

- EPA Region 7 and MARC play important roles in bringing groups together to discuss water issues at regional level in addition to work being done at individual city level

- Wet Weather Community Panel convened large group of stakeholders to gather public input on wet weather management in the region

Policy and Program Successes

- Extensive community engagement and stakeholder buy-in
- Enhanced regional coordination on land use and water

Opportunities for Replication

- Regional discussions and stakeholder engagement can reduce litigation, build relationships, and build trust between stakeholders

Interview Contact(s) Perspective

- Tom Jacobs, Environmental Program Director, MARC
- Charles Stevens, Water Utility Officer, KCWS
- Terry Leeds, Director, KCWS

MANATEE COUNTY, FLORIDA

Manatee County, Florida is located on the Gulf coast of Florida. The county wholly contains the Manatee River and Lake Manatee watershed. Lake Manatee provides the majority of the county's drinking water - the other major water source is groundwater. The population was 363,369 in 2015 and the county has an area of 743 square miles. The major water and land use challenge realized by Manatee County is the high costs associated with reclaimed water system installation to serve developed residential areas. Key players in alternative water supply programs in Manatee County include State Water Management Districts, Manatee County, and agricultural users.

Key Policy and Program Findings

Non-potable reuse has been a part of the water supply in Manatee County since the 1970s. The county's water reclamation facilities lack National Pollutant Discharge Elimination System (NPDES) permits so wastewater must be either completely reused or disposed of via deep well injection. Eventually the reclaimed water service was extended to residential irrigation, and new development is required by code to have reclaimed water irrigation facilities. This reuse has been closely tied to the county's comprehensive plan that requires the lowest quality water to be matched to the lowest quality need. For example, irrigation meters are no longer issued for potable water. Development code requires alternative water sources for irrigation, such as rainwater, stormwater ponds, shallow wells, cisterns, or reclaimed water.

Example: Irrigation Reuse

Manatee County has a large non-potable irrigation system that uses reclaimed wastewater. The program grew from its agricultural roots to include residential irrigation in the 1990s when the regional water district began cutting back on permits. Stretching existing supplies through alternative methods prevented the need for more expensive conventional supplies. Even though the county has used reclaimed water for agriculture for decades, the agricultural community still has some qualms about using it for certain crops, particularly those where the water directly comes into contact with the food product. For those crops, groundwater is preferred but is not always available and so reclaimed water and other alternative supplies have filled the gap.

Alternative Supply Considerations

- Conservation is an important part of the County's water supply planning efforts
- Brackish reverse osmosis system is being considered for future supply but is not currently not cost effective and is not a needed supply (current reliable supplies through 2035)
- Regional water supply authority allows for shifting of supply contracts to meet local needs

Integration Solutions

- Institutionalized collaboration through various planning/development stages (comprehensive planning, land development code and review)

- Established structure for regional scale planning which encourages flexibility in water supply planning
- Requirement of alternative supplies built into policies and codes

Policy and Program Successes

- Long history of non-potable reuse, which has allowed water quality to be properly matched with the quality required by the end-use
- Water in Florida is managed by Water Management Districts which are organized along basin lines rather than typical geopolitical boundaries
- Conservation, water, and wastewater elements included in comprehensive plan

Opportunities for Replication

- Early adoption of reuse is seen as a key factor in the success of the program. The long history of reuse shows that it can be a viable alternative supply for communities, particularly when it is adequately supported through the land development code
- Regional water management districts are a good model for encouraging partnerships and thinking about water supply planning at different levels

Interview Contact(s) Perspective:

- Mark Simpson, County Water Division Manager
- Jeff Goodwin, County Wastewater Division Manager

PIMA COUNTY AND TUCSON, ARIZONA

Pima County, Arizona encompasses a 9,189-square-mile area, has a population of over one million residents with more than half living in Tucson as well as several smaller cities. As with much of the arid west, climate change, water supply, and population growth are key factors in future planning. Water and land use challenges facing Pima County include the following:

- Drought, water shortages, and development impacts on water resources
- Flood control and stormwater quality regulations
- Local and regional coordination on water and land use planning
- Funding for investment in infrastructure (like roads) to move development to infill areas
- Buy-in from developers, flood control, and water utilities regarding green infrastructure feasibility

Pima County has significant coordination at the local and regional levels. Recently, federal regulation, community, staff interest, and grants have supported green infrastructure workgroups and planning efforts leading to adoption of policies and regulations. Master planning and comprehensive planning efforts for water resources and development impacts have resulted in green infrastructure studies.

Key Policy and Program Findings

At the utility level, instituting a commercial water harvesting ordinance and zoning changes and the inclusion of alternative supplies in the comprehensive and general plans have driven green infrastructure planning. Collaboration between county and city land use planners and water resource managers on a water and wastewater study led to a policy that aligned the water service and land use planning areas. Regionally, regulatory drivers and community interest around stormwater and rainwater capture have led to the formation of interdisciplinary workgroups and policies. This led to green infrastructure resolutions, guidelines, regulations, rebate programs, and planning tools.

Alternative Supply Considerations

- Rainwater harvesting and stormwater capture
- Reclaimed water use and greywater stub-outs required for new City development
- Effluent reuse and aquifer recharge of Central Arizona Project (CAP) water

Integration Solutions

- Institutionalized collaboration included a multi-jurisdictional working group that advanced green infrastructure and a city/county collaborative study led to integration of water resources into land planning documents
- Planning at the city/county scale built trust and ongoing coordination between agencies and departments
- Public education and stakeholder engagement secured buy-in from jurisdictions and brought builders, developers, and the public to the table. Presenting robust information addressed community concerns and pulled people to the middle.

- Policy and regulatory changes and voluntary approaches made alternative water supply use more viable. Alignment of water and land use planning areas advanced infill/access to alternative supplies.
- New technology and innovation used remote sensing to prioritize green infrastructure areas

Policy and Program Successes

- Developed a Green Infrastructure Prioritization Tool and online dynamic map
- 2015 "Green infrastructure for Regional Vibrancy" resolution that showed developers cost/benefit
- LID Working Group developed Low Impact Development/Green Infrastructure Case Studies
- Inclusion of water resource impacts and related land use changes in the Comprehensive Plan Water harvesting ordinances and related incentive programs

Opportunities for Replication

- Data and information sharing that influenced policy change
- Alignment of water utility and land-use planning areas
- Groundwater recharge and recovery of CAP water and effluent and comprehensive plan changes that require information from developers on access to renewable supplies to protect groundwater

Interview Contact(s)

- Mead Mier, Pima Association of Governments
- Kathy Chavez, Water Policy Manger, Pima County Regional Wastewater Reclamation Department
- Evan Canfield, Project Manager, Pima County Regional Wastewater Reclamation Department
- Irene Ogata, Urban Landscape Manger, City of Tucson

SAN FRANCISCO, CALIFORNIA

Over 2.6 million people in San Francisco and throughout the Bay Area rely on water supplied by the SFPUC to meet their daily water needs. The RWS is a municipally-owned utility operated by the SFPUC, a department of the City and County of San Francisco, and serves both retail and wholesale customers. The RWS supplies high-quality drinking water from the Tuolumne River watershed and from local reservoirs in the Alameda and Peninsula watersheds. The RWS draws an average of 85% of its supply from the Tuolumne River watershed, collected in Hetch Hetchy Reservoir in Yosemite National Park. This water feeds into an aqueduct system delivering water 167 miles by gravity to Bay Area reservoirs and customers. The remaining 15% of the RWS supply is drawn from local surface waters in the Alameda and Peninsula watersheds. The split between these resources varies from year to year depending on the water year hydrology and operational circumstances. Major water supply and land use challenges include:

- Population pressures on water supply
- History of drought
- Earthquakes
- Climate change

Planning projections are provided to the SFPUC to conduct water demand forecasting out 25 years.

Key Policy and Program Findings

To protect the water supply during extended periods of drought a wide portfolio of supply options are part of the SFPUC's water management strategy. Conservation has been considered a part of the portfolio for almost three decades. Additional local water supplies, including groundwater, recycled water, and non-potable water are part of the SFPUC's water supply portfolio. The SFPUC is also involved in a number of feasibility studies to examine other potential water supplies, such as desalination, purified water, and water transfers. Finally, San Francisco is the only city in the United Sates that has established a local Non-Potable Water Ordinance that allows for the collection and treatment of alternate water sources (grey, rain, etc.) and coordinates the oversight of this ordinance with four city agencies.

Alternative Supply Considerations

- Longstanding investment in conservation
- Groundwater to blend with surface water supplies to serve customers for potable purposes
- Reclaimed water, supplies for large parks and golf courses
- Desalinization, purified water, and water transfers are under study
- Non-potable water supplies through the collection and treatment of water in buildings
- Non-potable Water Ordinance allows the collection, treatment, and use of alternate water sources for non-potable applications at the building and district scales. The ordinance also mandates the installation of non-potable water systems in new developments meeting specified criteria.

Integration Solutions

SFPUC has prepared OneWaterSF Vision and Initiatives documents, that include the following Guiding Principles:

- Match the right resource to the right use.
- Look holistically at our water, wastewater, and power systems to develop programs, policies, and projects that provide multiple benefits
- Plan for variable outcomes and build in flexibility to adapt to future changes
- Develop projects and programs that conserve resources and promote ecosystem health, including the health and quality of watersheds, the San Francisco Bay, and the Pacific Ocean
- Work across traditional boundaries within our organization to foster collaboration that results in the efficient use of water, wastewater, energy, and financial resources
- Engage our communities to foster awareness and collaboration around OneWaterSF
- Pursue partnerships with other agencies, the private sector, and other stakeholders to generate new and creative ideas
- Pilot state-of-the-art technologies, and test new approaches to develop new business practices

Policy and Program Successes

- Conservation is SFPUC's most cost-effective supply of water
- Ordinances were passed in 2012 and 2013 to allow private sector to collect and treat water onsite for non-potable uses at the building and district scale. This has greatly streamlined the permitting process.
- Non-potable reuse for toilet flushing and irrigation required for new development

Opportunities for Replication

- The Blueprint for Onsite Water Systems: A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems providing 10 steps for other water providers to establish and implement local on-site water system programs
- *Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems* providing information to state and local health departments on developing water quality standards and monitoring strategies to adequately protect public health
- *National Blue Ribbon Commission for Onsite Non-Potable Water Systems* crafting a state guidance and policy framework that recommends mandatory water quality criteria for non-potable water systems that can be transferable from state-to-state

Interview Contact(s)

- Paula Kehoe, San Francisco Water

SAN JOSÉ, CALIFORNIA

As California's third largest city, San José has a population just over one million and is located in Silicon Valley. The city is highly diverse, with more than 40 languages spoken. San José's water and land use challenges include the following:

- Water resource challenges
- Sprawling development patterns
- Lack of staffing to fully implement some programs

Key players include staff in the departments of Environmental Services, Public Works, Transportation, and Planning, Building and Code Enforcement.

Key Policy and Program Findings

San José has taken a very proactive approach to integrate water into its comprehensive plan. The city and its residents felt it was important to integrate water into their most recent comprehensive plan update. Private utilities provide a majority of the city's water with the city utility only providing portions of the total supply need. The biggest push for alternative water supply is through recycled water, especially with the South Bay Water Recycling Program. Motivation for pushing recycled water was increased by the city nearing its allowable discharge limits into the San Francisco Bay under its wastewater treatment plant permit. The goal is to bring water back to the city to use for landscaping and toilet flushing as non-potable sources of water. The city wants to expand its recycling program as well as other alternative supplies over the coming years, but progress is slow due to the required expansion of the pipe network.

Alternative Supply Considerations

- Water efficiency and conservation are an important part of the City's water supply portfolio
- Recycled water is receiving the biggest push with wastewater effluent limits are acting as a driver.
- The San Francisco Bay Municipal Regional NPDES Stormwater Permit has required new development projects to consider re-use; however, bioretention remains the primary approach to managing post-construction stormwater runoff

Integration Solutions

- Institutionalized collaboration where the Planning Division reached out to all other departments in production of comprehensive plan (General Plan)
- Significant public education and stakeholder engagement in development of comprehensive plan (General Plan)

Policy and Program Successes

- Strong reduction in city water use, including in both the private and municipal water supply
- Water efficient landscape ordinance that must be met to receive a building permit

Opportunities for Replication

- Involving the water suppliers in the development review process ensures the development is set up to connect to recycled water lines, if possible, and that there is enough water available for the project

Interview Contact(s):

- Jared Hart, Supervising Planner, City of San José

SARASOTA COUNTY, FLORIDA

Sarasota County, Florida is on the Gulf Coast of Florida and historically relied heavily on groundwater supplies. In the 1990s the county began investing in non-potable reuse (i.e., reclaimed water) for use on outdoor landscaping, driven in part by more stringent water quality requirements of discharged effluent as well as dwindling groundwater supplies. The county is home to about 380,000 residents, a majority of which live in the unincorporated areas outside the towns.

Key Policy and Program Findings

New developments require water use permits that are issued to developers by the Southwest Florida Water Management District (SFWMD). For developments with irrigation needs, feasibility of reclaimed water use is evaluated first and groundwater is evaluated second.

Sarasota County has also been pioneering the injection of reclaimed water into deep aquifers for future recovery. The injection sites tend to be very deep (e.g., 3,000 feet) as salt water intrusion is a problem for the groundwater. Also, the limestone formation into which the city was injecting the reclaimed water was causing arsenic to precipitate out of the limestone due to the levels of dissolved oxygen in the water. The city has worked with new technologies to resolve that issue and is moving forward with its first reclaimed water ASR well.

Alternative Supply Considerations

- Non-potable reuse
- ASR using non-potable reuse

Integration Solutions

- Institutionalized collaboration has resulted in the water permitting process to prioritize use of reclaimed water before groundwater
- There is good data sharing between SFWMD (permit authority) and County to determine feasibility of use
- New technology enabled reclaimed water to be stored in aquifers for future recovery

Policy and Program Successes

The county has such a long history of using reclaimed water that developers will often approach the county about the potential for using it even before a pre-application meeting takes place. Nearly all wastewater produced by the county is applied to outdoor landscapes. Many towns within the county – like Englewood and Venice - have also heavily invested in reclaimed water, using about 85 percent of wastewater effluent on outdoor irrigation.

Opportunities for Replication

- Institute prioritization and evaluation of reclaimed water use for all new, proposed developments

- Most reclaimed water is delivered to a pond from which the water is pumped by the user. Some reclaimed water is delivered to residential homes through pressurized delivery systems.

Interview Contact(s):

- David Sell, Wastewater Superintendent, Sarasota County
- Brian Fagan, Utilities Planning, Sarasota County Public Utilities

SOQUEL CREEK WATER DISTRICT, CALIFORNIA

Soquel Creek Water District (SCWD) is approximately 75 miles south of San Francisco and forms part of the north coast of Monterey Bay. It serves about 40,000 residents in parts of several communities. The district is governed by a board and receives 100 percent of its water from groundwater. SCWD is not a high growth area but cannot necessarily respond to all the planned growth without adverse impacts to its groundwater supply. SCWCD's major challenges include the following:

- Overdraft of existing groundwater sources
- Salt water intrusion
- Program challenges (limited credits, equity concerns, water factor calculations, resources)

Because SCWD is a special district with a charter to provide water only, it does not have as much integration with planning departments as other municipalities, such as cities and counties.

Key Policy and Program Findings

In response to groundwater overdraft and seawater intrusion, SCWD developed a mandatory Water Demand Offset (WDO) program in 2003 that has evolved over time and currently requires developers to pay a WDO fee (credit) that is calculated based on development type and size and includes an offset mark-up factor. Credit fees go back into water saving programs to reduce total water usage. Applicants can get at least a 15 percent WDO fee reduction by installing ultra-high efficiency plumbing fixtures (toilets, showerheads, and faucets) and not installing turf and overhead sprinklers in their landscape. They can earn additional fee reductions by implementing other voluntary measures such as greywater and rainwater harvesting. While offering flexibility to applicants is a benefit, this program is more time intensive for staff to verify measures are implemented. In-house conservation initiatives completed with WDO fees to date include school toilet and urinal replacement, mobile waste-free flushing system, and an ultra-high efficiency toilet rebate. All in-house conservation projects must meet set criteria and require reporting.

Alternative Supply Considerations

SCWD developed a Community Water Plan, with customer input, that includes evaluating four alternative water supply options:

- Stormwater recharge projects
- A groundwater replenishment project using advanced water purification methods to purify recycled water
- Purchasing desalinated water from a private company
- Water sharing with an adjacent municipal water provider

Integration Solutions

- Institutionalized collaboration is being driven by the need to align planned growth with the need for supplemental water due to overdraft and seawater intrusion and the District's WDO program
- Public education and stakeholder engagement is critical to gather public input on new supply and offset projects
- Policy and regulatory change has occurred overtime to adjust to changing program conditions and the need to save larger water volumes
- New technology and innovation approaches include a "Go Green" program option for developers that results in less offsets needed, and a waste-free mobile flushing system

Policy and Program Successes

- Greater coordination with land-use planners over time (due to limited offset credits and water projections)
- Avoided water-service moratorium on development and still significantly reduced water use over time as a result of the WDO program's requirement that development offset 160% of its anticipated water needs and on-going conservation efforts
- Utility-run program provides quality control, options, and applicant convenience

Opportunities for Replication

- Direct install of fixtures is the most effective
- Focus on required actions increases certainty of savings
- Flexible incentive programs are key

Interview Contact(s)

- Shelley Flock, Conservation & Customer Service Field Manager, SCWD

STERLING RANCH, COLORADO

Sterling Ranch will soon be home to a multitude of new residences with differing home types, spaciously sweeping across thousands of acres of natural, preserved environment. It is located southwest of Denver in Douglas County. It is a mixed-use community with nine planned villages. Major challenges for incorporating rainwater harvesting from the initial phases of planning and construction at Sterling Ranch include the following:

- At the time of the initial Sterling Ranch development proposal, rainwater harvesting was not permitted under Colorado water law unless the volume of rainwater captured and used at Sterling Ranch would be matched with a volume of an alternative legally available water supply that would be purchased and put back into the stream
- The permitting of rainwater harvesting requires integration of stormwater regulations and water rights laws, which were created separately and are administered by different agencies
- The construction and maintenance of rainwater harvesting systems had not been broadly tested under local geologic, hydrologic, and climate conditions

Through legislative action in 2009, the Colorado Department of Natural Resources created a precipitation harvesting pilot program to allow state-authorized projects to collect data to apply to the water court for an augmentation plan to use a portion of captured precipitation (rainfall and snowmelt runoff) without replacement. Key players involved in creating the program and advancing the implementation of rainwater harvesting in Colorado included state and county officials and policy makers as well as state, county, water district, and developer representatives with expertise in planning, engineering, water supply, and stormwater.

Key Policy and Program Findings

Sterling Ranch found that developing rainwater harvesting for use on community landscaped areas instead of on individual lots allows efficiencies of scale to be realized. By combining more water-efficient approaches to landscaping and irrigation with rainwater harvesting, total water use is projected to be far below the current standard for a similar type of development in Douglas County. Sterling Ranch is collecting data and information for a future water court application, which will then allow it to store and use a portion of the rainwater. Sterling Ranch's philosophy about water management is motivated by customer desires for sustainability and affordability. Landscaping was designed with an eye towards both water quantity and water quality. Alternative Supply Considerations

- Leading-edge outdoor water conservation solutions
- Community-scale rainwater harvesting

Integration Solutions

- Regulatory changes to allow for rainwater harvesting
- Data collection and information sharing to demonstrate impacts of rainwater collection on downstream water users
- New technology and innovation in using stormwater as irrigation water source

- Public engagement helped build support and current efforts help to build awareness within local and neighboring jurisdictions, water agencies, state agencies, as well as school and university groups

Policy and Program Successes

- Building on a neighborhood and regional scale reduced rainwater harvesting costs significantly compared with rainwater harvesting at individual residences
- Parties who were originally strongly opposed are now cautiously supportive of rainwater harvesting
- Homebuilders have embraced the process as they build water-efficient homes in many other states

Opportunities for Replication

- Colorado water law and stormwater regulations currently make local replication difficult. Sterling Ranch is part of a state authorized pilot project
- The benefits cannot be assumed to be the same at different scales and locations throughout the state
- Rainwater harvesting can be used to promote water supply and stormwater integration for meeting landscaping demands

Interview Contact(s)

- Harold Smethills, Founder, Sterling Ranch Development Company
- Beorn Courtney, President, Element Water Inc.
- Rachel Krantz, Public Relations Manager, Art and Business One

WESTMINSTER, COLORADO

Westminster has 108,000 residents and is located between Denver and Boulder with 34 square miles within city limits and 3,050 acres of open space. Westminster's major water and land use challenges include the following:

- Water demand of the city's zoned land is higher than the existing supply
- Developers' sticker shock at the cost of water
- Conflicting policy objectives at the city between affordable housing and increasing density

Key players in Westminster who are driving coordinated planning efforts include the Planning Division, Public Works & Utilities staff, and City Council. Day-to-day coordination includes plan review components, tap fees, field audits, etc.

Key Policy and Program Findings

Water is well integrated into the city's comprehensive plan and day-to-day planning activities. The city uses water as a growth management tool. City planning documents show that current supplies will not meet projected water demands. At the same time, the city must be strategic about its land use development as it has a limited amount of developable land left. To coordinate these two objectives, water is worked into the development process at an early stage. There are numerous technical meetings between planning and utility staff every week, monthly meetings to discuss policy issues, and a large annual meeting to discuss how much water the city will auction off each year for new growth.

Alternative Supply Considerations

- Conservation and recycled water are relied upon for closing the supply gap

Integration Solutions

- Institutionalized collaboration at multiple levels of city government, especially on water and land use planning
- Policy changes at the city council to ensure water supply for new development is considered
- Data collection and sharing across departments

Water and Planning Coordination

- Regular interaction between Planning Division and Public Works & Utilities staff began in 2005
- Interaction grew out of recognized co-benefits (e.g., coordinated water line installs and street paving)
- City Council is very sensitive to the water/growth interaction
- Water staff attends pre-application development meetings, enabling a conversation with developers around water efficiency, project impacts, and streamlining development review

Policy and Program Successes

- Solid coordination between water and land use planners
- Avoided moratorium on development while still meeting water conservation goals

Opportunities for Replication

- Procedures for department interactions (make water an integral part of development review)
- Linking the water supply plan with the comprehensive plan
- Determining water per land use calculations and comparing demand to total supply

Interview Contact(s)

- Mac Cummins, Planning Manager
- Stu Feinglas, Water Resources Analyst

APPENDIX E
FOCUS GROUP INTERVIEW TEMPLATE

Interviewer:
Date:
Focus Group Attendees (Name, Title & Organization):

INTRODUCTION

Hi, thanks again for taking the time to meet with me today. Goals for today's meeting include:

- Get a summary of efforts in your community to improve integrated planning, with a specific focus on considerations for alternative water supply
- Summarize key players; collaborative opportunities; barriers and solutions to overcome them
- Identify what worked well and what didn't to gather ideas for successful replication and scaling

QUESTIONS

- **Alternative Supply Barriers, Gaps, and Solutions** (to get them warmed up and talking about Alternative Supplies and their experiences)
    - What challenges/barriers have you seen or experienced related to planning for/pursuing/implementing alternative water supply projects? (cite examples)
    - Why did you choose to pursue alt water supplies in the development?
    - What have you seen/done that works related to integrating alternative water supplies?
    - What factors drive choosing to implement alternative supply? (cost, ease of permitting)?
    - Do you have any noteworthy experiences or innovative ideas to help address these gaps or barriers (e.g., information, resources, examples)?
- **Developer Roles and Processes**
    - What is the current role of developers in planning for and/or implementing alternative water supply? What is the ideal role for developers?
    - Who/when/where/why/how to bring the discussion of alternatives to traditional water development into the development process?
    - Who should be responsible for advancing alt supplies?
    - Water provider, planning community, developer, neighborhood group?
    - Teasing out funding may help lead to responsibility for alt supply – follow the money
    - Maybe no one is responsible so getting missed? Who owns it? Can planners be the glue? Planners already involved in sustainability/resiliency should be naturally drawn
- **Role of Others**
    - What can planners do to pave the way for or support the development community with respect to alternative supplies (e.g., policies, regulatory adjustments, facilitate

dialogue)?
    - What can water utilities do support the development community with respect to alternative water supplies (e.g., more transparency/data, regulatory adjustments, facilitate dialogue)?
- **Financing**
    - Is there a financial case for alternative supply projects in the market (i.e., is it profitable)?
    - How have/might you finance alternative supply projects?
    - What other financial barriers or solutions have you encountered with these projects?

APPENDIX F
FOCUS GROUP SUMMARY

INTEGRATING ALTERNATIVE SUPPLY FOCUS GROUP

Participant Perspective

- David Rouse, Managing Director of Research and Advisory Services, American Planning Association
- Joanna Nadeau, Director of Community Programs, Audubon International
- Kwan Delon, Civil Engineering Associate, Los Angeles Department of Water
- Nicholas Schiavo, Public Utilities Director, City of Santa Fe
- Daryl Slusher, City of Austin

General Discussion

Integration of water and land use planning around alternative supply must overcome several stumbling blocks, not the least of which includes overcoming technical and terminology barriers that may inhibit uptake. The group felt that the term "alternative supply" may be too vague but can work if it is clearly defined. At the same time, land use planning integration is not considered even when focusing on traditional water supply.

> "Get ahead of drought…work with the economic development departments to ensure city growth aligns with water availability and infrastructure."
>
> -Daryl Slusher
> City of Austin, TX

Integrating land use and water supply more generally would make alternative supply considerations easier. Capitalizing on a specific event, such as a drought, can capture the public's attention and help drive change. In the end, alternative water supply diversifies water portfolios, enhances sustainability, and increases resilience.

Key Insights

- Rapid growth makes planning difficult and getting ordinances passed requires a grassroots effort
- Established processes and procedures should be set between water and planning departments
- The "One Water" framework can be used as an integrated framework for water management
- Because alternative supply can be more costly, funding and responsibilities need to be clear

Lessons Learned

- It takes time for regulators and the public to fully embrace cost-effective alternatives
- Voluntary measures can go beyond ordinances (e.g., stormwater for recharge and recycled water)
- Identify goals in the development review process and engage the water agency / provider

- Placing a focus on the impacts of impervious surfaces on groundwater recharge is key

Roles and Responsibilities

- In some communities, developers have to bring water supply to the development plan
- There is a need to emphasize the value of water and the cost benefits to spur investment
- The water utility has an untapped potential to help promote alternative supply with developers
- Planners can help compare traditional supply impacts with alternative supply benefits
- Planners are critical to have at the table because the sites they develop collect and use water

GEOGRAPHIC DIVERSITY FOCUS GROUP

Participant Perspective

- Katharine Jacobs, Director of the Center of Climate Centered Solutions, University of Arizona
- Theresa Connor, One Water Solutions Institute, Colorado State University
- John Rehring, Project Manager, Carollo Engineers
- Judson Greif, Deputy Director, US Water Alliance

General Discussion

Alternative water supply projects have been implemented across the U.S, not just in the Western United states, though the examples may be more abundant there. For example, Texas, Florida, and Georgia have done a lot with water reuse regulations, permitting, and development. But in each case, there are opportunities for increased coordination between water and land use planners.

Key Insights

- Hundreds of examples exist for reuse systems, predominantly implemented in water-short and arid areas. Examples that may be most relevant to the topic of coordinated land use planning include El Paso, TX, Austin TX, Hampton Roads, VA, Sarasota County, FL, and Manatee County, FL.
- The drivers of alternative water supplies vary across regions. For example, water reuse in Austin was driven in part by endangered species concerns. Groundwater depletion was a driver for water reuse in Hampton Roads, VA. In Florida water quality, groundwater depletion (and subsequent salt water intrusion) was a driver of developing water reuse.
- Several examples of water reuse and rainwater harvesting exist at the site scale as well, rather than community scale, for reasons such as economics, lack of water supply or capacity to treat the wastewater. Examples include Battery Park in New York, the Target Center in Minnesota, the Gillette Stadium in MA, the Mercedes Benz stadium in Atlanta, GA, and several projects in San Francisco CA have decentralized wastewater treatment operations (see more from the National Blue Ribbon Commission for on-site non-potable water systems).

Lessons Learned

- Sarasota County implemented a reclaimed water system at the community (county wide) scale. Each municipality had its own approach to process, which may yield interesting insights into the variety of approaches that can be taken
- While much of this research has been focused on how to leverage the land use planning process to promote alternative water supplies, it's important to acknowledge that state law and local regulations can also be a barrier to promoting alternative water supplies. For example, the City of Norman, Oklahoma's plans for implementing indirect potable reuse (by augmenting surface water supplies in Lake Thunderbird) provided support for the State of Oklahoma to revise its regulatory structure to allow indirect potable reuse.

- Development of alternative water supplies has occurred in a variety of regions around the US, but not everywhere. Whereas assessments of alternative supplies in the West are often driven largely by water supply, the drivers in other regions include water quality regulations, aquifer and groundwater management, and lack of local capacity to treat large, new volumes of wastewater.
- Other drivers such as water quantity (flooding and drought), water quality (including non-point source pollution), and climate change will likely help drive more integration of water resources and land use planning

Roles and Responsibilities

- Water quality requirements have played a significant role in encouraging - and in some cases discouraging - reused water
- Several municipalities have developed water reuse systems, but individual sites can also be leaders in this area

DEVELOPERS FOCUS GROUP

Participant Perspective

- Joe Knopinski, Actual Communities
- Harold Smethills, Sterling Ranch Development
- Eric Hecox, Shea Properties

Major Challenges and Barriers

Water rights and water law can be major barriers to implementing alternative water supplies. There are limitations on rainwater harvesting for example. At the same time, conserving outdoor water use can be a strong driver but there are issues outside of regulation that complicate practical implementation of alternative supply approaches. For example, there are health concerns and liability issues with reuse water (e.g., kids drinking reuse water out of garden hoses). From getting project support to navigating approving authorities or even combatting customer perceptions, there are barriers that must be overcome to develop a project with alternative water supplies.

> "Public health responsibility errs on the side of being safe and conservative for consumers. Water supply errs on the side of multiple alternatives and redundancies. There are different priorities and we need to find a middle ground."
>
> -Eric Hecox
> Shea Properties

Key Insights

- Using creative water budgets and rate structures can help drive down outdoor water use
- Increased water prices help drive changes in customer norms
- The environmental community can be an ally in pushing new sustainability efforts in developments
- Trends show greater payback on direct reuse (not dual systems) and treatment, rather than new supply

Lessons Learned

- Full Reuse Policy in Castle Rock, Colorado: The idea of implementing a two-pipe system for potable and reuse water failed in the 1970s due to lack of development community and regulatory support.
- Non-potable Irrigation in Fort Collins, Colorado: The proposed Waters' Edge neighborhood development project in northeastern Fort Collins proposes to supply neighborhood households with non-potable water (not reuse water). The project is using cost savings, water rights, and secured supply to gain traction and support. However, these are also project challenges.
- Zero Discharge for Meridian Colorado Project: Meridian has a zero discharge (fully reusable) system that treats sewer flows to nearly potable standards before serving irrigation water to businesses, golf courses, and apartment buildings. The challenge is in

balancing the system as there is no opportunity to discharge to streams, but there may be long-term opportunities for integrated aquifer storage and recovery.

Roles and Responsibilities

Working across various jurisdictions is generally not an impediment but can be challenging when roles and responsibilities are not clear or where they overlap. A lot of developments have a design review committee/architectural committee where ordinances are enforced whereas the water community is not very connected to this type of control even though these groups can enforce things like water use and landscape design. When everyone sits at the table to collaborate, it works well and training for planners to better learn how land use impacts water demand could help.

THIRD PARTY CONVENERS FOCUS GROUP

Participant Perspective

- Mead Mier, Sustainability Coordinator, Pima County Association of Governments
- Edward DiFiglia, Municipal Policy Specialist, Stony Brook-Millstone Watershed Association
- Chris Faulkner, Watershed Planner, Atlanta Regional Commission
- Tiffany Zezula, Managing Director for the Land Use Law Center, Pace University

General Discussion

Third-party conveners can play a powerful role in facilitating and helping fund land use and water discussions. Regional planning uses the same population projections for land use, transportation, and water planning, which sets a level playing field for baseline coordination but larger integration is dependent upon regulatory drivers or a demonstrated value proposition. Limited water resources tend to be the major drivers of alternative supply discussions.

> "Developers are interested in efficiency of process, incentive-based compliance, flexibility in finding methods to achieve goals (not prescriptive) to aid economic feasibility, return on investment, and information that demonstrates making communities attractive to growth."
>
> -Mead Mier
> Pima Association of Governments

Key Insights

- From grants to organizational dues, funding is widely available for third-party groups
- Partners are needed to do on-the ground implementation that turns policy into action
- Setting a baseline understanding of the gaps and opportunities with support data and research is key
- Water providers have a strong desire to maintain independence and water rights

Alternative Water Supply Project Lessons Learned

- Pennington, New Jersey: Pennington incorporated green infrastructure, vegetative swales, and an underground infiltration basin to support new development due to limited water supply and citizen support.
- Land Use Law Center, New York: The center offers a 4-day training on land use and collaborative decision-making. Customizable curriculum builds partnerships and knowledge base.
- Metro Water District, Georgia: The district was formed in 2001 to support water, wastewater, and stormwater issues related to supply and rapid growth in the metro area. In partnership with the state, the district requires municipalities to take actions that have helped cut the gallons per capita per day (gpcd) water use from 160 gpcd down to 100 gpcd.
- Pima Association of Governments, Arizona: The organization provides a coordinator role that moves across jurisdictions and boundaries. Services include workshops to help

industries navigate ordinances, policy guides, investment tools (e.g., return on investment tool to demonstrate green street value), and staff education.

Roles and Responsibilities

- Third parties are not regulatory agencies and take a collaborative approach as neutral moderators
- These groups have to navigate being seen as an additional governmental layer or an outsider
- If done correctly, third parties can have huge impacts that build lasting partnerships with stakeholders

GLOSSARY

Alternative water supplies (AWS), sometimes called auxiliary or augmentation supplies, are used to supplement and diversify a water provider's more traditional surface and groundwater supplies.

Aquifer permeable underground rock, sand gravel or silt that can transmit or hold groundwater.

Aquifer storage and recovery (ASR) uses groundwater aquifers as underground storage reservoirs with the intent of future recovery and reuse. Storing the water underground reduces losses from evaporation and may even provide some treatment, depending on the method of storage, while also providing some operational flexibility by storing water during wet times for use during future dry times. Water is introduced to the aquifer either through surface infiltration or direct injection.

Certificate of Occupancy is a document that deems a building is in compliance with building codes and laws, thereby indicating that it is suitable for occupant use.

Codes and regulations are specific rules or laws that dictate how and where buildings, infrastructure, development, etc. can be constructed.

Conservation is the act of reducing water consumption through activities, such as efficiency improvements/equipment upgrades and end user behavior change, and eliminating system leaks and other transmission inefficiencies. Conservation can be achieved directly by the utility as well as by customers.

Coordinated Planning Guide is the companion resource to this Research Report intended for use by water providers and community planners looking for opportunities to improve integration and collaboration. It provides significantly more detail on when and how alternative water supplies and land use can be integrated, with supporting case study examples throughout.

Desalination treats either seawater or brackish groundwater to remove salts and other constituents, typically through an ultra-filtration (rather than conventional treatment) process. With enough treatment, the water may be used as a potable water supply.

Development codes regulate development activities. In some communities, unified development codes integrate zoning and subdivision regulations with other development specifications; in others, they are separate documents. Development codes or adopted policies typically specify development standards, including site, building, landscaping, and related design and land use specifications to ensure new development is properly planned and built.

Greenbelt is a land use designation or policy designed to protect undeveloped and/or wild areas surrounding urban areas.

Green infrastructure is when infrastructure such as roads or parking lots protect, restore, and/or mimic the functions of the natural water cycle.

Greywater is a specific category of wastewater, typically described as residential/non-industrial wastewaters coming from appliances such as showers and tubs, clothes washers, and bathroom sinks. The key to greywater is that it excludes water contaminated with fecal matter and limits the level of organics, greatly improving the quality compared to traditional wastewater and making it suitable for non-potable reuse with limited treatment.

Groundwater is the water below the Earth's surface. It is usually stored in the fractures of rocks or in soil pore spaces in an aquifer.

Integrated Water Planning establishes policy-level direction for water managers in planning activities often at the scale of 30 years or longer, considering multiple aspects of water management (e.g., water supply, wastewater, stormwater, water quality, and water efficiency) while taking into consideration social, environmental, and economic objectives.

Long-Range Planning is a planning effort undertaken by a municipality, county, or other land use authority to articulate the vision for long term growth in a given region, taking into account social, economic, and environmental objectives.

Membrane bioreactor treatment is the integration of a membrane process with a suspended growth bioreactor. It is now commonly used for municipal and industrial wastewater treatment.

Non-potable reuse treats wastewater for reuse but limits the use of the treated water to applications other than drinking, such as industrial uses, agriculture, or landscape irrigation, thereby reducing the level of treatment required.

Ordinances are laws made by a municipality or county.

Process water is water which cannot be classified as drinking water and which is used in connection with technical plants and processes in production companies, heat and power plants, and institutions.

Potable reuse treats wastewater, improving it to meet drinking water quality standards, with the intent of either direct or indirect reuse. Direct reuse systems send the treated wastewater directly into the water distribution system while indirect systems introduce treated wastewater into a natural groundwater or surface water source and then reclaim and put through a second drinking water treatment process before adding to the distribution system.

Rainwater capture is the collection of rainwater before it contacts the ground, most often collected from roof top down spouts or directly.

Subdivision regulations guide how a segment of land is developed into lots for individual sale and development. Subdivision regulations are designed to ensure lots have adequate access to streets and utilities, and to avoid sensitive lands such as floodplains and steep slopes. Subdivision regulations address the quality of new development, such as neighborhood design and layout of the site.

Surface water is water that exists on the ground or surface, such rivers and lakes.

Stormwater capture collects the runoff from rainfall events once water has made contact with the ground and makes the water available for beneficial uses instead of allowing it to run off into surface waterbodies. Captured stormwater can be used directly or go through a treatment process prior to use.

Water sharing programs facilitate the transfer of water from regions or users that have an abundance to those who are facing a lack of water.

Water sustainability ordinances are incorporated into various municipal and county code sections. These types of ordinances support more sustainable water supplies by reducing indoor and outdoor water demand and requiring alternative water supplies to reduce potable water use. Indoor conservation ordinances are generally found in plumbing codes. Outdoor water conservation codes may address irrigation efficiency, water features, golf courses, large landscaped areas, and also contain requirements to use alternative water supplies for irrigation purposes.

Zoning codes form the blueprint for future development by dividing land into zones, and prescribing the type of land uses - such as residential, commercial, industrial - and intensity of development allowed within each zone. Zoning can also be used to designate the amount and location of undeveloped land, or open space. Lands can also be rezoned, overriding the original zoning, subject to certain conditions.

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ABBREVIATIONS

APA	American Planning Association
ACWA	Association of California Water Agencies
ANOVA	Analysis of Variance
ASDWA	Association of State Drinking Water Administrators
ASR	Aquifer Storage and Recovery
AWRA	American Water Resources Association
AWS	Alternative Water Supplies
AWWA	American Water Works Association
CAP	Central Arizona Project
ELCO	East Larimer County Water District
EPA	Environmental Protection Agency
FCLWD	Fort Collins-Loveland Water District
FCU	Fort Collins Utilities
KCWS	Kansas City Water Services
LID	Low Impact Development
MARC	Mid-America Regional Council
MOU	Memorandum of Understanding
NACWA	National Association of Clean Water Agencies
NFL	National Football League
NGO	Non-Governmental Organization
NPDES	National Pollutant Discharge Elimination System
SCWD	Soquel Creek Water District
SFPUC	San Francisco Public Utility Commission
SFWMD	Southwest Florida Water Management District
WDO	Water Demand Offset
WEF	Water Environment Federation
WE&RF	Water Environment & Reuse Foundation
WRF	Water Research Foundation