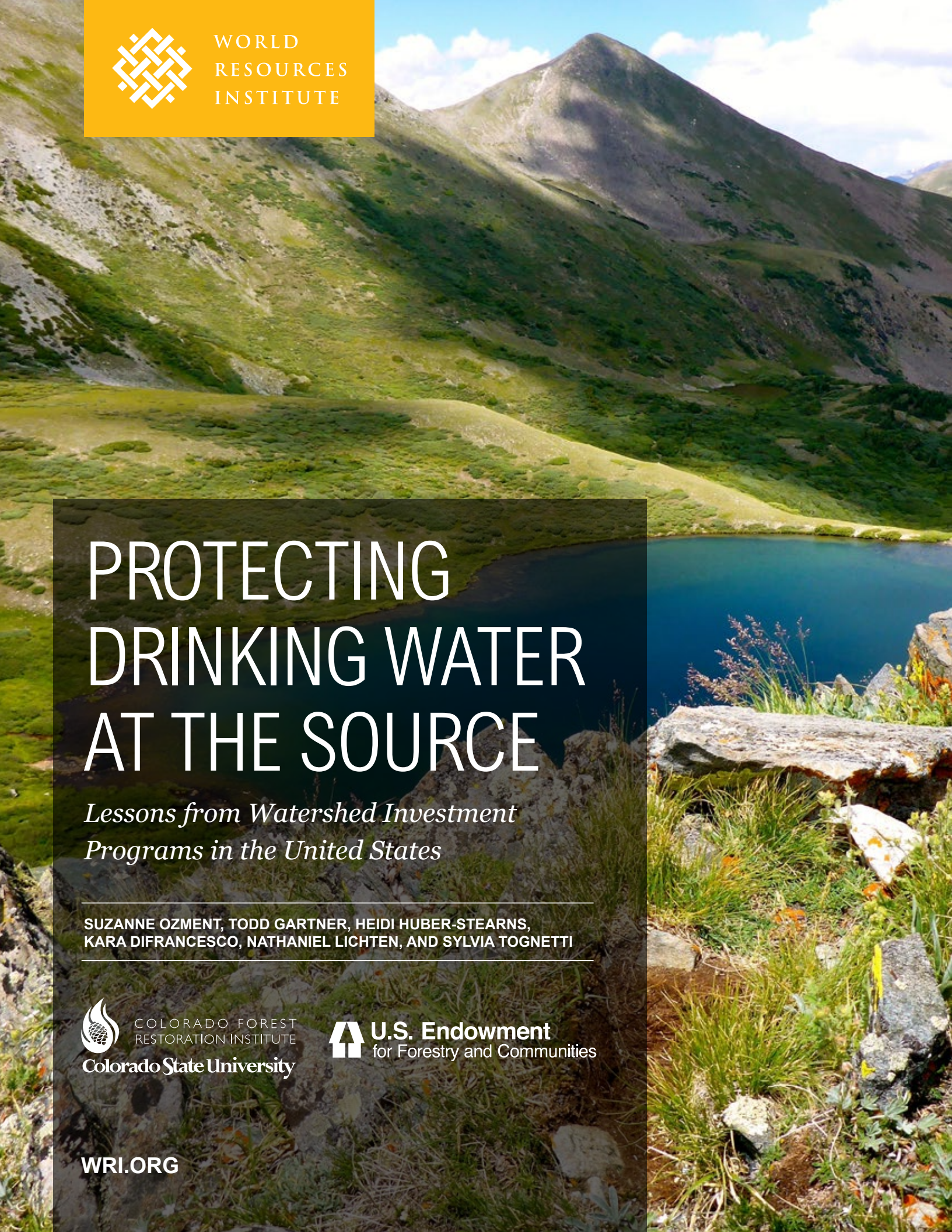

WORLD RESOURCES INSTITUTE

PROTECTING DRINKING WATER AT THE SOURCE

Lessons from Watershed Investment Programs in the United States

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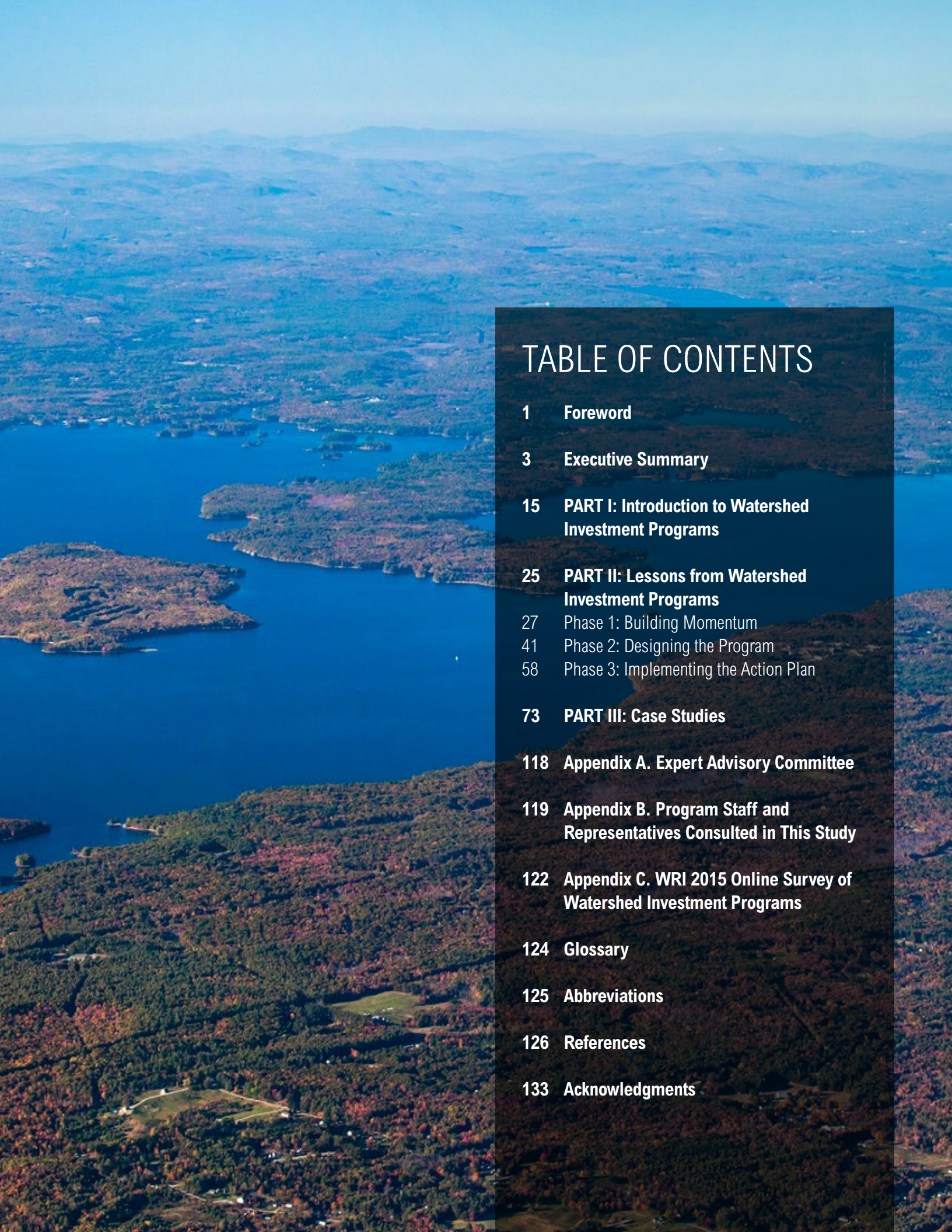

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FOREWORD

The U.S. water sector is at a historic intersection. Many of the pipes and filtration systems that capture, clean, and move public drinking water are nearing their life expectancy. The American Water Works Association estimates that replacing them could cost more than $1 trillion over the next 25 years. New risks to water supplies and security concerns have communities thinking more holistically about their water sources. For example, protection and sound management of the forests that provide two-thirds of U.S. fresh water is becoming a national priority. Daunting as these challenges are, they provide an exceptional opportunity to rethink our approach to water supply systems. The pathways we choose will affect generations to come.

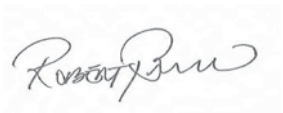
Increasingly, community leaders are looking for more cost-effective and durable solutions to water management. Rather than rely solely on built infrastructure systems, they are incorporating "green" approaches that harness or mimic nature's own processes, such as by conserving forests that are the source of drinking water and maintaining natural floodplains to lessen the impacts of storms. Experience shows that when paired with traditional infrastructure, natural infrastructure—wetlands and forests—can reduce water management costs and deliver other cultural and economic benefits coveted by twenty-first century communities, like recreational green spaces and fish and wildlife habitats.

For many communities, the biggest challenge to adopting these green approaches is understanding how to finance and implement them. Fortunately, a handful of projects across the country offers helpful insights to landowners and managers, utilities, and community groups. *Protecting Drinking Water at the Source: Lessons from Watershed Investment Programs in the United States* mines these insights to reveal the conditions that have helped natural infrastructure projects succeed. Its lessons come straight from the water management practitioners who work daily to maintain and improve water quality and supply while saving consumers money.

Together, the projects featured here show that an integrated approach to water management opens the door to improved performance and reduced costs. Landowners who manage a forested watershed upstream from a city's water source play an integral role in maintaining water quality and supply. Engaging those landowners and helping them to protect and manage their forests is increasingly important to water management. In agriculture-dominated watersheds, finding innovative ways to finance water quality improvements on private working lands could help solve persistent water quality challenges. On public lands, the U.S. Forest Service has developed partnerships with several water providers across the country to protect source watersheds through collaborative planning, select management prescriptions, and targeted investments. USDA's Conservation Innovation Grants (CIG), the source of funding for this report, has been a key federal program in driving innovation in watershed investment programs, as well.

Think of this report as a roadmap to help guide your planning and implementation of natural infrastructure projects. We hope the stories of successes and challenges compiled here will inspire and guide utilities and communities as they work together to protect precious source waters.

Andrew Steer
President and CEO, World Resources Institute



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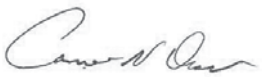

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EXECUTIVE SUMMARY

Watershed investment programs aim to sustain the supply of clean and safe water to communities by funding the conservation and restoration of lands that protect water quantity and quality. These programs connect downstream water users (such as water utilities, municipal governments, businesses, and the public) to upstream landowners (such as private forest owners and public lands managed by the U.S. Forest Service). They unite drinking water utilities, rural landowners, government agencies, conservation organizations, and others around the goal of providing safe drinking water through sustainably managed watersheds.

Most water supply systems in the United States trace their source to small headwater streams surrounded by forests that play an integral role in filtering impurities, reducing sedimentation, regulating water flows, and delivering other benefits. However, declining forest health and deforestation are threatening water supplies across the country. At the same time, much of the U.S. built water infrastructure is also under stress. By one estimate, local and national authorities must invest more than $1 trillion over the next 25 years to maintain, repair, and expand the U.S. water infrastructure system to meet demand for safe drinking water (AWWA 2013). Much of this investment might be inefficiently spent, however, without additional investments in forests' contribution to water security.

Behind many watershed investment programs is the expectation that local water utilities will achieve operational and budgetary improvements compared to business-as-usual built infrastructure: water supply will be more reliable and cleaner when it arrives at the utilities' facilities, reducing operational risks and treatment costs. Depending on how programs are designed, investments in watersheds might also boost rural economies through green jobs and provide a host of ecosystem services, such as wildlife habitat, recreational opportunities, and carbon sequestration.

Yet despite their potential benefits, there are only a few dozen watershed investment programs in the United States. Program representatives cite a lack of investment and a lack of support from key stakeholders as the main barriers to establishment and growth. They explain that challenges in generating sufficient funds stem from difficulties in communicating a return on investment as well as lack of data on outcomes with which to evaluate program performance.

Water managers are looking for guidance on how they can overcome these challenges and build programs that work in their particular contexts. To date, however, most research on watershed investment programs has focused on framing conceptual opportunities and challenges, conducting national-level surveys, or detailing individual case studies that may not be relevant to other geographies and contexts.

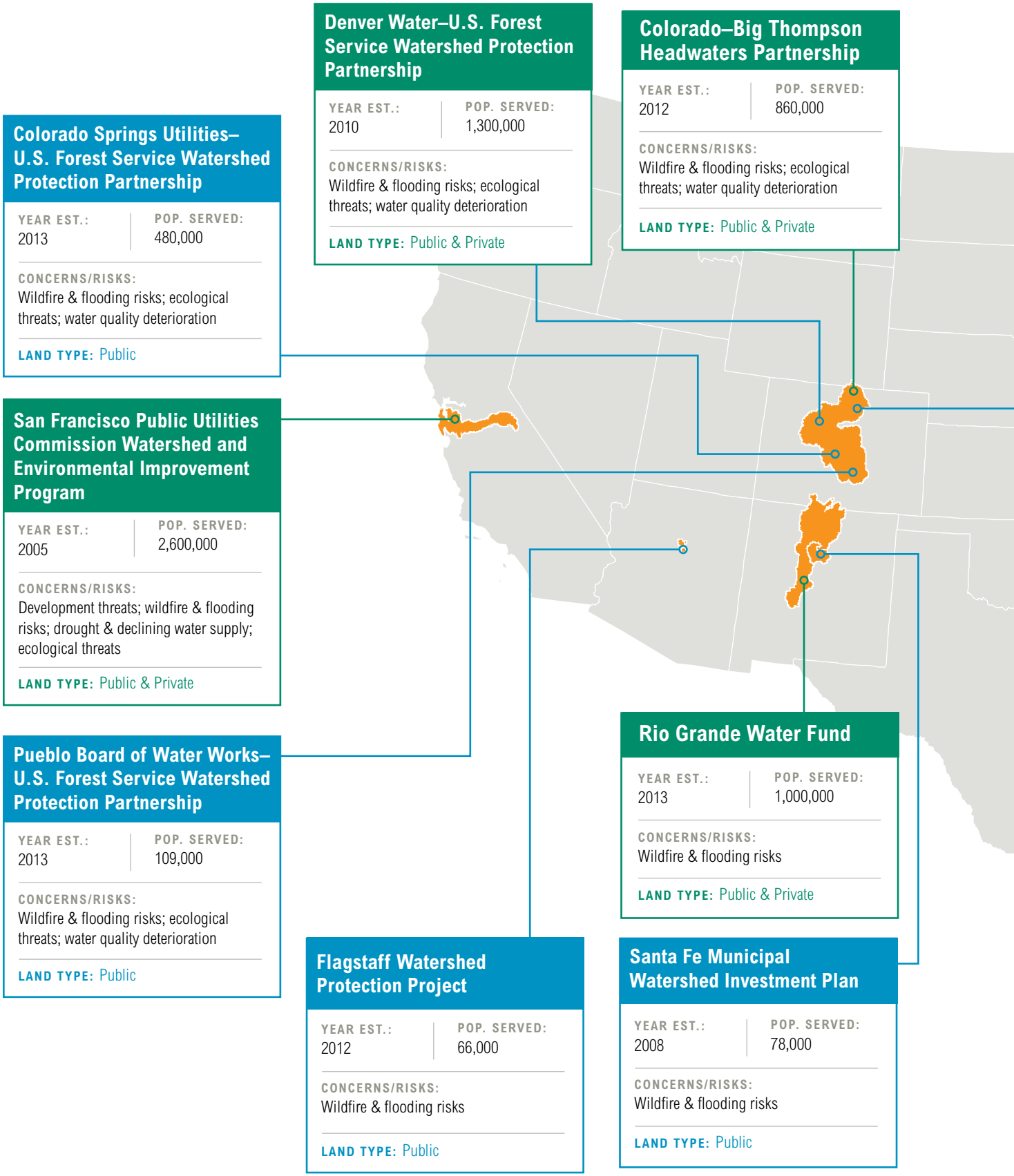
To fill this gap, this report identifies common approaches and underlying conditions that led to the establishment and growth of 13 watershed investment programs in the United States. Between 2013 and 2016, researchers from the World Resources Institute and Colorado State University analyzed 13 watershed investment programs across the United States (Figure ES-1), interviewing key stakeholders associated with each program. Specifically, we studied programs that address forest management for drinking water protection.

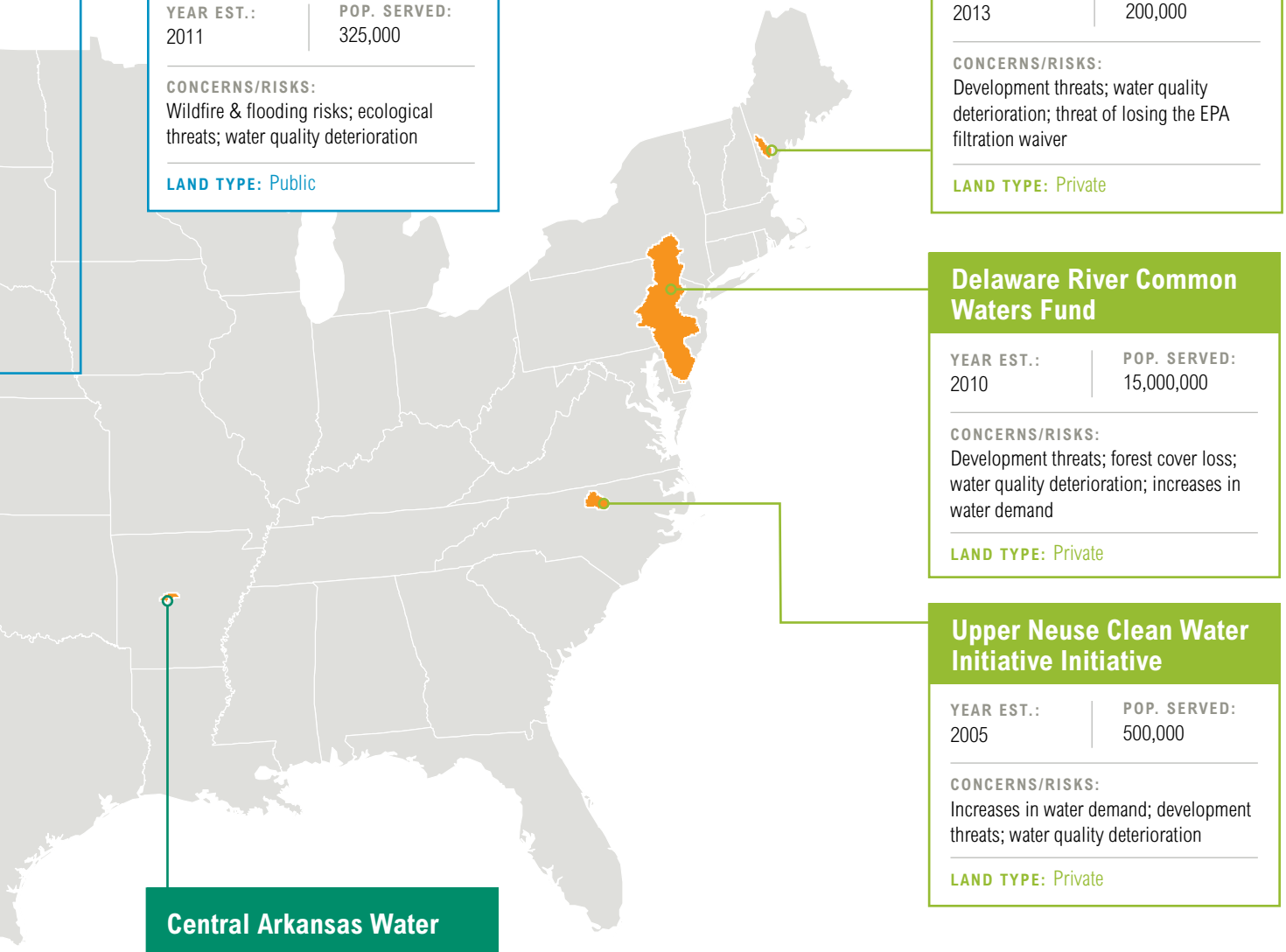
Through interviews, surveys, and input from an expert advisory committee, we identified clear themes, common characteristics, and overarching lessons that were relevant to programs across geographies and in various contexts. (See Appendix A for more information on the advisory committee. A complete list of the 64 individuals we spoke with—employees of water utilities, state and federal government agencies, municipal governments, nongovernmental organizations (NGOs), academic institutions, and landowner associations—appears in Appendix B.)

Through several rounds of feedback, we refined these lessons and organized them into a framework that characterizes a general approach for successful watershed investment program development (Table ES-1). The framework is not intended as a step wise prescriptive guide to the process of program development. Rather, it is a distillation of the strategies and tools that worked for watershed investment programs in multiple contexts. Drawing on these experiences, programs can learn from each other to overcome common challenges, evaluate their own approaches to program development, and save time and money by benefiting from the experience of others. Water managers can also use this study to educate stakeholders about the purpose and structure of watershed investment programs.

Most water supply systems in the United States trace their source to small headwater streams surrounded by forests that play an integral role in filtering impurities, reducing sedimentation, regulating water flows, and delivering other benefits. However, declining forest health and deforestation are threatening water supplies across the country.

Figure ES-1 | **Map of 13 Studied Watershed Investment Programs**





Aurora Water–U.S. Forest Service Watershed Protection Partnership

YEAR EST.: 2011

POP. SERVED: 325,000

CONCERNS/RISKS: Wildfire & flooding risks; ecological threats; water quality deterioration

LAND TYPE: Public

Portland Water District

YEAR EST.: 2013

POP. SERVED: 200,000

CONCERNS/RISKS: Development threats; water quality deterioration; threat of losing the EPA filtration waiver

LAND TYPE: Private

Delaware River Common Waters Fund

YEAR EST.: 2010

POP. SERVED: 15,000,000

CONCERNS/RISKS: Development threats; forest cover loss; water quality deterioration; increases in water demand

LAND TYPE: Private

Upper Neuse Clean Water Initiative Initiative

YEAR EST.: 2005

POP. SERVED: 500,000

CONCERNS/RISKS: Increases in water demand; development threats; water quality deterioration

LAND TYPE: Private

Central Arkansas Water

YEAR EST.: 2007

POP. SERVED: 400,000

CONCERNS/RISKS: Development threats; water quality deterioration; legislative threats

LAND TYPE: Public & Private

Sources: Spatial data provided by Katherine Sever, Colorado State University. Program data provided by practitioners listed in Appendix B.

Lessons from Watershed Investment Programs

Table ES-1 | **Lessons from Each Phase of Watershed Investment Program Development**

PHASE OF PROGRAM DEVELOPMENT	DESCRIPTION	LESSONS
Building momentum	Identifying a clear need and purpose for a watershed investment program; securing commitment from key stakeholders	1. Identify risks (wildfire, drought, etc.) and seize opportunities to rally support 2. Build partnerships to fill essential roles and responsibilities 3. Articulate a clear vision of success 4. Cultivate champions and advocates to build support (from water utilities, local government, NGOs, landowners, etc.)
Designing the program	Assessing the scientific and economic underpinnings of the program; creating a strategy to achieve program goals	5. Develop a scientifically informed watershed plan 6. Evaluate the business case for investment 7. Identify investors (water utilities, companies, foundations, etc.) and financing mechanisms for initial and long-term funding
Implementing the action plan	Actively and adaptively managing the program to make investments; tracking the results of those investments	8. Engage landowners and public managers to conserve, restore, and sustainably manage natural infrastructure 9. Define roles and plans for program administration 10. Monitor and evaluate performance (acres of forestland protected, acres treated for fire risk reduction, pounds of sediment avoided from filling waterways, etc.)

Building Momentum

1. Identify risks and seize opportunities to rally support

Each program we studied formed in response to an important water supply or quality risk caused by watershed degradation, whether linked to wildfire in the West, gradual land-use change in the East, or a combination of factors. Program proponents began to build momentum by working with local stakeholders to articulate these risks as shared problems that could be addressed through collaboration.

Representatives from each program emphasized the importance of capitalizing on windows of opportunity to focus attention on watershed issues. A window might open in the wake of a sudden catastrophic event that threatens drinking water supplies (such as a forest fire), a regulatory change, new scientific information, or increases in water treatment costs. Program representatives stressed that building relationships and knowledge in anticipation of these moments dramatically increased their program's ability to seize windows of opportunity.

LESSON IN PRACTICE

Central Arkansas Water's program developed in response to a risk of increasing water treatment costs linked to forest loss and degradation in its source watershed. The utility used academic studies of watershed risks to rally support for the program's rapid formation, culminating in passage of a water use fee dedicated to funding watershed management.

2. Build partnerships to fill essential roles and responsibilities

All 13 programs in our study formed as collaborative partnerships, enabling them to benefit from the skills, resources, and connections of multiple organizations. Common roles emerged among the 13 programs, with one organization sometimes filling two or more of them. Essential partners include the follwing:

- **Investors**, such as municipal and federal governments, public utilities, grant-making entities, philanthropic organizations, and water customers, particularly those who pay a fee for watershed investment. Increasingly, water-dependent companies such as food and beverage manufacturers are also investing in watersheds.

- **Land conservation and restoration suppliers**, the private landowners or public land managers who use investors' funding to implement local forest restoration and conservation.
- **Coordinators** manage funding, broker deals, distribute investments, facilitate decision-making, bridge communications, and coordinate the efforts of partners. Often NGOs serve in this role.
- **Approving bodies** approve regulatory requirements or measures. They may include municipal, state, or federal governments, or boards of directors for investors.
- **Intermediaries** establish relationships between investors and landowners, and sometimes offer technical support for planning and monitoring. Intermediaries can include land trusts, conservation districts, environmental organizations, and other groups that are seen as a trusted entity by a majority of players.
- **Technical experts**, such as universities and organizations with natural resources expertise, can provide technical assistance to support science-based decisions, spatial analysis, or economic evaluation.
- **Public outreach groups** can conduct strategic outreach to build support for program activities among local environmental organizations, water customers, business representatives, and elected officials.

LESSON IN PRACTICE

In Maine, the **Portland Water District** had no experience working directly with landowners. Local land trusts bridged this gap and effectively led outreach with forest owners. In turn, land trusts accessed new financial support for their conservation work.

3. Articulate a clear vision of success

Vision statements helped to build collaboration among partners, communicate the program goals to funders, and set a course of action early in program development. Eleven of the 13 programs formed a vision of success before initiating their program. Developing a joint vision of success entailed collaborative processes that accounted for the opinions and goals of many stakeholders, and resulted in a written long-term plan. Some programs elaborated targets and performance metrics in their vision of success.

The content of these visions of success varied considerably and the majority stated multiple goals. While all acknowledged the link between healthy forests and water as an impetus for program formation, surprisingly, only five stated a direct goal of maintaining or improving drinking water supply. One reason for this is that directly observing water quality impacts is costly and technologically challenging. Some interviewees noted that it is currently easier and cheaper to measure the amount and type of forest treatments and land protection than to confidently estimate downstream water quality impacts of watershed management activities. Programs may be setting land management goals that can be more easily measured and monitored, and omitting water quality targets that are challenging to attribute to these activities. The lack of direct water supply goals creates some risks: if programs are not able to demonstrate water improvements attributed to program activities, they may struggle to build support from partners and adaptively manage their program to maximize outcomes. Furthermore, a strong business case is often necessary to secure long-term financing.

LESSON IN PRACTICE

In 2014, the **Rio Grande Water Fund** created a shared statement among partners to, "achieve the vision of healthy forests and watersheds that provide a reliable supply of high-quality Rio Grande water and other benefits for New Mexico…. The goal of the water fund is to protect storage, delivery and quality of Rio Grande water through landscape-scale forest restoration treatments in tributary forested watersheds, including the headwaters of the San Juan Chama Project."

4. Cultivate champions and advocates to build support

Eleven programs emphasized that during initial program development, they benefited from individuals' leadership in putting ideas into action at a watershed scale. Two types of leaders emerged:

- "Champions" were leaders within key decision-making bodies like government agencies and utilities who helped partners navigate bureaucracy and gain necessary approvals of funding allocations, bond measures, and regulatory compliance.
- "Advocates" were leaders, often from community groups or NGOs, who helped form alliances among key stakeholders, lobby interest groups, measure public opinion, and garner public support.

LESSON IN PRACTICE

In North Carolina, the mayor of Raleigh championed the establishment of the **Upper Neuse Watershed Investment Program**, building support among city council members. At the mayor's prompting, the council voted in 2005 to approve a $500,000 grant to fund developing the Upper Neuse Clean Water Initiative.

Designing a Program

5. Develop a scientifically informed watershed plan

To enact their visions of success, all of the programs we considered created either work plans or guiding principles to help prioritize their watershed interventions. The plans defined the parcels of land that would be targeted for protection or management, and the types of forest treatments (e.g., thinning overstocked forest stands to reduce fire risk, managing pests or invasive species, set-aside protected areas, or riparian area management) that should be funded.

Eight of the 13 programs developed work plans by spatially analyzing the watershed to identify priority lands for downstream water quality. Interviewees noted that developing a plan on paper was not sufficient. Ideally, decisions on how to prioritize and treat forests in the watershed should be "ground truthed" by taking the map into the field and judging the feasibility of implementing the plan (e.g., taking into consideration landowner willingness to participate and the cost of watershed management activities).

Most programs combined scientific information with stakeholder consultations to develop a feasible plan for the watershed. Although developing a collaborative watershed management plan with input from all partners is laborious, all programs engaged partners as a way to open a dialogue about priorities and interests. This also increased mutual understanding and trust among partners.

LESSON IN PRACTICE

In Colorado, the **Watershed Wildfire Protection Working Group** formed to collaboratively develop and implement strategies to protect critical local watersheds from high-severity wildfires. Organizations within the group have commissioned assessments to prioritize hazardous fuel treatment projects for every major watershed that supplies water to Colorado Front Range cities and communities.

6. Evaluate the business case for investment

Interviewees reported that evaluating the financial or economic benefits of their programs helped to justify the programs to investors and other partners and to build a financing strategy. The programs that developed in response to catastrophic wildfire threats all referenced the financial damages of past fires to demonstrate the cost of inaction. At the time of our study, three programs had financially modeled potential returns on natural infrastructure investments for water utilities and two were in the process of doing so.

Some programs took less quantitative approaches to building a business case for action. Interviewees from some of the Colorado programs agreed that dealing with the costs of recent wildfires, or watching nearby utilities address wildfire impacts, was sufficient to justify watershed investment to potential investors; detailed financial analysis was not needed. In several cases, utilities already knew their increased costs from sedimentation impacts in portions of their water system.

The retrospective and prospective studies of the costs and benefits of watershed protection analyzed a range of financial benefits that accrue to utilities and other stakeholders. Benefits to water utilities included avoided or reduced costs of infrastructure upgrades or expansion, reduced costs of water system operations and maintenance, reduced regulatory risks, and reduced cleanup and revitalization costs during and after catastrophic fires. Benefits that other stakeholders might enjoy included recreation, habitat protection, rural income, avoided cost of firefighting, and avoided damages to homes from fire and post-fire flooding.

LESSON IN PRACTICE

A full-cost accounting of the impact of the catastrophic Schultz Fire helped make the business case for the **Flagstaff Watershed Protection Program**. University researchers conservatively estimated that the total impact of the fire was between $133 and $147 million. The researchers are now analyzing how the Flagstaff Watershed Protection Program could avoid future costs by reducing the likelihood of a similar fire.

7. Identify investors and financing mechanisms for initial and long-term funding

Interviewees affirmed that securing sufficient funding for program activities was a top challenge and key concern, especially because water utilities and communities expecting a quantified return on investment are not always interested in funding program startup costs. The programs were innovative and flexible in engaging multiple investors and in designing and enacting financing mechanisms to unlock long-term investments. Every program had multiple funding sources, and no two programs had the same financing strategy.

The programs' main sources of funding varied, depending on their stage of program development. Five programs identified seed funders (philanthropic organizations or public grant programs) that covered startup costs and funded demonstration projects in their earliest days.

After demonstrations were up and running, larger-scale investors were engaged who expect to receive direct, long-term benefits from the program. Across the board, core program investors are municipal governments and water utilities. Three programs have been partially financed through municipal bonds. Six have received funding allocations from water utilities' pre-existing operating budgets. In three other cases, water utilities have adopted watershed protection fees or rate surcharges that dedicate a portion of revenue to watershed investments. Currently, two more utilities involved in these programs are considering watershed protection fees or similar mechanisms to finance their watershed investments.

LESSON IN PRACTICE

In San Francisco, the **Watershed and Environment Improvement Program** is financed through two main sources. First, a built infrastructure bond measure to fund watershed improvements authorized the San Francisco Public Utilities Commission to allocate $20 million for watershed improvements. Second, the San Francisco Public Utilities Commission dedicated $30 million from its operating budget. The funds will be spent over 10 years to protect land in source watersheds.

There are pros and cons to each funding source, making a diverse funding base important for the longevity of any watershed investment program. Despite the time and effort required to pool funding from multiple investors, the oldest programs in the study noted that further extending the partnership to incorporate new investors remains a priority.

Implementing an Action Plan

8. Engage landowners and public land managers to conserve, restore, and sustainably manage natural infrastructure

Natural infrastructure suppliers are the upstream landowners, often in rural areas, who can implement the forest management and conservation activities that may produce downstream water benefits for utilities and communities. Because watershed investment programs rely on landowners, recruiting and sustaining their participation is critical.

Four programs in the eastern United States, where there are many small-scale (or nonindustrial) forest landowners, focused on protecting forest on private land. In the West, where the majority of forestland is managed by state or federal government agencies, the programs focused on engaging public land managers. Five programs (in San Francisco, Central Arkansas, New Mexico, and Colorado) focused on an "all-lands approach," targeting both public and private lands.

Programs have faced different challenges and used different engagement strategies, depending on the type of landownership in their target watersheds. To efficiently reach private landowners, interviewees partnered with land trusts, conservation districts, and university extension services. These intermediaries already had relationships with landowners and a sense of what type of program might be most attractive to them.

LESSON IN PRACTICE

The **Delaware River Common Waters Fund** worked directly with landowners to implement best management practices funded through the federal Farm Bill's conservation title; the program also assists land trusts in completing easement transactions. This has resulted in improved management of 50,000 acres, involving more than 100 private landowners.

9. Define roles and plans for program administration

As partnerships, watershed investment programs leverage staff time across multiple organizations to manage and administer the many demands of budgeting, partner engagement, communications, landowner recruitment, contractual agreements, performance monitoring, communications, and other activities. All of the programs reported operating with formally dedicated part-time or full-time staff. Eleven programs had dedicated staff providing administrative support, six had at least one full-time staff person dedicated to management, and three utilities had at least one part-time staff member helping to manage their program.

While partners may feel a need to dedicate funds as quickly as possible to watershed management activities, administrative costs must also be covered. Two programs stated that dedicating a full-time staff position to raising support for a natural infrastructure bond was critical to unlocking large-scale funding, and was therefore a worthwhile early investment.

LESSON IN PRACTICE

Starting in 2009, the U.S. Forest Service and the City of Santa Fe collaboratively developed a Watershed Management Plan as the primary document outlining overall goals and guiding each partner's role in the **Santa Fe Municipal Watershed Program**. Dedicated staff from The Nature Conservancy carry out activities on behalf of the program.

10. Monitor and evaluate performance

Monitoring can help staff track progress and evaluate program performance, which is important for adaptive management and ongoing stakeholder support. All but one of the programs have monitoring plans to track progress and, in some cases, to evaluate performance; the only program that did not already have a monitoring program was in the process of developing one.

Partners must decide which performance parameters to monitor; plans vary according to partners' goals and interests, time and funding available, and technical capacity. Ten programs monitor progress on watershed management activities, such as acres of forestland protected, acres treated for

fire risk reduction, or acres restored after wildfire. Six programs monitor water quality or sediment transport. Nine use their monitoring plan to keep track of economic impacts of their program, such as dollars spent on watershed interventions, jobs created, and, in one case, cords of firewood produced through watershed restoration activities.

Although most do not quantitatively evaluate how their activities impact downstream water quantity or quality, several programs expressed interest in going beyond monitoring "proxies" and modeling or observing performance as well. Some programs initiated partnerships with research organizations or universities to better estimate performance. These partners bring expertise and capacity to build models and conduct fieldwork to track program results. Partnering with experts can help increase understanding of the cumulative impacts of watershed investments to inform future initiatives.

Interviewees consistently stated that monitoring and reporting outcomes was challenging. Monitoring may be costly and difficult to fund, and observing or even estimating downstream water quality benefits attributable to program activities is a complex process rife with uncertainty. Although watershed modeling tools and other technological advances that aid monitoring efforts are gaining traction, there is room for improvement. Moreover, many programs suggested that they do not currently have the capacity to apply these tools.

LESSON IN PRACTICE

For some Colorado programs, the **Colorado Forest Restoration Institute** at Colorado State University evaluates fire hazard mitigation program effectiveness by systematically quantifying changes in forest health and composition and assigning a fire risk index to each forest stand. The monitoring data provide an objective, quantitative assessment of how program activities are reducing fire risk, which, in turn, links with reduced water supply risks.

Supporting Watershed Investment Program Development

The lessons we extracted can inform new program development and the expansion of existing watershed investment programs. The themes that emerged from our study highlight trends that have contributed to the evolution of watershed investment and point to gaps where future research is needed. Other collaborative efforts will likely forge new paths, which may, in turn, reveal new lessons.

Government plays several important roles, from providing seed funding and regulatory approval, to implementing watershed management on public lands and aligning with watershed investment programs that engage private forest owners to achieve landscape-level goals. Watershed investment programs also provide advantages to government—they offer opportunities to leverage nonfederal funding for landscape-level forest management, but they also promote public-private partnerships that can bring new information and perspectives into landscape management planning and help build trust among sectors.

Programs consistently faced challenges in securing funding and in clearly attributing cleaner, safer, or more secure water supply to program activities. These challenges are connected, as many interviewees noted. Core investors—water utilities and municipal governments—expect a quantifiable return on their investment. Without reliable estimates and ongoing evaluations of how programs impact water supply, investors may not be confident that their money is achieving its goals, prompting them to reduce or scale back their investment.

Emerging partnerships between research organizations and watershed investment programs can help overcome this challenge by leveraging the most recent science and environmental monitoring technologies. At the same time, program representatives must communicate to investors that, despite uncertainty and lack of precise measurements, the data indicate that watershed investment programs can be a powerful and cost-effective approach to providing safe drinking water and supporting the resilience of rural communities.

PART I

INTRODUCTION TO WATERSHED INVESTMENT PROGRAMS

In the face of environmental threats to communities' water sources, watershed restoration or conservation can provide long-term protection of water quality and quantity. Part I describes the challenges facing America's water supply and how investments in forest management can ease threats to water quality and quantity. While watershed investment programs are on the rise, the number of programs is still small, and existing programs face challenges in sustaining and expanding their programs, described herein. To support the effort to scale up watershed investment programs and expand upon the collective knowledge of watershed investment, we conducted an in-depth, comparative examination of 13 programs across the United States. The methodology employed for this study concludes Part I.

Environmental Changes Threaten America's Water Supply

Most of the water supply systems in the United States trace their source to small headwater streams enveloped by forests that play an integral role in filtering impurities, reducing sedimentation, and regulating water flows, among other benefits (Table 1). However, declining forest health and deforestation are threatening water supplies across the country. At the same time, much of the U.S. built water infrastructure is under stress. By one estimate, local and national authorities must invest more than $1 trillion over the next 25 years to maintain, repair, and expand the U.S. water infrastructure system to meet demand for safe drinking water (AWWA 2013). Much of this investment could be wasted, however, if it focuses only on built infrastructure solutions while ignoring forests' contribution to water security.

In many communities around the United States, drinking water supplies are threatened by land-use change, urbanization, industrialization, wildfire, agricultural pollution, and other environmental changes. Over the next 50 years, Alig et al. (2010) project a 7 percent reduction in nonfederal forestland cover in the United States due to growth in residential and urban areas, transportation, and related uses. The conversion of forestland due to development disproportionately affects the eastern United States, where more than 80 percent of forests are privately owned (Nelson, Liknes, and Butler 2010). In the East, development pressures not only reduce the capacity of ecosystems to sustainably provide water-related services, but they also increase the demand for safe drinking water (de la Cretaz and Barten 2007; Ice and Stednick 2004).

While certain areas in the western United States also face pressure from development and land-use change, catastrophic wildfires represent the major threat to headwater forests in much of the West. Wildfires and post fire rain result in flooding that threatens water infrastructure, along with erosion that decreases water quality and fills reservoirs with sediment, reducing storage capacity (Eichenseher 2012; Smith et al. 2011; Larsen et al. 2009). Insect-induced tree damage or mortality is also threatening western forests (CSFS 2014; Pugh and Small 2012; USFS 2015). Climate change and

Table 1 | **Examples of How Natural Infrastructure Can Provide Better Drinking Water Supply**

WATER SECURITY OBJECTIVE	BUILT INFRASTRUCTURE	NATURAL INFRASTRUCTURE
Ensure adequate drinking water supplies in times of drought	Storage such as reservoirs and tanks, water conservation, and water-use efficiency technologies	Varied and healthy soil composition promotes infiltration and holds moisture, releasing water during periods of low rainfall and improving water availability, especially at the regional scale (de la Cretaz and Barten 2007; Ellison et al. 2012; Ice and Stednick 2004).
Secure water quality by protecting against nutrient pollution, toxic algae, and microbes that intensify with increasing water temperature	Membrane filtration, coagulation, reverse osmosis filtration Requires water treatment plant	Plant nutrient uptake and organic matter in soils absorb nutrients as they flow into water systems (McBroom et al. 2008; Sanders and McBroom 2013).
Prevent nutrient pollution from sediment or silting of waterways as storm intensity increases	Removal of deposited and suspended sediment Requires water treatment plant; dredging	Root systems anchor soil in place. Forests have thick root systems, while native grasslands and no-till agriculture also provide some erosion control. During intense storm events forests can reduce rates of erosion (Neary et al. 2009).
Flood control by reducing peak flow during storm events	Dams, diversion canals, levees, reservoirs, etc.	Forest layers: promote water infiltration into the soil and groundwater, provide a barrier that slows downslope water movement, and reduce runoff, thereby reducing flooding and related siltation (Neary et al. 2009).

Note: For more information, see Gartner et al. 2014a; Qin et al. 2016.

related droughts and reduced snowpack are likely to amplify forest-related threats to water supply in parts of the country (Theobald et al. 2013), increasing the need for resilient ecosystems to enhance aquifer recharge and water storage.

The effects of these trends can be severe. In 1996 and 2002, two catastrophic wildfires burned more than 150,000 acres of forested land in Colorado, critically threatening Denver's drinking water supply. Debris flows destroyed water infrastructure and more than 1 million cubic yards of sediment accumulated in Denver Water's Strontia Springs reservoir (Gartner et al. 2013). The city was forced to spend more than $26 million to repair damaged infrastructure, and millions more to restore its watersheds and reservoirs (Gartner et al. 2013).

In Maine, residential development, deforestation, and population growth threaten Sebago Lake's exceptional water quality, jeopardizing Portland's drinking water (Gartner et al. 2013). Because the water quality in the forested watershed is high, the local water utility enjoys a rare exemption from the federal requirement to filter drinking water; the loss of this waiver would force the utility to install a conventional filtration system at an estimated cost of $97 to $155 million over 20 years (Gartner et al. 2013).

The experiences in Colorado and Maine illustrate a nationwide trend: declining forest health and deforestation are threatening water supply in many parts of the country. Water providers, municipal governments, and even water-dependent businesses and philanthropies have a clear and growing interest in safeguarding water supplies upstream of their intake points, where rural landowners can strategically manage their land assets to produce watershed benefits. The multistakeholder partnerships that recognize this interest and unite downstream water users with upstream landowners (along with help from conservation organizations and community groups) are referred to as **watershed investment programs** (See Glossary for a definition of *watershed investment program* and other key terms).

Watershed Investment Programs Can Offer Economic and Environmental Benefits

While water managers often use built infrastructure systems to address drinking water security challenges, mounting evidence suggests that watershed investment programs can generate considerable economic benefits for water utilities and, accordingly, to the communities that use and pay for drinking water (Freeman et al. 2008; Gartner et al. 2013). Postel and Thompson (2005) showed that seven cities in the United States avoided between $725,000 and $300 million in annual water treatment costs and between $25 million and $6 billion in capital costs by investing in the protection and sustainable management of watersheds that deliver urban water supplies. When conventional infrastructure measures are combined with sustainable management of natural infrastructure, they can reduce utility operation costs, improve water system performance, increase predictability of water supply, and generate ecosystem services for the enjoyment of communities in the watershed (Forster and Murray 2001; Freeman et al. 2008). In particular, natural infrastructure may have cost-saving potential for utilities by preventing sediment buildup in reservoirs, thereby reducing capital, maintenance, and variable costs for water treatment (Freeman et al. 2008).

At the same time, forest landscapes can also sequester carbon, bolster regional climate adaptation, sustain rural livelihoods, and protect habitat. Project proponents can use these multisectoral benefits to further justify and make the business case for natural infrastructure. Properly calculating the value of natural resources and services associated with watershed investments—a process known as natural capital accounting (see Glossary)—can increase the economic viability of green infrastructure in comparison to gray infrastructure. For example, forests in the United States provide the following services:

- Fuel a $200 billion industry for traditional forest products like lumber, pulp, and paper, which provides income to many of the 11 million private forest landowners in the United States (USFS 2008).

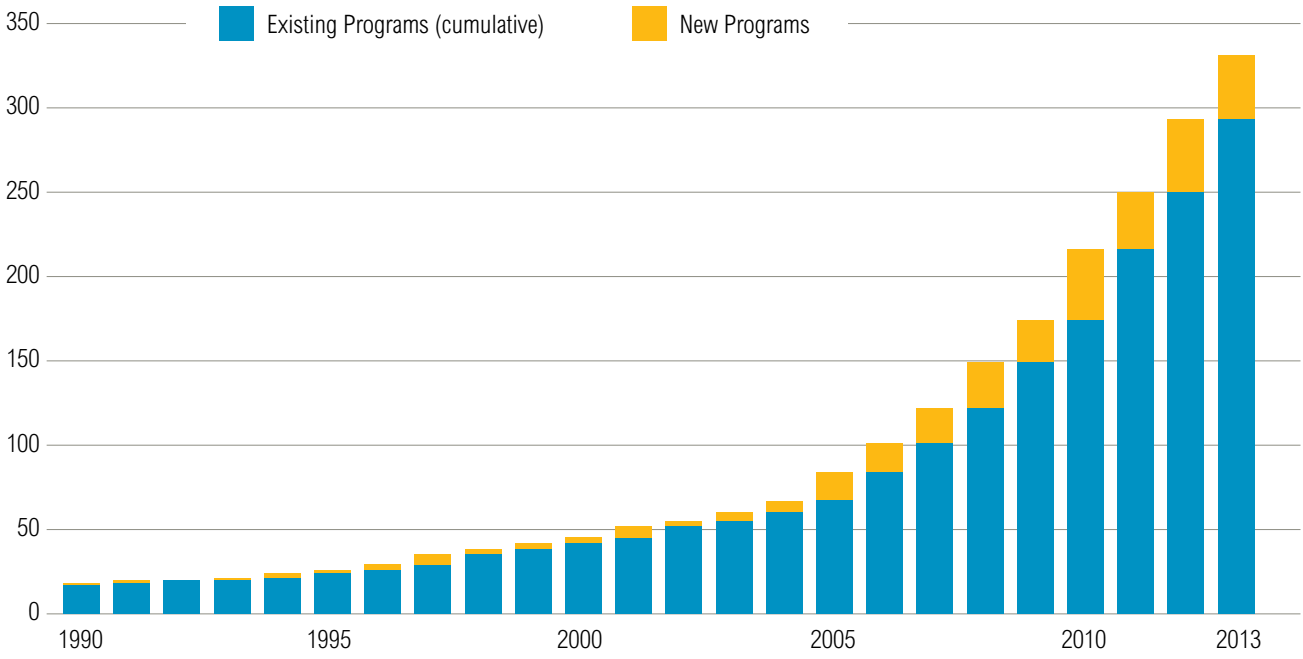
- Act as powerful carbon sinks. The average forest in the southern United States will store nearly 89 tons of carbon per hectare over 45 years; in other words, every hectare of forestland will store the annual carbon produced by 69 cars (Smith et al. 2006).
- Harbor many of the rarest and most culturally important species in the United States, including the imperiled gopher tortoise and the endangered red-cockaded woodpecker (Hanson et al. 2010).
- Provide recreational opportunities for people to hike, play, fish, and boat. In 2009, national forests in the United States received over 173 million visits (USFS 2010a). In 2014, national park visitors generated approximately $15.7 billion dollars of revenue (Cullinane Thomas, Huber, and Koontz 2015).
- Buffer hydrologic extremes, which are projected to increase under climate change, by attenuating floods and providing sustained base water flow under drought conditions (Brauman et al. 2007).

Watershed Investment Programs are on the Rise

As more policymakers and water providers recognize the range of public and private benefits of natural infrastructure, watershed investments are gaining prominence worldwide. In 2013 alone, global investments in watershed services totaled $12.3 billion, restoring and protecting over 365 million hectares—an area larger than India (Bennett and Carroll 2014). The total amount invested in watersheds has increased by 12 percent per year on average since 2008, and the number of programs has more than doubled in that period (Figure 1).

Precursors to watershed investment programs in the United States began as early as the 1880s, when the City of Philadelphia acquired 9,000 acres of land to protect its potable water and the City of Seattle began to acquire 90,000 acres of forestland for watershed services (Gartner et al. 2014a). The best-known example of a modern watershed investment program aimed at protecting drinking water is New York City, which, in the 1990s, protected more than 1 million acres of

Figure 1 | **Number of Global Watershed Investment Programs, 1990–2013**



Source: Bennett and Carroll (2014).

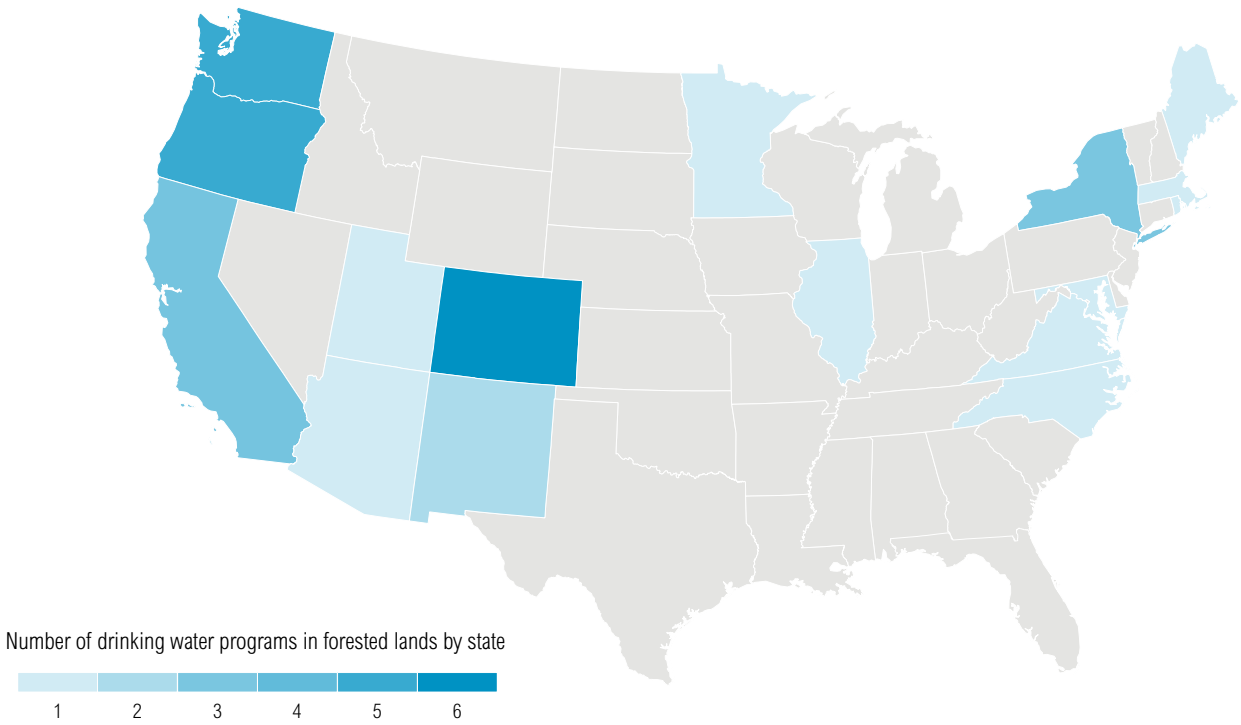
rural lands (much of it forestland) to help with downstream water quality and to comply with the Clean Water Act (Appleton 2002). The city avoided the $6–8 billion cost of building a water filtration plant by instead investing $1.5 billion to protect the watershed (Appleton 2002). In addition, the city plans to allocate $300 million to watershed protection projects from 2010 to 2020 (WPPC 2009), in comparison to the required *annual* operating costs of $250 million for a filtration plant (Appleton 2002).

Over the past decade, support for national initiatives and policies has grown, and watershed investment programs have taken root as viable water management strategies (Box 1). According to Forest Trends (Bennett and Carroll 2014), there are 93 active watershed investment programs in the United States and at least another six under development—representing about one-third of the worldwide programs identified by Forest Trends. These 93 programs in the United States had an aggregate investment of $383 million in 2013, and have resulted in about 21.5 million acres managed for watershed services. Looking forward, at least $400 million has already been committed to the watershed investment programs in the United States between 2014 and 2020 (Bennett and Carroll 2014).

Thirty-five of these programs focus on forest conservation, forest restoration, or sustainable forest management to help secure drinking water supply (Figure 2), by addressing the following concerns:

- Restoring/augmenting flows
- Wildfire/flood risk
- Nitrogen and/or phosphorus pollution
- Sedimentation
- Wetland conservation

Figure 2 | **Drinking Water-Focused Watershed Investment Programs That Include Forest Protection and Management in the United States**



Source: Derived from primary data compiled in Bennett and Carroll 2014.

BOX 1 | NATIONAL EFFORTS ADD SUPPORT TO WATERSHED INVESTMENT PROGRAMS

Recent advances in public national land management policy underpin a growing investment in watershed management. For example, in October 2015, the White House released a memorandum directing federal agencies to incorporate the value of natural infrastructure into land management and infrastructure planning decisions (Dickinson, Male, and Zaidi 2015). The memorandum builds on efforts from 2012, when the U.S. Forest Service issued a planning rule for National Forest Systems to better value ecosystem services, including watershed services, to inform land-use planning. Further, the Farm Bill Conservation Title (P.L. 113–79, Title II), one of the largest sources of funding for conservation programs in the United States, allocates a portion of its funds for soil and water conservation in forestry, enabling forest owners to invest in watershed conservation measures that benefit downstream communities.

Recent private-sector efforts to advance green infrastructure reflect a shifting trend toward private-sector participation in watershed investments. For example, in May 2016, the Water Research Foundation announced a new project to identify how green infrastructure and low-impact development can be incentivized on private property, beyond the minimum required by development and redevelopment ordinances (Lang 2016).

In addition, the U.S. Endowment for Forestry and Communities Inc., in partnership with the U.S. Environmental Protection Agency, initiated a Healthy Watersheds Consortium Grant Program in 2016 with the goal of accelerating strategic protection of healthy freshwater ecosystems and their watersheds through strong partnerships. The inaugural round of the grant program attracted nearly 170 proposals, and funded the following nine projects:

- Permanently Protecting the Largest Rivers in Eastern Maine: $150,000 to Downeast Salmon Federation to conserve 80 percent of the habitat corridors along the remaining three unprotected rivers in Washington County, Maine, by 2025. Funds will support a full-time director for three years for the Federation's Downeast Rivers Land Trust.
- Healing Waters Regional Landscape Initiative. Cacapon River Watershed, West Virginia: $100,000 to Cacapon and Lost Rivers Land Trust to develop the Healing Waters Regional Landscape Initiative, build capacity for large-scale protection efforts throughout the watershed, and create a strategic local and regional collaboration model.
- Myakka Island Conservation Corridor, Florida: $156,000 to Conservation Foundation of the Gulf Coast to conserve more than 10,000 acres over the next six years within the Myakka River watershed in rapidly growing Sarasota and Manatee Counties. These properties will link and buffer already protected lands and help keep waterways drinkable, fishable, and swimmable.
- Colorado Conservation Exchange, Accelerating Investment in Watershed Health: $150,000 to accelerate investment in watershed health to reduce wildfire threats in the Big Thompson and Cache La Poudre watersheds and beyond, through a watershed investment fund linking investors with land stewards.
- Healthy Watersheds California: $225,000 to Pacific Forest Trust to develop the policies, technical assessments, and financing instruments needed to leverage private and public capital for restoration and conservation of an estimated 7 million acres of watersheds that serve California's primary reservoirs.
- Protecting Forests to Protect Watersheds: $200,000 to the Trust for Public Land and the Save the Redwoods League to work collaboratively to seek California Clean Water State Revolving Fund loans for large-scale protection of forested watersheds.
- Protecting Blue Creek and the Klamath River for Salmon, Wildlife, and People: $100,000 to Western Rivers Conservancy to implement long-term watershed protection plans, sell carbon offsets, and create new jobs in rural northern California. Partners, including the Yurok Tribe, will protect 47,000 acres within four watersheds in northern California's temperate rainforest.
- Framework for Acquiring and Sustainably Managing Agricultural Land: $200,000 to Freshwater Trust to build a replicable framework to acquire and sustainably manage agricultural land in the John Day Basin, Oregon. The model will address the increasing conversion of farmland to other uses nationally. As farmers retire over the next 20 years, nearly one-half of all U.S. farmland—400 million acres—will change hands. Sustainable management of these farmlands will enhance watershed protection.
- Accelerating Watershed Protection in the Central Puget Sound Region: $200,000 to Puget Sound Regional Council, a Metropolitan Planning Organization that includes 86 jurisdictions. Their project will develop a regional open space plan focused on protecting high-priority, threatened ecosystems; prepare a watershed protection report that informs the upcoming update of the region's growth plan, VISION 2040, to integrate growth management with ecosystem protection; and promote use of a new online ecosystem service valuation tool for regional watershed benefits, decision-making, and local actions.

For more information on the Healthy Watersheds Consortium Grant Program, visit the program webpage: www.usendowment.org/healthywatersheds.html.

The 35 active programs identified by Forest Trends (Bennett and Carroll 2014) include a mix of private and/or government-managed forests and receive funding from a variety of sources. Most of these programs take the form of collective action funds, in which resources from multiple stakeholders are pooled (Bennett and Carroll 2014). Bilateral agreements between program investors and landowners are also common, where one investor pays for and runs the program.

Challenges to Scaling Up Watershed Investment Programs

Despite their adoption by some cities, the amount of money invested in watershed management in the United States remains relatively small, and it is by no means certain that natural infrastructure will become the norm for water resource managers. Drinking water is just one of many priorities that require investment in water infrastructure. Water resource managers face challenges from increasingly stringent storm water requirements, aging sewers, and pressure on existing wastewater treatment systems as communities grow. Furthermore, shrinking public budgets may pose funding challenges. As a result, even as watershed investment programs expand, they are likely to be a small piece of the estimated $1 trillion investment needed in U.S. water infrastructure systems over the next 25 years (AWWA 2013). While the number of watershed investment programs did increase between 2012 and 2014, total U.S. investment in watershed services shrank slightly in the same period, meaning that investment has decreased in some existing programs (Bennett and Carroll 2014).

The barriers to scaling up watershed investment programs across the United States are complex. In Bennett and Carroll's 2014 survey of 35 forest-focused watershed investment programs aimed at protecting drinking water, practitioners identified a number of barriers to growth, including insufficient funding opportunities; lack of buy-in among regulatory bodies, potential suppliers, and/or investors; and lack of evidence-based outcome data (Box 2).

Purpose of this Report

Overcoming these challenges is critical to success for both existing and future programs. Without information to guide program development, stakeholders new to watershed investment programs may not know where to begin and run the risk of encountering barriers. Existing programs seeking to expand may also be unsure of what strategies to employ and how to build upon others' experimentation.

The absence of a deep knowledge base to provide guidance and evidence in support of watershed investment contributes to each of the key challenges listed in Box 2. Practitioners in the growing field of watershed investment often cite the same well-known watershed investment programs, such as New York City and Portland, Maine. However, these case studies may not be relevant to all geographies and contexts, nor do they provide the entire range of options necessary to address the challenges in Box 2.

BOX 2 | KEY CHALLENGES FOR INVESTMENTS IN WATERSHED SERVICES REPORTED BY NORTH AMERICAN PROGRAMS, 2013

Ranking	Challenge
1	Lack of buyers (investors) for watershed services
2	Difficulty raising initial capital
3	Regulatory uncertainty for compliance-driven programs
3	Lack of land managers interested in participating as watershed service suppliers
3	Lack of scientific data on outcomes
6	Lack of support from policymakers
6	Perceived lack of direct benefits to constituents

Source: Derived from primary data compiled in Bennett and Carroll 2014, Table 18.

To fill this gap, in this report we expand on the collective knowledge of watershed investment through an in-depth, comparative examination of 13 programs across the United States. Our methodology is set out below. We focus on the processes and actions that enabled the success of projects across geographies and in different contexts, as well as on the common challenges they faced and overcame. In Part II, we categorize 10 lessons that could contribute to successful watershed investment program development and describe how these lessons played out in different contexts. We build upon this examination to synthesize insights gleaned from the case studies and how these can be used to guide and inform existing and future watershed investment programs. For those wanting more detail on individual programs, Part III presents case studies on each of the 13 programs.

Study Methodology

Between 2013 and 2016, researchers from the World Resources Institute and the Colorado State University Department of Forest and Rangeland Stewardship studied 13 watershed investment programs in the United States to identify a set of common enabling conditions and activities that have proven important to advancing watershed investment programs. This study received financial support from the U.S. Department of Agriculture (USDA) Conservation Innovation Grant program, the U.S. Endowment for Forestry and Communities, and the Agricultural Experiment Station, Colorado State University (National Institute of Food and Agriculture Project No. COL00671A). A project advisory committee composed of natural infrastructure experts and practitioners provided guidance and feedback along the way (Appendix A).

We interviewed and surveyed individuals involved with 13 watershed investment programs in the United States, all of which aim to protect drinking water through improved forested lands management. We selected these 13 programs from the pool of 35 identified in Forest Trends' 2014 *State of Watershed Investment* report (Bennett and Carroll 2014), along with a few additional programs identified by the project advisory committee. With input from the project advisory committee, we narrowed the pool to 13 programs based on five criteria:

- Program maturity (programs that had been established for at least a year)
- "Newness" (programs that had not been established for more than 15 years and had not already been extensively promoted as success stories)
- Geographic spread (programs within different forms of landownership with varying social, political, and ecological conditions)
- Track record of progress (programs that had achieved notable accomplishments toward their goals)
- Access to program stakeholders (programs with stakeholders that were willing and able to participate in the study and share information)

Of the 13 programs we selected, four are in the eastern United States and nine are in the West. (See Figure ES-1 on pages 6–7 for more information on program locations.) As of 2016, the selected programs ranged in age from 3 to 11 years and had an average age of six years. They had each expended between $50,000 and $50 million on watershed protection efforts, depending on project age and size.

We intentionally selected programs that we deemed "successful" in that they are established and have grown for at least two years. We purposely omitted "failed" programs (ones that were never established or were abolished), due to inherent data collection challenges, such as lack of staff to contact and lack of documentation.

Between 2013 and 2016, we conducted case studies of these 13 programs through interviews, document analysis, and a survey. In 2013 and 2014, we interviewed 62 practitioners from these programs. Interviewees held positions at water utilities, municipalities or city departments, federal and state government agencies, NGOs (e.g., watershed advocacy groups or land trusts), and also included a private landowner and private business consultants (see Appendix B for list of interviewees). Interviews followed a semi-structured format, using the following set of guiding questions to structure the discussion:

1. What were the major drivers behind initiating a program?
2. How did you make the economic case to investors?
3. What were the major challenges and successes faced during the design, implementation, and maintenance of the program?
4. What helped facilitate the design of the program? For example, did you use any studies, public outreach, organizational capacity, and/or partnership building to support program design?
5. Did your program involve any individuals and/or organizations that played a key role in development of a program?
6. What opportunities and challenges were encountered working across land jurisdictions and with different partners?
7. What have been the most critical factors leading to the success of your program thus far?
8. What do you wish you had known before designing this program? What should other programs know before embarking on this type of program development?
9. What specifically has been successful about the program to date?

To complement these interviews, we conducted program-specific document analysis, including the following:

- Public communications and outreach materials
- Annual reports
- Contractual agreements (e.g., memorandums of understanding)
- Protocols for decision-making processes and performance monitoring

We analyzed the interviews and program documents to develop descriptions of the process of establishing, designing, and implementing each program, highlighting notable challenges and successes experienced by each program along the way. These case studies can be found in Part III of this report.

In order to distill common lessons and insights from across the programs, we qualitatively analyzed the cases by thematically grouping interview responses. These lessons capture what interviewees consistently identified as important to their programs' development, including factors that were challenging to overcome, as well as approaches that enabled establishment and growth. We prioritized these identified themes by considering the number of programs that identified an activity or issue as important, as well as the level of emphasis that interviewees gave to the issue. We also solicited feedback from the project advisory committee to refine the themes and ensure they aligned with critical aspects of watershed investment programs. We then followed up with each program by e-mail to confirm that our analysis accurately captured the experiences and perspectives of those we interviewed.

Finally, in 2015, we sent an online survey to all the interviewees to test whether the themes we identified in our comparative analysis accurately represented the experiences of these programs (Appendix C). The objective of this survey was not to receive a 100-percent response rate from all interviewees, but rather to check in with key personnel from each program. The survey elicited responses from 16 individuals covering all 13 programs and representing stakeholder perspectives ranging across the U.S. Forest Service, water utilities, NGOs, consulting firms, and municipal offices. Some interviewees passed the survey along to staff who started working on these programs after the 2013–2014 interviews. These three new contacts are noted in the interview list as having completed a survey but not an interview (Appendix B). The survey allowed us to verify our identified themes, gather additional details, and note updates on program progress.

PART II

LESSONS FROM WATERSHED INVESTMENT PROGRAMS

This part of the report identifies and analyzes 10 common lessons that watershed investment program representatives identified as important to the successful establishment and growth of their programs. The order in which we present the lessons is based on a general sequence of events related to program development. While the common experiences and lessons from the studied programs generally fit into these phases, it is possible that they may apply to programs in integrated or nonlinear ways.

The three phases of program development are:

PHASE 1 — 1 — 2 — 3 — 4 — PHASE 2 — 5 — 6 — 7 — PHASE 3 — 8 — 9 — 10

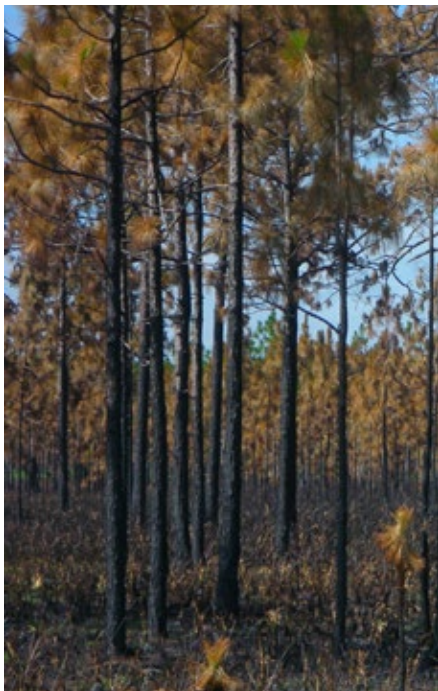
Building Momentum (lessons 1–4): Developing the collective will to engage in watershed investment. Stakeholders must be engaged and buy into a collective vision; each group must be sufficiently convinced that the program will address its motivations and concerns.

Designing the Program (lessons 5–7): Creating the blueprint for watershed investment. Scientific and economic assessments provide the basis for collaborative planning necessary to prioritize investments and determine feasible options. Includes the development of financial strategies, which will vary depending on funding sources and program needs.

Implementing an Action Plan (lessons 8–10): Putting the planned watershed investment program into action. This is where work starts on the ground, such as restoration of forests in riparian zones or reaching out to private landowners to set aside land for conservation.

Unless otherwise noted, information in this chapter is drawn from the case studies in Part III.

This part of the report concludes with a discussion of the development of watershed investment programs.



Phase 1: Building Momentum

PHASE OF PROGRAM DEVELOPMENT	DESCRIPTION	LESSONS
Building momentum	Identifying a clear need and purpose for a watershed investment program; securing commitment from key stakeholders	1. Identify risks and seize opportunities to rally support 2. Build partnerships to fill essential roles and responsibilities 3. Articulate a clear vision of success 4. Cultivate champions and advocates to build support

1. Identify Risks and Seize Opportunities to Rally Support

The studied programs formed in response to increasingly likely or severe risks to water supply and gained traction during windows of opportunity that built awareness or support for watershed investments. Risks to water supply typically took the form of a current or future ecological shock to forest health or forest cover that threatened water security, and the potential cost to utilities, municipalities, or other entities associated with those risks. Opportunities to rally support were characterized as events or circumstances that draw the attention of community leaders and the public to the importance of watershed investment. In some cases, risks and opportunities driving program development overlapped—for example, highly visible risks to water supply also created a window of opportunity to educate the public about watershed investment programs. The common types of risks and opportunities that led to program formation and establishment are discussed below.

Risks to water supply and drivers of watershed degradation

One way practitioners have built support for their programs is by positioning watershed investment within the context of relevant external events such as land-use changes, wildfires, and forest insect infestations (Table 2) to appeal to the goals of key stakeholders.

The main risks to source water that sparked concern in the selected programs were sedimentation, reduced water availability, nutrient pollution, and flooding. Drivers of watershed degradation that gave rise to these risks included wildfire, deforestation or other forms of land-use change, growing water demand, excessive fertilizer application, and changes in forest health due to pest or disease outbreaks. No programs directly identified climate change as a driver of watershed degradation. However, studies have linked rising temperatures with the uptick in forest insect infestations, as well as drought and flooding caused by weather events,

Table 2 | **Risks and Drivers of Watershed Degradation That Led to Program Establishment**

	PROGRAM	RISKS	MAIN DRIVERS OF WATER RISK
Eastern United States	Central Arkansas Water (AR)	Water quality; impending regulation	Land-use change
	Delaware River Common Rivers Fund (DE)	Water quality; water availability	Land-use change
	Portland Water District (ME)	Water quality; impending regulation	Land-use change
	Upper Neuse Clean Water Initiative (NC)	Water quality; water availability	Increasing demands; land-use change
Western United States	Flagstaff Watershed Protection Project (AZ)	Water quality; flooding	Wildfire
	San Francisco Public Utilities Commission Watershed and Environmental Improvement Program (CA)	Water quality; flooding; water availability	Land-use change; wildfire; insect infestation; drought
	Aurora Water–U.S. Forest Service Watershed Protection Partnership (CO)	Water quality; flooding	Wildfire; insect infestation
	Colorado–Big Thompson Headwaters Partnership (CO)	Water quality; flooding	Wildfire; insect infestation
	Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership (CO)	Water quality; flooding	Wildfire; insect infestation
	Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	Water quality; flooding	Wildfire; insect infestation
	Pueblo Board of Water Works–U.S. Forest Service Watershed Protection Partnership (CO)	Water quality; flooding	Wildfire; insect infestation
	Rio Grande Water Fund (NM)	Water quality; flooding	Wildfire
	Santa Fe Municipal Watershed Investment Program (NM)	Water quality; flooding	Wildfire

so climate change is likely also an implicit driver of watershed degradation where these programs operated (Gartner et al. 2014b).

Some drivers, such as wildfire, were immediate and highly visible. Others, such as land-use change, arose more gradually and went unnoticed by the general public for many years. Notably, the characteristics of program drivers varied geographically.

For the eight programs located in the Intermountain West and Southwest, drivers of watershed degradation often took an immediate, highly visible form: large-scale wildfires that, in some cases, have already drastically transformed watersheds, resulting in damaging debris flows, erosion, and sedimentation. In Colorado, the Hayman and Buffalo Creek Fires of the early 2000s and their aftermath convinced water utilities across the Colorado Front Range to invest in natural infrastructure; debris flows and erosion alone cost Denver Water $26 million in cleanup costs. The impact of these fires and concern for future watershed impacts prompted the development of the Denver Water–U.S. Forest Service Watershed Protection Partnership and a similar program with Aurora Water, two of the first natural infrastructure programs in the state. After another series of severe fires in 2012–2013, and observing the responses of Denver and Aurora, other Colorado water providers and land managers developed similar programs. Fires also prompted development of watershed investment programs near Flagstaff, Arizona and Santa Fe, New Mexico.

For the other five programs (located in the East and on the West Coast), piecemeal conversion of forest to impervious surfaces and buildings, along with forest degradation, posed a more gradually unfolding threat in the form of increased runoff, contamination, and nutrient pollution. In the Upper Delaware River Basin, for example, the forests historically provided high-quality water to downstream communities. However, increased water demand and long-term trends in deforestation are threatening the region's water supply. The gradual and diffuse nature of development makes it difficult to pinpoint the issue and mobilize rapidly around it. This has prompted local groups in the region to adopt a proactive approach toward conservation and stimulated the development of their watershed investment program.

In some cases, complex ecological dynamics gave rise to multiple water security threats at the same time. The San Francisco program, for example, developed in response to a series of threats that included immediate wildfire threats as well as long-term land-use change and development pressures.

Although physical risks to water supply and associated cost implications were the main impetus for watershed investment across all programs, regulations provided additional incentive for action in some cases. In these cases, drivers of watershed degradation intersected with regulatory thresholds, posing regulatory risks to water providers. In the case of North Carolina's Upper Neuse Basin, burgeoning water demand and development pressures have compromised water quality since the 1990s. While the Upper Neuse Clean Water Initiative was initiated in 2005, local water quality came under public scrutiny in 2008, when the basin was listed as impaired under the Clean Water Act 303(d), threatening to cost the City of Raleigh up to $200 million in water treatment plant upgrades. Ultimately these concerns drove the creation of a dedicated financing source for the program, enabling its establishment and growth.

Windows of opportunity

Windows of opportunity are the confluence of events that spark conversations or decisions to invest in watershed services. When program proponents are prepared to seize the moment, they can use these windows to precipitate support and even large investments (Box 3). Programs in our study took advantage of several different windows of opportunity to draw attention to how watershed investment programs could help solve existing or emerging drinking water challenges facing their respective communities (Table 3). Exploiting these windows of opportunity enabled program advocates to bring in new partners, formalize the program, and gain approval to commence watershed investments. Common windows of opportunity included the following:

- New scientific findings or studies that raise awareness (e.g., studies on water quality, supply, forest cover, forest health, or news headlines on costs and damage of watershed degradation or fires)
- Actual or potential policy or regulatory changes (e.g., loss of filtration waiver, establishment of new total daily maximum loads that regulate wastewater treatment plants, new groundwater withdrawal regulations)
- Highly visible events (e.g., catastrophic wildfires, major floods or storms, algal blooms in drinking water reservoirs—as previously noted, these events are risks to water supply, but they can also serve as teachable moments)
- Successful creation of other programs nearby

Many of the studied programs were developed in the aftermath of catastrophic watershed events to ensure that crises would not be repeated. Wildfires can cause serious risks to urban water supply, but they can also lead to teachable moments that rally support for action. For example, in New Mexico, the Cerro Grande Fire occurred as Santa Fe water planners and managers were developing strategies to address elevated fuel loads in the municipal watershed. Witnessing the destruction wrought by fire just 25 miles away, stakeholders hastened the planning process, capitalizing on the surge of public support for wildfire management and mobilizing watershed investments. In Colorado, water providers began to pay increased attention to the state of the forested watersheds after wildfires damaged their water infrastructure in 1996 and 2002. Wildfires and subsequent post fire rain events were shared threats that partners could rally against by bonding together, and fostering collaborative initiatives to manage watersheds and mitigate wildfire risk.

Several programs also used new studies and information to transform short-term attention to long-term momentum. Long-term studies of land-use trends can encourage decision-makers to invest in watersheds by enabling them to consider emerging and future forest health threats in present decision-making. A U.S. Forest Service analysis of land-use trends (Barnes et al. 2009) revealed that forests in the Crooked River watershed upstream of Portland, Maine, were vulnerable to future development. This finding formed the early evidence base that eventually gave rise to the Portland Water District's watershed investment program.

Interviewees also reported that policy changes opened channels for debate and progress on watershed investment. For example, the water utility of Little Rock and surrounding cities, Central Arkansas Water, made progress on establishing its watershed investment program in the 1990s when the state senate took up a bill proposing developments near the intake facility in the Lake Maumelle watershed, potentially threatening water supply. The bill focused attention on the continuing expansion of Little Rock, driving Central Arkansas Water to reconsider whether its management of the watershed would protect the water supply. Central Arkansas Water responded by conducting outreach and advocacy, referring to studies of long-term development trends expected to affect water quality. It also formed a task force to further research this concern. This, in turn, spurred community support that was instrumental not only in defeating the bill, but also in developing a formal watershed management program. In 2007, Central Arkansas Water launched a watershed management program to protect critical watershed land from development.

Table 3 | **Windows of Opportunity That Led to Program Establishment**

	PROGRAM	WINDOWS OF OPPORTUNITY			
		NEW SCIENTIFIC FINDINGS OR STUDIES	POLICY OR REGULATORY CHANGES, OR POTENTIAL CHANGES	HIGHLY VISIBLE EVENTS	SUCCESSFUL CREATION OF NEARBY PROGRAMS
Eastern United States	Central Arkansas Water (AR)	●	●		
	Delaware River Common Rivers Fund (DE)				
	Portland Water District (ME)	●	●		
	Upper Neuse Clean Water Initiative (NC)		●		
Western United States	Flagstaff Watershed Protection Project (AZ)			●	●
	San Francisco Public Utilities Commission Watershed and Environmental Improvement Program (CA)		●	●	
	Aurora Water–U.S. Forest Service Watershed Protection Partnership (CO)	●		●	●
	Colorado–Big Thompson Headwaters Partnership (CO)	●		●	●
	Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership (CO)	●		●	●
	Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	●		●	
	Pueblo Board of Water Works–U.S. Forest Service Watershed Protection Partnership (CO)	●		●	●
	Rio Grande Water Fund (NM)			●	●
	Santa Fe Municipal Watershed Investment Program (NM)			●	

BOX 3 | TRANSFORMING WINDOWS OF OPPORTUNITY INTO ENDURING MOMENTUM

Beyond the practical challenges of establishing watershed investment programs, interviewees mostly agreed that having a proactive long-term strategy helps to capitalize on short-lived motivating events and increases the likelihood of building momentum for new programs. As Rick Cables, former Regional Forester for the Rocky Mountain Region of the U.S. Forest Service, recalls:

"It was like multiple prongs on this strategy. Show up at water conferences, get an agreement with the state, work on the utilities, show them that there's a return on investment. . . . Where all the stars align, then boom, you've got a thing going. That's how that happened. . . . It was an eight-year at least effort of plowing the ground, planting the seeds, and hoping. Fortuitously, you had some big fires. I hate to look at it that way, but without a precipitating event like that that really cost the utility money, it was hard to make the compelling case to them. But, had we not plowed the ground sufficiently [beforehand], I don't think we would have had the traction we did."

Source: Cables 2014.

Among the programs we studied, enacting a strategy to address drivers of watershed degradation in the absence of these windows of opportunity proved to be much more difficult. In the Upper Delaware Basin, for example, the lack of a clear water quality catalyst or regulatory threshold posed a significant challenge to engaging water quality beneficiaries. In the case of the Delaware River Common Waters Fund, organizers reached out to more than 20 public and private water utilities in the basin, but were unable to recruit a utility or other water quality beneficiary to make financial contributions to the Fund. Interviewees cited a range of factors behind this lack of interest, including relatively good water quality, a lack of political will to increase water rates, limited empirical data to use in making the economic case for watershed investments, and institutional policies and priorities at the utilities that limited utilities' ability to engage in watershed management (Pinchot Institute 2013).

Although drivers of watershed degradation can seriously damage water supplies, they can also raise awareness and willingness to invest in natural infrastructure among decision-makers and the public. Understanding local risks and drivers and preparing to take advantage of windows of opportunity therefore seem to be the logical starting points for creating a watershed investment program. Once risks and windows of opportunity are well understood, practitioners have the basic information they need to start building partnerships with stakeholders.

2. Build Partnerships to Fill Essential Roles and Responsibilities

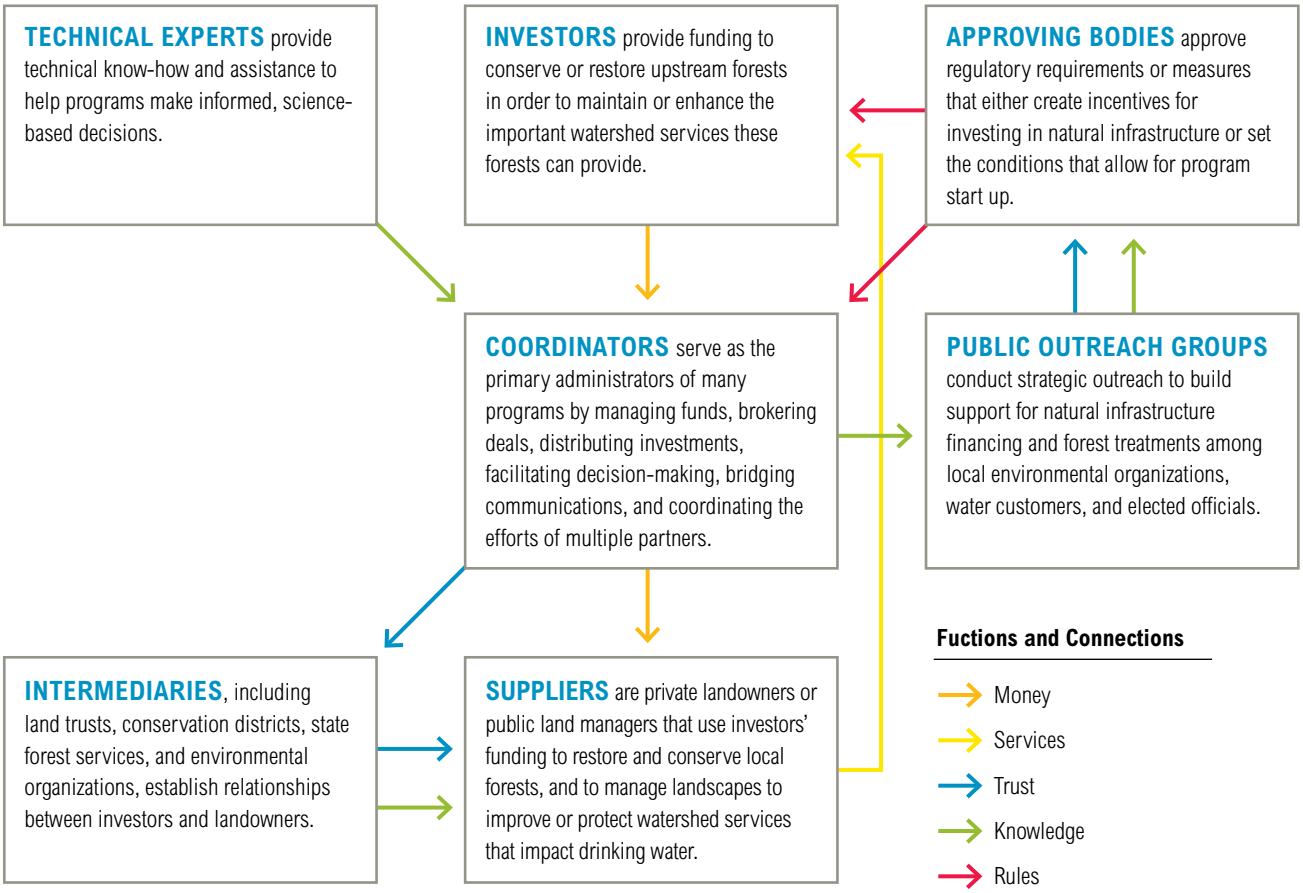
Watershed investment programs are inherently collaborative efforts that engage a range of stakeholders and leverage the relative strengths and capacities of partner organizations (Gartner et al. 2013). The programs we studied employed extensive networks to build connections among stakeholders, particularly between upstream forest owners and downstream water-dependent communities. This section discusses the essential roles and responsibilities that are involved in watershed investment programs, as well as common approaches to building partnerships.

Identifying potential partners for watershed investment programs

Interviewees emphasized that connecting with existing efforts and bringing relevant organizations to the table to build partnerships is key to building shared understanding of each partner's interests and capacities. Six types of role were common across the 13 studied programs: investors, natural infrastructure suppliers, intermediaries, coordinators, technical assistance and expert organizations, and public outreach groups. In some cases, the same organization can play more than one of these roles. Figure 3 illustrates the general roles and functions that exist in these watershed investment programs.

Investors. Investors represent a range of private and public entities; investors in the 13 programs we studied included municipal and federal governments, public water providers (such as water utilities), and grant-making organizations (Table 4).

Figure 3 | **Diagram of Common Roles in Watershed Investment Partnerships**



Source: Adapted from Gartner et al. 2013.

Suppliers. All nine of the western programs in this study operated at least in part on public lands, managed primarily by the U.S. Forest Service, but also by the Bureau of Reclamation and the National Park Service. Six of these western programs work exclusively on public lands, while three work on a combination of publicly and privately owned lands. All four of the eastern programs work primarily with private landowners (Table 5).

Coordinators. While coordinators sometimes initiate programs, their help is often solicited by other partners later on in program development. In the Rio Grande Water Fund, The Nature Conservancy (TNC) plays the coordinating role. TNC arranges investments from individuals, businesses, corporations, foundations, and governments, and then allocates these funds to identified prioritized projects to reduce fire risks on both public and privately owned lands.

Intermediaries. Unlike coordinators, which essentially run the program, intermediaries forge trust and relationships among essential but sometimes disparate stakeholders. Frequently, programs used intermediary organizations working on private lands in the watershed that had established relationships with private landowners. Both the Portland Water District and the Upper Neuse Clean Water Initiative partnered with land trusts to facilitate conservation easement purchases on private lands. Programs in Colorado, Santa Fe, and San Francisco also leveraged intermediary organizations to engage and conduct business with landowners in order to implement watershed management plans.

Table 4 | **Natural Infrastructure Investors**

	PROGRAM	INVESTOR(S)
Eastern United States	Central Arkansas Water (AR)	Central Arkansas Water, U.S. Forest Service, State of Arkansas, U.S. Fish and Wildlife Service
	Delaware River Common Rivers Fund (DE)	USDA, William Penn Foundation, U.S. Endowment for Forestry and Communities
	Portland Water District (ME)	Portland Water District, U.S. Forest Service
	Upper Neuse Clean Water Initiative (NC)	Raleigh Public Utilities, USDA, North Carolina Clean Water Management Trust Fund
Western United States	Flagstaff Watershed Protection Project (AZ)	City of Flagstaff, U.S. Forest Service, Arizona State Forestry, Coconino County, local partners (businesses and conservation nonprofits)
	San Francisco Public Utilities Commission Watershed and Environmental Improvement Program (CA)	San Francisco Public Utilities Commission, City and County of San Francisco
	Aurora Water–U.S. Forest Service Watershed Protection Partnership (CO)	Aurora Water, U.S. Forest Service
	Colorado–Big Thompson Headwaters Partnership (CO)	Northern Water, U.S. Forest Service, Bureau of Reclamation, Western Area Power Administration, Colorado Department of Natural Resources, Colorado State Forest Service
	Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership (CO)	Colorado Springs Utilities, U.S. Forest Service
	Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	Denver Water, U.S. Forest Service
	Pueblo Board of Water Works-U.S. Forest Service Watershed Protection Partnership (CO)	Pueblo Board of Water Works, U.S. Forest Service
	Rio Grande Water Fund (NM)	LOR Foundation, Lowe's Charitable and Educational Foundation, private, federal, and local entities (includes individuals, businesses, corporations, foundations, and governments)
	Santa Fe Municipal Watershed Investment Program (NM)	U.S. Congress, New Mexico Water Trust, U.S. Forest Service, Santa Fe Water Division

Note: This list is not exhaustive—it reflects the major investors discussed in interviews with more than 64 watershed investment program representatives (Appendix B). Some changes in investors have occurred since interviews were conducted between 2014 and early 2016.

Table 5 | **Natural Infrastructure Suppliers Engaged in Each Program**

	PROGRAM	SUPPLIER(S)	INTERMEDIARY FOR PRIVATE LANDOWNERS	PRIVATE LAND	PUBLIC LAND
Eastern United States	Central Arkansas Water (AR)	County government, private landowners		●	●
	Delaware River Common Rivers Fund (DE)	Private landowners	Pinchot Institute for Conservation	●	
	Portland Water District (ME)	Private landowners	Western Foothills Land Trust and other land trusts.	●	
	Upper Neuse Clean Water Initiative (NC)	Private landowners	Ellerbe Creek Watershed Association, Eno River Association, Tar River Land Conservancy, Triangle Greenways Council, Triangle Land Conservancy, and The Conservation Fund	●	
Western United States	Flagstaff Watershed Protection Project (AZ)	U.S. Forest Service			●
	San Francisco Public Utilities Commission Watershed and Environmental Improvement Program (CA)	U.S. Forest Service, National Park Service, San Francisco Public Utilities Commission, private lands	Alameda Upper Watershed Partnership	●	●
	Aurora Water–U.S. Forest Service Watershed Protection Partnership (CO)	U.S. Forest Service			●
	Colorado–Big Thompson Headwaters Partnership (CO)	U.S. Forest Service, Bureau of Reclamation, private landowners	Colorado State Forest Service	●	●
	Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership (CO)	U.S. Forest Service			●
	Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	U.S. Forest Service, Colorado State Forest Service		●	●
	Pueblo Board of Water Works–U.S. Forest Service Watershed Protection Partnership (CO)	U.S. Forest Service			●
	Rio Grande Water Fund (NM)	Public land management agencies, private forest owners	Chama Peak Land Alliance, Rio Grande Water Fund	●	●
	Santa Fe Municipal Watershed Investment Program (NM)	U.S. Forest Service			●

Technical experts range from local universities to research organizations and often specialize in the scientific or economic analysis of watershed management. For example, in the Big Thompson watershed, the Colorado Forest Restoration Institute at Colorado State University provides Northern Water with pre- and post treatment measures of ground, surface, and canopy fuels from which to make objective assessments about the value of acres treated and funds invested (CFRI n.d.).

Approving bodies often include municipal, state, or federal governments, or boards of directors for investors. In all study cases, funding for programs or program activities was approved either by city councils or utility boards of directors. Agencies responsible for enforcing the Safe Drinking Water Act, the Clean Water Act, and other laws have also played a role in building support for watershed investment programs that help regulated entities to achieve compliance more cost-effectively.

Public outreach groups are typically nonprofit organizations that raise public awareness about the need for and benefits of programs, or advocate for adoption of new rules or funding for program start-up. The Santa Fe Watershed Association and The Nature Conservancy played a central role in building support for the Municipal Watershed Investment Program in Santa Fe. In Flagstaff, a group of citizens formed a political action committee, "Yes On 405," to lead the campaign to build support among voters for the bond measure that funded the Flagstaff Watershed Protection Project.

Approaches to partnership building

Across the 13 programs, interviewees emphasized that building trust and strong relationships was vital to effective partnerships. The level of trust among stakeholders affected their willingness to partner for watershed work, the amount of funding they would provide, and how the work was conducted. Box 4 summarizes some broad recommendations for building watershed investment partnerships from sources outside this study.

Programs took different approaches to building trust. Some programs used existing relationships as building blocks for program partnerships. As trust was built over time, partnerships that leveraged existing bonds benefited significantly from the accelerated stakeholder engagement process. Several programs drew from previously established relationships while forming partnerships. For example, in Colorado, many stakeholders already had working relationships, particularly through networks like the Watershed Wildfire Protection Working Group. These networks and their previous efforts to assess watershed risks in the region (JW Associates 2009a, 2009b, 2010a, 2010b, 2011, 2013) drove the stakeholders' willingness to engage with the broader program throughout the Colorado Front Range. Furthermore, the success of early partnerships with the U.S. Forest Service, as in Denver and Aurora, bolstered trust between utilities and federal agencies, instilling confidence in other utilities to engage in similar partnerships.

While programs built on existing relationships, they also forged new partnerships to build momentum for watershed investment programs. Programs sought new allies that could complement existing capacities or leverage available resources. In both Portland, Maine, and the Upper Neuse Basin, North Carolina, land trusts and utilities formed partnerships that harnessed their complementary strengths. The local land trusts had extensive experience working with landowners at the ground level and were best equipped to engage in the outreach component of the program. The Portland Water District (Maine) and the Raleigh Public Utilities Department (North Carolina) provided the essential investments for the watershed investment programs, contributing to start-up operating expenses, matching funds to leverage other grants, and purchasing land and conservation easements in priority areas.

After stakeholders work together to consider their common interests, concerns, values, and priorities, they can identify a set of common goals and a vision for watershed investments.

BOX 4 | TIPS FOR BUILDING PARTNERSHIPS

A wealth of literature on building collaborative partnerships is relevant to watershed investment programs (see, for example, Cantor et al. 2013; Sorice et al. 2013; and Wondolleck and Yaffee 2000). Approaches to partnership building include the following:

1. Invite all stakeholders to the table early, even if some choose not to participate.

Examining and mapping the interests and potential of each stakeholder can inform program-planning activities and the prioritization of resource use. Program stakeholders may include the following:

- **Conservation groups**— Entities engaged in efforts in the watershed related to conservation, sustainable forest management, landscape and river restoration, watershed protection, or water security.
- **Community groups**—Local groups working on community health and well-being, rural livelihoods, or other interests aligned with the watershed investment program.
- **Landowners and land managers**—Those who possess the ability to safeguard watershed services through protection, restoration, or sustainable management of forestland.
- **Government bodies**—Agencies and councils that should be involved in the approval of program activities, and that could provide policy and political support to a program.
- **Water providers and related companies**—Public utilities or private companies that depend on water as an input to their operations. Increasingly, water-dependent companies are also investing in watersheds—Coca-Cola, Nestlé, and AB-InBev are just a few that have committed to the role of watershed stewards by investing in watershed management in the United States and abroad (Bennett and Carroll 2014; TNC 2012).
- **Potential opponents or casualties**—For example, environmental groups concerned about the thinning of forests or air pollution from prescribed burns. Similarly, businesses could feel threatened by potential efforts to limit development. Including these and other "opposing" groups early in program development can help to head off future issues, conflicts, or even litigation, by keeping all groups involved and up-to-date with program developments and the benefits that watershed investments provide to the community.
- **Peers and neighboring programs**—Programs of similar scale and ecological context can also help. Input from these practitioners can significantly reduce the design time needed for new programs, because they can help identify high-level program needs and effective strategies more quickly and accurately. These partners, however, will be less able to advise on more local and context-specific needs of the program.

2. Build trust and collaboration among partners.

Strategies to consider include the following:

- Develop shared goals.
- Take time to thoroughly discuss risks of unintended trade-offs, such as impacts to habitat, recreational opportunities, or ecosystem services, that could be caused by program activities.
- Ensure transparency in decision-making and other program activities.
- Facilitate sharing data and relevant organizational information among all partners.
- Draw from examples of other partnerships, and network and reach out to other programs and experts to learn from their formalization process—this can be especially helpful when programs encounter barriers and need to brainstorm new solutions.
- Keep year-to-year budgetary and human resource capacities in mind.
- When working under memorandums of understanding (MOUs), ensure that the MOUs are written to accommodate changes in organizational needs over time.

3. Articulate a Clear Vision of Success

A strategic vision guides all aspects of coalition building, program design, evaluation of program performance, and even program communications. Ideally, the vision of success should be results-oriented and relevant to key decision-making bodies. Eleven of the 13 programs reported that stakeholders discussed a shared vision of success before initiating the program (Table 6), and all programs provided us with a written vision of success. By establishing mutual goals, each stakeholder had clear incentives to engage in the program. This essential step lays the groundwork for a lasting, effective partnership, even if watershed investment programs face the later challenge of prioritizing program goals. In San Francisco, the Watershed and Environmental Improvement Program and local NGOs developed a collective vision of conservation in the Alameda watershed. Over a series of stakeholder engagement sessions, the entities jointly developed collective mission goals and defined the approval processes for each agency. According to the program coordinator, this process was pivotal in developing a strong partnership, as stakeholders became more receptive to information sharing and adopting a collaborative approach. See Box 5 for additional insights on articulating a clear vision of success.

4. Cultivate Champions and Advocates to Build Support

Eleven programs emphasized that during the initial stages of program development, they benefited from individuals' leadership in putting ideas into action at a watershed scale. Two types of leaders emerged: champions and advocates.

Champions are found in political or institutional leadership roles, and include mayors or city managers, utility CEOs, and federal agency leaders who build support for natural infrastructure investments at crucial moments in the program's development. Within the case studies, eight programs highlighted champions who were key in generating momentum for watershed investment. In Raleigh, following meetings with advocacy groups, Mayor

BOX 5 | INSIGHTS ON CRAFTING A VISION OF SUCCESS

While there is no recipe for developing a joint vision of success, there are some key questions that can help to ensure that the program's goals and objectives will guide program development:

Is the vision strategic, responding to key risks and opportunities?
Consider how the program could be designed to multiply benefits across stakeholders' goals, and to generate co-benefits. Beyond protecting or even improving water quality, and achieving watershed protection goals, what can be accomplished that benefits partners? This could include broad visions such as providing more wildlife habitat or recreational areas, appealing to desires to conserve the rural character of a community, or adapting to the risks of climate change.

Does the vision resonate with key stakeholders?
Does the program's vision of success incorporate stakeholders' needs? If yes, consider how this vision can be applied in planning a watershed investment program, or if further scoping and focusing of the vision is necessary to direct program needs and goals. Is the vision backed by concrete goals that include benchmarks and milestones that stakeholders understand?

Does it fit with measurable performance metrics?
The vision itself can be broad; for example, ask stakeholders to imagine what they would like the watershed to look like in 20 years. However, ensure that reporting goals can be aligned with the vision as well—consider how the vision can relate to specific quantitative goals, such as number of acres protected or treated, landowners engaged, or funds raised. Measuring the condition and trends in watershed services (e.g., water quality, instances of flooding) over time is a logical way to measure program performance, but as noted in the "monitor and evaluate performance" discussion below, attributing watershed service trends to program activities can be challenging and costly using currently available science and technology.

A number of programs have developed strategic vision documents, offering insights into the core components of a vision for success, and approaches to articulating the vision. Examples include the following:

- *Comprehensive Plan for Wildfire and Water Source Protection* (RGWF 2014)
- *Santa Fe Municipal Watershed Plan, 2010–2029* (Everett et al. 2013)
- *Denver Water/U.S. Forest Service Partnership 5-Year Operating Plan (2011–2015)* (Denver Water 2011)

Table 6 | **Programs' Visions of Success**

	PROGRAM	EXPLICIT GOALS*	VISION STATEMENT
Eastern United States	Central Arkansas Water (AR)	Water quality; community welfare	"To maintain a long-term, abundant supply of high quality drinking water for the present needs and continuing growth of the community." (WRI 2015 Survey—see Appendix C)
	Delaware River Common Rivers Fund (DE)	Water quality; forest health; landscape management	"To preserve the quality of water in the Delaware River Basin by helping forest landowners in the Upper Delaware River Watershed improve the management of and conserve their private forest lands, and to enlist downstream users who benefit to help in that conservation effort." (CWF n.d.)
	Portland Water District (ME)	Forest health	"Toward the goal of supporting Sebago Lake watershed landowners who seek to conserve their land in perpetuity, the District's Board of Trustees will contribute between 0% and 25% of the estimated conservation value for qualifying projects." (PWD 2013)
	Upper Neuse Clean Water Initiative (NC)	Multistakeholder collaboration; landscape management; water supply	"This partnership of nonprofit organizations and local governments seeks to protect the lands most critical for ensuring the long-term health of drinking water supplies in the Upper Neuse River Basin." (CTNC n.d.)
Western United States	Flagstaff Watershed Protection Project (AZ)	Forest health; city water supply; flood mitigation and sediment control; community welfare	"To proactively improve the health and resiliency of forests and watersheds critical for providing and delivering water to the City and its customers, protect the City from flooding and sedimentation, protect public safety and provide for the economic vitality of the City and surrounding areas." (USFS 2013c)
	San Francisco Public Utilities Commission Watershed and Environmental Improvement Program (CA)	Water supply; landscape management; multistakeholder collaboration	"To conserve the watershed, ecosystem, and cultural resources of the upper Alameda Creek Watershed through land protection, land management, restoration, and sustainable ranching practices. To further the mutual goals of partner organizations by establishing a structure for partners to collaborate and complement each other's capacities, thus collectively contributing to a larger conservation impact" (WRI 2015 Survey—see Appendix C) and, to "proactively manage, protect, and restore environmental resources that affect or are affected by the operation of the SFPUC [San Francisco Public Utilities Commission] water supply system." (SFPUC 2014)
	Aurora Water–U.S. Forest Service Watershed Protection Partnership (CO)	Forest health; city water supply	"To proactively improve the health and resiliency of forests and watersheds in areas critical for providing and delivering water to the City of Aurora." (USFS 2011a)
	Colorado–Big Thompson Headwaters Partnership (CO)	Forest health; city water supply; electricity supply	"To proactively improve the health and resiliency of forests and watersheds and preplan for post-wildfire response actions in areas critical for providing and delivering water to the Northern Water and generating hydro-electric power through Reclamation's C-BT Project facilities." (USFS 2012)
	Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership (CO)	Forest health; city water supply	"To proactively improve the health and resiliency of forests and watersheds in areas critical for providing and delivering water to the City of Colorado Springs through the operations of Colorado Springs Utilities." (USFS 2013b)

Table 6 | **Programs' Visions of Success (continued)**

	PROGRAM	EXPLICIT GOALS*	VISION STATEMENT
Western United States	Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	Forest health; city water supply; water quality; multistakeholder collaboration	"To proactively improve the health and resiliency of forests and watersheds in areas critical for providing and delivering water to the City and County of Denver" (USFS 2010b) and, "for a wide variety of stakeholders (including the four counties within the watershed, environmental interests, and others) to identify, understand, and prioritize concerns that affect source water quality and work together to address them." (WRI 2015 Survey—see Appendix C)
	Pueblo Board of Water Works–U.S. Forest Service Watershed Protection Partnership (CO)	Forest health; city water supply	"To proactively improve the health and resiliency of forests and watersheds in areas critical for providing and delivering water to the City of Pueblo." (USFS 2013a)
	Rio Grande Water Fund (NM)	Forest health; water supply; landscape management	"To achieve the vision of healthy forests and watersheds that provide a reliable supply of high-quality Rio Grande water and other benefits for New Mexico … The goal of the water fund is to protect storage, delivery and quality of Rio Grande water through landscape-scale forest restoration treatments in tributary forested watersheds, including the headwaters of the San Juan Chama Project." (RGWF 2014)
	Santa Fe Municipal Watershed Investment Program (NM)	Multistakeholder collaboration; water supply	"The ongoing collaborative work in the municipal watershed is known as the Santa Fe Municipal Watershed Investment Program. The plan addresses four areas critical to the maintenance of the municipal watershed: (i) vegetation management and fire use; (ii) water management; (iii) public awareness and outreach; and (iv) financial management based on payment for ecosystem services." (Everett et al. 2013)

**Note:* These categories were selected by the authors to show commonalities and differences among the programs' vision statements. They were not self-selected by interviewees who participated in the study.

Charles Meeker assumed a lead role in championing the establishment of the watershed investment program, convening actors, and building support on the city council, which approved an initial $500,000 grant to develop the program. As mayor, Meeker was able to "get the right people in the room" and to build visible support for the program among council members.

Advocates include dedicated employees within water utilities, land management agencies, and conservation organizations. They provide ongoing, sustained advocacy by promoting the idea of natural infrastructure investment over time. Sandy Hurlocker, a U.S. Forest Service manager suggested, "It is important to find those leaders in the community that . . . can start talking to the community about the importance of the work." In Santa Fe, one of the critical leadership roles came from within a conservation advocacy organization, the Santa Fe Watershed Association, which advocated for investment in fuel load reduction, convened experts, developed a Watershed Restoration Action Plan, and conducted public education to build support for controlled burning. Paige Grant, then the executive director of the small Santa Fe Watershed Association, worked to convene groups of experts to address concerns voiced by the city's extensive environmental community. She also provided key capacities by coordinating the development of the action plan for parts of the watershed, and documented the program's early history through several publications.

Explicitly identifying partnership roles and collaboratively identifying risks and opportunities in the momentum-building phase helps to ensure that stakeholders enter the design and implementation stage committed to the program and with a clear vision of success.

Phase 2: Designing the Program

PHASE OF PROGRAM DEVELOPMENT	DESCRIPTION	LESSONS
Designing the program	Assessing the scientific and economic underpinnings of the program; creating a strategy to achieve program goals	5. Develop a scientifically informed watershed plan 6. Evaluate the business case for investment 7. Identify investors and financing mechanisms for initial and long-term funding

5. Develop a Scientifically Informed Watershed Plan

Eleven programs in this study used a collaborative planning process to assess watershed needs and develop a plan of action. Collaborative planning processes enabled partners to jointly identify key issues that needed to be addressed by the program, and to discuss the concerns and interests of the groups involved. Collaborative planning processes provided an opportunity for stakeholders to translate their long-term visions for the watershed into specific actions or treatment options, with consideration of the resources available. In doing so, stakeholders set consistent goals for and expectations of program activities. This section discusses the approaches and tools that programs used to prioritize parcels of forestland for watershed investment, and to determine which watershed management activities were most appropriate for their program.

Identifying and prioritizing parcels for watershed investment

Eight of the 13 programs conducted geospatial analysis to identify subwatersheds or parcels where forest treatments could generate improved downstream water quality. These programs used a spatial prioritization tool or process that ranked parcels of land based on a set of criteria (Box 6). Table 7 lists basic information that might be input into this process. Each program had a distinct process for this prioritization, based on its own parameters of interest.

For the Upper Neuse Clean Water Initiative in North Carolina, the program's technical advisory group developed a two-part prioritization model. First, a watershed assessment scored individual catchments' impact on Falls Lake water quality according to a combination of ecological indicators, including forest cover. Second, an implementation model identified priority parcels within each catchment based on size, management practices, and development pressures (Triangle Land Conservancy and Tar River Land Conservancy 2010).

For some programs, estimated costs for each parcel were taken into account, balancing environmental impact with economic considerations. Interviewees reported that these assessments served primarily to focus investments on the most suitable areas, maximizing ecological benefits. Five programs did not geographically prioritize their interventions within the watershed, typically because the programs were working in small watersheds where all parcels of land were of similar concern. For example, the Flagstaff Watershed Protection Project plans to treat all forests in two critical smaller watersheds where debris flows caused by fire could threaten downtown Flagstaff and water infrastructure.

Assessing forest treatment options for source water protection

In addition to defining priority geographic areas for investment, programs also specified "treatments" (i.e., forest management activities) that could be implemented in priority areas. Because the drivers of change and local conditions vary from place to place, planned treatments must also reflect local needs and capabilities. Programs addressing fire risk in the Southwest and Mountain West focus on forest treatments such as "thinning" (i.e., removal of trees), as well as prescribed burning of patches of forest, to reduce the tree density of the forest and thereby reduce fire risk. Programs in the East that aim to protect forest from development have focused on very different activities on target lands, such as conservation easements or acquisition.

Interviewees explained that assessing the suitability and feasibility of treatment options early on can help guide implementation and enhance the impact of the program. In Arkansas, for example, Central Arkansas Water contracted with Tetra Tech to develop a comprehensive and scientifically robust Lake Maumelle Watershed Management Plan (Tetra Tech 2007). The management plan explores the wide range of options available for source water protection, from land acquisition and land-use planning to water quality monitoring and pollution control. The plan was adopted in 2007 and has directed Central Arkansas Water's subsequent watershed management activities.

While many programs have used models and mapping exercises to inform their treatment plans, interviewees emphasized that on-the-ground verification is also needed. Even though a geographic area may appear suitable for treatment on a map, a number of factors in the field can drastically reduce the amount of forest that can be treated. Steep slopes or rocky terrain, for example, can render some areas impassable for treatment, or substantially increase the cost of treatment. Acknowledging this reality by dedicating time and funds to verifying the suitability and feasibility of plans is an important part of the planning and communication process with program partners.

Few programs reported instances in which forest treatments for source water protection conflicted with other management goals. In Flagstaff, there was some concern that thinning could degrade the habitat of endangered Mexican Spotted Owls. Program partners addressed this by agreeing to track habitat impacts as a part of their larger monitoring plan.

Finally, it is important to address public perception of forest treatments so that partners are confident their activities can be implemented without backlash. Interviewees noted that the public is generally hesitant about thinning and logging and, to a lesser degree, prescribed burns (fire concerns relate to smoke and potential wildfire risks). In some cases, it has been necessary to invest in public outreach in order to move forward with forest treatments. In the Santa Fe and Flagstaff programs, many years of outreach and education by a range of program partners, particularly conservation nonprofits and the Flagstaff Fire Department, have transformed negative public perceptions of controlled burns and have made it a viable treatment method. Santa Fe's 20-year Watershed Investment Plan outlines long-term outreach activities to be conducted by non-profit partners. This outreach plan is designed to meet the twin goals of "providing general watershed education, including forest and riparian ecology, natural and cultural history, and water issues, and building and maintaining support for the Payment for Ecosystem Services model" (Everett et al. 2013).

Table 7 | **Possible Inputs to a Watershed Assessment and Planning Process**

TYPE OF INFORMATION	EXAMPLES OF INFORMATIONAL INPUTS
Hydrological conditions and risks	■ Watershed boundaries ■ Water and road networks ■ Baseline assessment of water quality and quantity ■ Water sources (reservoirs) and intakes ■ Projections for future water risks ■ Nutrient runoff risk ■ Drought or flood risk
Ecological conditions and trends	■ Forest cover, land-cover trends ■ Fire risk ■ Erosion risk ■ Key habitats
Legal conditions	■ Landownership □ Private or public lands □ Second homes, absentee landowners □ Parcel size ■ Land conservation status □ Protected areas □ Lands enrolled (or percent enrolled) in USDA cost-share programs ■ Land uses and zoning
Stakeholder input	■ Landowner willingness to participate ■ Public perception of program activities
Land treatment options	■ Conservation easements ■ Best management practices ■ Forest thinning and fuel loads reduction ■ Prescribed burns ■ Land acquisition ■ Restoration

As the programs mature, they will likely need to update prioritization analyses and treatment plans to reflect their work and changes in the landscape and partner objectives. These changes may result from external transformations (and take an adaptive management approach), from lessons learned through performance monitoring, or from a resolution to pursue new strategies to scale up program activities. For example, drought has inspired the San Francisco Public Utilities Commission to consider extending its drinking water supply system to neighboring watersheds. This may encourage San Francisco's Watershed and Environmental Improvement Program to better understand the actions and priorities for source water protection in these auxiliary watersheds. In North Carolina, the Upper Neuse Clean Water Initiative expanded its geographic focus to protect additional water supply watersheds. The initiative recently began working to preserve forest cover in the Swift Creek Watershed, from which Raleigh began drawing drinking water in 2010. Initiative partners have completed one conservation project in this new watershed and are considering rebranding the initiative as the "Watershed Protection Program" to reflect its expanded focus.

6. Evaluate the Business Case for Investment

Interviewees largely agreed that quantifying or qualitatively describing the costs and benefits that the program will deliver, and providing information on the added value of the program compared to alternatives, is important to securing partners, and especially to engaging investors. Among the 13 programs we studied, approaches to communicating the benefits of watershed investments ranged from qualitative assessments to quantitative investment options analyses. Box 7 highlights some assessment

BOX 6 | TOOLS AND RESOURCES FOR CREATING A SCIENTIFICALLY INFORMED PLAN FOR THE LAND

Before embarking on a spatial planning process, programs can benefit from checking with stakeholders to ascertain whether a landscape prioritization for watershed services has already been conducted. Relevant information could be included in regional or state forest management plans, or existing fire prioritization plans. If the information presents robust, peer-reviewed science related to watershed services, it could be valuable to a watershed investment program's planning process.

In some cases, programs focus on protecting watersheds in good condition, while others focus on restoring watersheds in poor condition. The U.S. Forest Service's Watershed Condition Framework allows users to identify common areas of interest, and to identify areas at high ecological risk, without having to do new analysis (USFS 2011b). This approach may form one input to a watershed investment prioritization process, especially in cases where the U.S. Forest Service is a potential partner.

Several geospatial analysis tools can aid in modeling the environmental outcomes of a landscape management plan:

- **Conservation Priority Index:** a GIS mapping tool that scores and ranks the importance of land parcels to different conservation objectives, including watershed management (Zhang and Barten 2009).
- **InVEST:** a GIS mapping tool that models the supply of ecosystem services under different land management scenarios (NCP n.d.)
- **TPL Greenprint:** a service provided by the Trust for Public Land to develop community-driven conservation plans utilizing mapping and stakeholder engagement (TPL n.d.)

Watershed investment programs can also benefit from the experiences of separate but related sectors. After all, watershed investment programs are not the only initiatives facing the challenge of prioritizing conservation interventions to maximize impact on a limited budget. Perez and Walker (2014) modeled the financial and environmental outcomes of targeting Farm Bill conservation dollars to priority areas to optimize positive impacts on water quality. They found that a targeting approach that considers geographic and benefit-cost factors can improve cost-effectiveness and could potentially reduce nutrient loads by an order of magnitude relative to business as usual (no targeting approach). For watershed investment programs, the key takeaways of this study are twofold: first, while targeting approaches can require a significant investment of time and money, the payoff can also be significant. Second, incorporating public conservation funds into watershed investment programs may increase funding for the program and multiply the impact of the funds.

methods for evaluating the business case for watershed investments. This section describes some of the common strategies that programs used to make the business case for action.

Retrospectively analyzing the costs of watershed degradation

All seven programs that were developed in response to catastrophic wildfire threats have analyzed the financial, social, and environmental damages that past fires inflicted on water infrastructure management systems. Financial damages included additional water treatment, loss of water use, infrastructure repair, and forest restoration costs faced by the utility. Some programs produced detailed accountings of the fires' full impact on local economies, as shown in the Flagstaff Watershed Protection Project case study. Following the Schultz Fire, local forest managers asked Northern Arizona University researchers to conduct an estimated full-cost accounting for the fire. Using a robust range of data, they estimated the total cost of the fire to governments, private property owners, and society at between $133 million and $147 million (Combrink et al. 2013).

BOX 7 | TYPES OF ASSESSMENTS TO EVALUATE THE BUSINESS CASE OF WATERSHED INVESTMENTS

Some common assessments that factor into building a strong business case for watershed investment include the following:

- **Green-gray assessment:** Cost-benefit analysis that compares the present value of costs and benefits of two or more water management options involving natural "green" infrastructure and conventional "gray" infrastructure. The green-gray assessment can be scenario-driven and coupled with sensitivity analysis for robust results (see Figure 4 for more information).
- **Social benefit analysis:** Assesses many or all of the impacts of natural infrastructure on relevant stakeholder groups. This could include quantification and valuation of ecosystem services provided by natural infrastructure, such as improved air quality, recreation opportunities, carbon sequestration, and others. The analysis can also evaluate which stakeholders will be burdened by the costs of the program, and which will reap the benefits.
- **Beneficiaries' willingness to pay:** Identifies individuals or groups that will benefit from the program and estimates their willingness to pay. This could include polling the public's support for watershed-related bond measures, or surveying local businesses with high dependence on water.

These assessment methods can be tailored to fit different contexts and can analyze different aspects of watershed investments, such as:

- Reduced costs of operations and maintenance: for example, the extent to which watershed investments could reduce turbidity and related filtration and treatment costs.
- Avoided or reduced costs of infrastructure upgrades: for example, the extent to which watershed investments could reduce sediment loads into reservoirs, which, if left unchecked, require costly dredging and increase wear and tear on the water utility's intake system.
- Reduced regulatory risks: For example, the avoided cost to water utilities of complying with regulations if watershed investments avoid triggering regulatory drinking water quality thresholds, or if degraded water quality results in increased regulatory requirements for wastewater treatment plants and other point sources.
- Other costs or benefits beyond water quality, such as:
  - ☐ Reduction of property and public infrastructure damage due to wildfire or flooding.
  - ☐ Increased carbon sequestration: for example, the extent to which reforestation or improved forest management associated with watershed investments could sequester carbon and reduce emissions from catastrophic fire events; such actions might be eligible for carbon credits.
  - ☐ Fisheries benefits: for example, the extent to which watershed investments could improve water quality for key commercial and cultural fish species.
  - ☐ Recreational opportunities: for example, increased numbers of people who may enjoy access to wildlife and outdoors activities.
  - ☐ Job creation: for example, increased numbers of forest management jobs (e.g., conducting thinning and processing thinned wood into forest products) created through a new or scaled watershed investments program.

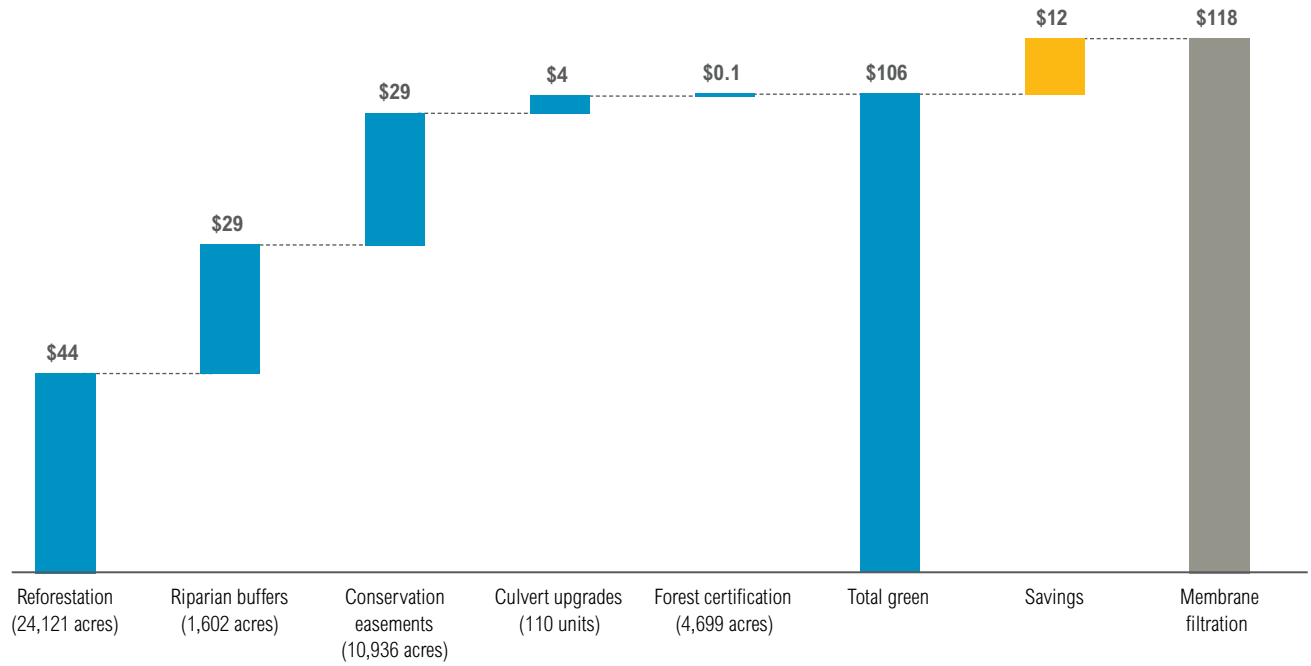
Financially modeling potential cost savings of natural infrastructure investments

Of the programs we studied, several have completed analyses quantifying financial returns on natural infrastructure investments. These studies evaluate how future investments in watershed management practices could reduce costs of downstream water treatment, or avoid other damages.

In the Portland Water District, a "green-gray assessment" compared the costs and benefits of natural (green) infrastructure with built (gray) infrastructure approaches to protecting the water supply (Talberth et al. 2013; Gray, Gartner, and Mulligan 2014). The assessment demonstrated a high likelihood that costs of more than $12 million could be avoided over a 20-year period through investment in a set of conservation practices (Figure 4). This finding supported the Portland Water District's decision to invest in improved watershed management (Gartner et al. 2013).

Beyond the programs studied, investors are placing greater emphasis on quantitatively evaluating cost savings and returns on natural infrastructure investments. In an October 2015 memorandum, the White House directed federal agencies to factor the value of natural infrastructure and ecosystem services into planning and decision-making (Dickinson, Male, and Zaidi 2015). The memorandum established a process for the government to develop more detailed guidance on integrating ecosystem-services assessments and directed agencies to institutionalize policies that promote consideration of ecosystem services in planning, investment, and regulatory contexts. Beyond public agencies and water utilities, corporations are increasingly expressing interest in watershed investments and trying to gain a greater understanding of potential returns on investment (Box 8).

Figure 4 | **Green-Gray Assessment to Estimate Cost Avoidance of Watershed Investments in Portland, ME**



This graphic shows the relative costs of multiple watershed interventions that were estimated through modeling to have a potential cumulative impact on water quality equivalent to that of installing a new water treatment facility. Researchers estimated that implementing a suite of natural infrastructure interventions in this watershed could produce the needed water quality to meet its U.S. Environmental Protection Agency–sanctioned water filtration waiver, and avoid costs of $12 million under a baseline scendario.

Sources: Gartner et al. 2013; Gray, Gartner, and Mulligan 2014.

Other ways programs communicated the case for watershed investments

Some interviewees reported that precise quantification of financial benefits was not necessary to inform and compel key decision-making bodies in their watersheds, and that there were more cost-effective ways to make the case for action. In Colorado, for example, a series of watershed wildfire assessments (JW Associates 2009a, 2009b, 2010a, 2010b, 2011, 2013) illustrated geographic regions of high risk and priority. Colorado water providers generally agreed that they and their decision-making bodies had enough information through these assessments to feel comfortable that they were serving their customers by engaging in forested watershed work.

Although simpler analyses have successfully mobilized initial program funding, this approach may not result in long-term support or work at the necessary scale. Some water utilities report the lack of a quantifiable business case as a barrier to sustaining natural infrastructure investments. This highlights the need to institutionalize watershed planning and natural capital accounting in investment decisions, so that the value of watershed investment can be incorporated into accounting for built infrastructure utility line items.

Programs report that not formally quantifying returns on investment can limit their ability to engage beneficiaries over the long-term and justify sustained investments. For example, despite the bond measure's success in Flagstaff, local stakeholders realize that they will need additional economic analyses to build support for long-term forest maintenance financed by a water rate surcharge. To remedy this, researchers are currently working on an avoided cost analysis to quantify the economic benefits of the Flagstaff Watershed Protection Project's long-term forest restoration work.

Similarly, the Upper Neuse Clean Water Initiative partners reported that not quantifying the water quality and economic impacts of conservation actions has limited their ability to engage a broader range of beneficiaries in watershed management. The utility has reconvened a technical advisory committee to better model the water quality impacts of conservation easement purchases and to better estimate the level of investment needed to avoid increased water treatment costs. In the meantime, the initiative has relied on a range of proxies, including acres conserved, funds leveraged, and estimates of nutrients avoided, to monitor and describe its success.

Approaches to evaluating the business or economic case varied greatly across the programs based on investors' interests. A detailed analysis of the financial return on watershed investments may appeal more to the CFO of a water utility than to the public. Similarly, investors may be interested in different benefits: public officials may be more interested than water utility staff in learning whether watershed investments will create jobs.

Understanding who the key investors are, or will be, is an important precursor to evaluating the business case. Lesson 7 discusses how the 13 studied programs identified and engaged investors and financing mechanisms to fund their programs.

BOX 8 | PRIVATE-SECTOR EVALUATIONS OF RETURN ON NATURAL INFRASTRUCTURE INVESTMENTS

Shifting the private sector from philanthropic contributions to investment in natural infrastructure as part of corporate long-term water security strategy requires quantification of the return on investment. For example, WRI is working with the FEMSA Foundation, which represents FEMSA, the largest public bottler of Coca-Cola products in the world and the second-largest stockholder of Heineken, to evaluate the costs and benefits of natural infrastructure investments in São Paulo, Brazil, and Monterrey, Mexico, where FEMSA has major bottling plants and assets (Gartner and Ozment 2016). Previous work, led by The Nature Conservancy, found that restoring 35,000 acres of degraded land in São Paulo's watershed would reduce sedimentation by 50 percent, saving $2.5 million every year and reducing water treatment costs by 15 percent over 10 years (Guimarães 2013).

BOX 9 | FUNDING SOURCES FOR DIFFERENT PROGRAM PHASES

Some funding sources are better positioned to support a program's initial phase or short-term budgetary needs, while others can provide sustained support only for mature programs.

Often, the first phases of program establishment involve partnership building, program design, and other start-up costs, as well as demonstration projects. These activities are not likely to be supported by major beneficiaries or investors that seek a return on investment. Consequently, seed funding in the form of grants may be more suitable funding sources during program establishment. As programs grow and demonstrate results, however, grants-based funding may become insufficient; at this point, building funding relationships with major program beneficiaries such as water utilities may be more feasible and appropriate.

When determining the right time to engage an investor, it may be useful to evaluate different funding sources based on, among other things:

- Time and cost it will take to establish and execute
- Amount of funding available, and the degree of competition for funding
- Ability of the program to meet funder needs in its current and future stages of development (e.g., reporting requirements, proof of a return on investment)
- Time frame over which the funder is interested in investing in the program
- Willingness of partners and landowners to accept support from the funder
- Program size/scale of project required to appeal to a funder
- Restrictions or flexibility to use funding for various activities

The Trust for Public Land's *Local Greenprinting for Growth Workbook* (TPL 2003) includes a guide on securing conservation funds that is in many ways relevant to securing funds for source water protection.

7. Identify Investors and Financing Mechanisms for Initial and Long-term Funding

To achieve their goals, all the programs have sought large-scale, sustained financial support for conservation and program administration activities. No program has funded its activities through a single funding source, and no two programs have adopted exactly the same strategy. In addition to setting forth a clear, credible vision for success and a business case for action, these programs used creativity, flexibility, and an ability to navigate local contexts and politics to access funding.

Generally, the programs we studied sought different sources of program funding at different stages of program development: grants and government appropriations were used to fund pilot projects early on, while water utility investments occurred later as the programs scaled up their efforts. After the initial phase demonstrated success, programs leveraged their success stories to establish financing mechanisms (e.g., bond measures or water rate increases) that generate continuous funding for program activities. The main sources of funds used by water utilities for watershed protection are utility general operating funds, municipal bonds or utility-issued revenue bonds (which are paired with rate surcharges to pay off debt), and source water protection fees (surcharges that generate annual income for the utility). In the western programs, other sources of funding are federal agency partners and state funds. Each of these sources can be used to leverage additional funding from other sources (Table 8). Box 9 discusses issues to consider when developing a funding plan.

Table 8 | Watershed Investment Program Funding

	PROGRAM	YEARS FUNDED	APPROXIMATE FUNDS INVESTED ($)*	REPORTED NUMBER OF INVESTORS	PRIMARY PROGRAM FINANCING MECHANISMS
Eastern United States	Central Arkansas Water (AR)	8	27.7 million	5+	Watershed protection fee; nutrient impact fee; government agency cost-shares
	Delaware River Common Rivers Fund (DE)	5	1.9 million	3	Grants
	Portland Water District (ME)	2	400,000	2	Allocation from utility's general operating fund
	Upper Neuse Clean Water Initiative (NC)	10	5.8 million	5+	Watershed protection fee; nutrient impact fee; grants and donations
Western United States	Flagstaff Watershed Protection Project (AZ)	7	13 million	12	Municipal bond
	San Francisco Public Utilities Commission Watershed and Environmental Improvement Program (CA)	10	50 million	2	Municipal bond and utility operating budget
	Aurora Water–U.S. Forest Service Watershed Protection Partnership (CO)	4	750,000	2	Utility operating budget allocation and government matching funds
	Colorado–Big Thompson Headwaters Partnership (CO)	3	2 million	6	Utility operating budget allocation and government matching funds
	Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership (CO)	1	765,000	2	Utility operating budget allocation and government matching funds
	Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	5	37.6 million	2	Utility operating budget allocation and government matching funds
	Pueblo Board of Water Works–U.S. Forest Service Watershed Protection Partnership (CO)	2	50,000	2	Utility operating budget allocation and government matching funds
	Rio Grande Water Fund (NM)	2	1 million	multiple	Grants, donations, government matching funds, and business investors
	Santa Fe Municipal Watershed Investment Program (NM)	7	9.5 million	4	Congressional earmark; water rate increase; municipal bond

* *Note:* Estimates of funds invested are based on information provided in interviews and written correspondence with interviewees (listed in Appendix B). The level of funds invested are not comparable across programs owing to differences in how funding was reported.

Early stage program funders

Five programs tapped seed funding from government and philanthropic donors for initial start-up projects to study watershed conditions, demonstrate viability, build capacities among partners, and rally support for core investments (Table 9). In the western programs where federal agencies were both natural infrastructure suppliers and investors, initial investments were cost-shared between the land management agencies and the water provider. In the eastern programs, USDA Conservation Innovation Grants were awarded to partners of the Upper Neuse Clean Water Initiative and Portland Water District programs, serving as crucial start-up funding. Conservation Innovation Grants also allowed programs to "match" non federal funds from other funders, reducing some risk for investors and multiplying the impact of the seed funding.

Programs used these initial funds to develop the program and prepare for additional funders to invest. In Santa Fe, for example, partners funded the restoration of the entire lower portion of the municipal watershed through U.S. Forest Service appropriations and more than $7 million in congressional earmarks between 2002 and 2009. This initial funding allowed partners to develop a track record of success and build community awareness of watershed health, lending it the political capital needed to establish a permanent "payment for ecosystem services" program sustained by water customers through their monthly bills.

However, the programs recognized that these piecemeal funding opportunities do not substitute for sustained funding from a committed primary investor. The main beneficiaries of watershed investment programs, like municipal governments and water utilities, are logical sources of sustainable long-term funding, but they often expect a return on their investment in the form of measured risk reduction or even cost reduction. These investors may therefore be more willing to invest after the first phase of program implementation.

Seed funders are conscious of this fact, and some of them reward programs that utilize grants to develop sustainable and durable funding streams. The U.S. Endowment for Forestry and Communities (Endowment) partnership with the USDA Natural Resources Conservation Service (NRCS) is one such example. In 2009, Carlton Owen, the Endowment's President

Table 9 | **Select Watershed Investment Program Seed Funding Sources**

PROGRAM	SEED FUNDER(S)	PROGRAM DETAILS
Central Arkansas Water (AR)	Central Arkansas Water	Established a watershed protection fee that was transparent to ratepayers and initially capped at $3 million, intending to build support for watershed protection. These funds were leveraged to obtain matching funds. In 2012, the cap was removed at the urging of community members supportive of watershed protection efforts.
Delaware River Common Waters Fund (DE)	U.S. Endowment for Forestry and Communities; USDA	$1.9 million from U.S. Endowment for Forestry and Communities, of which half was provided by a USDA National Resources Conservation Service Conservation Innovation Grant; helped finance conservation and best management practices on more than 50,000 acres of forests.
Portland Water District (ME)	USDA	Conservation Innovation Grant–funded study on avoided-cost analysis and development of the Conservation Priority Index, both of which played a role in the utility's decision to fund the program and stakeholder engagement.
Santa Fe Municipal Watershed Investment Program (NM)	Congress – Federal earmarks under Healthy Forest Restoration Act of 2003 (H.R. 1904)	Between 2003 and 2006, $7 million in congressional earmarks were allocated to kick-start forest thinning projects.
Upper Neuse Clean Water Initiative (NC)	USDA; City of Raleigh	Program received $3.7 million in appropriations from city, allowing it to establish a proven track record; Conservation Innovation Grant from USDA and matching funds from U.S. Endowment for Forestry and Communities provided seed funding that allowed the program to leverage matching funds.

and CEO, approached NRCS Chief Dave White with an innovative twist on the Agency's Conservation Innovation Grant Program (CIG). Rather than funding communities to implement traditional, "one-off" watershed protection projects, Owen proposed a thematic, sustainable approach that would link downstream water consumers with upstream water producers, such as forest landowners. He suggested a new "leverage grant" category for CIG to facilitate the concept. Owen secured a $2 million CIG award and matched that with Endowment funds.

The Endowment then administered a national grant competition for projects that advocated for sustainable watershed protection fees. More than a dozen proposals were received and three projects were funded: the Rivanna Watershed of Virginia; the Upper Delaware River Watershed of New York, New Jersey and Pennsylvania; and the Upper Neuse River Watershed of North Carolina. As of 2016, only Raleigh successfully established a sustainable watershed protection fee, which began in 2011 and was increased in 2015. The Endowment/NRCS partnership provided critical funding to help establish Raleigh's program and create momentum for other projects around the country.

Large-scale program investors and financing mechanisms

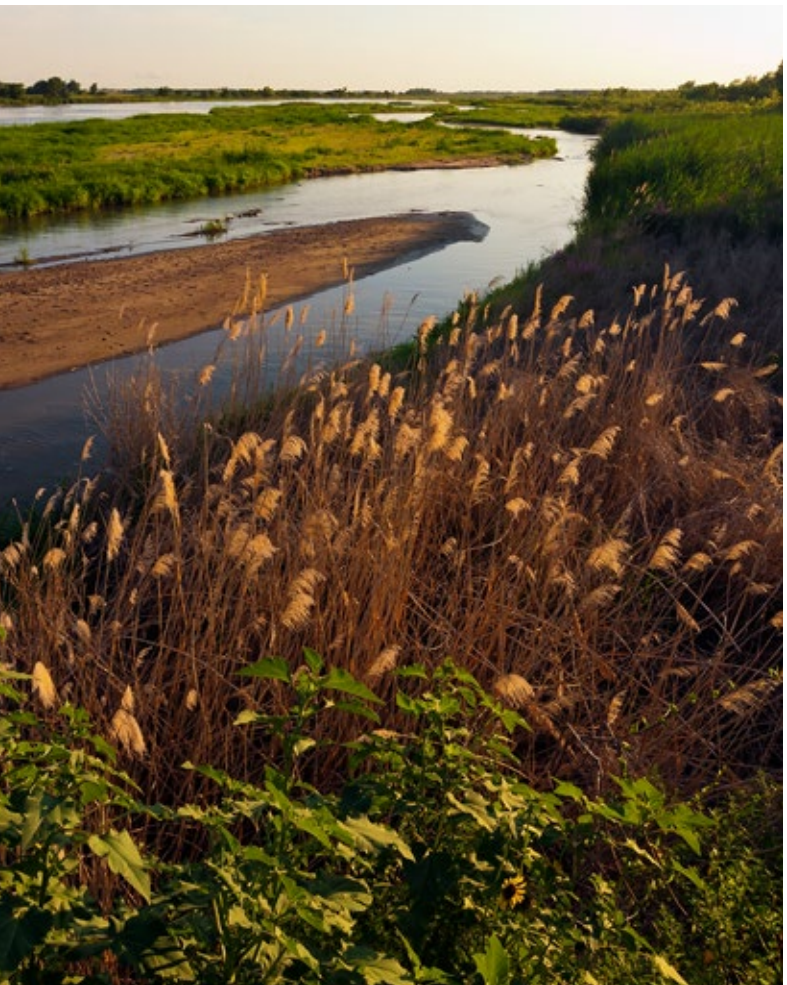
All 13 programs identified a water quality beneficiary to provide significant, ongoing investments. In most programs, water utilities acted as primary investors, although the Flagstaff Watershed Protection Project was funded directly by the city, and the Delaware River Common Waters Fund was in the process of engaging water utilities. These primary investors drew on a range of financing mechanisms to pay for source water protection investments, including general operating budgets, bonds, and surcharges on customers' water rates.

Water utility operating budgets: Five water providers—the Portland Water District, Northern Water, Colorado Springs Utilities, Aurora, and Pueblo—fund their portion of the source water protection partnership out of their general operating budgets. In Portland, conservation easement acquisitions are supported as a part of a multifaceted watershed protection program to which the utility dedicates about $1 million per year.

Although allocating existing operating funds to watershed management can put natural infrastructure in direct competition with the many other capital improvement projects, it begins to institutionalize the concept as a core water management strategy, and weaken the idea that natural infrastructure is an unconventional approach. In the long run, it is important to consider ways of creating new revenue streams to sustain the operating budget.

Municipal bonds: Several programs facing immediate water supply risks used municipal bonds to quickly raise a fixed amount of capital to jumpstart watershed investments. Municipal bonds allow government entities to borrow money from investors and repay it over time. Bonds can provide upfront capital quickly. However, they offer a fixed amount of funding that eventually runs out and may not be sufficient to support watershed maintenance.

Municipal bonds generally fall into one of two categories: revenue bonds and general obligation bonds. Revenue bonds can be issued by public utilities to fund capital improvement projects, and are repaid over time by the revenue collected by the utility from water users. Accounting standards make it difficult for utilities to account for natural infrastructure as an asset, which in turn presents challenges for issuing revenue bonds to support natural infrastructure. Despite these difficulties, two utilities in our study (in Santa Fe and San Francisco) have funded natural infrastructure investments through revenue bonds that were initially issued to fund large-scale gray infrastructure projects (Gartner et al. 2013).



For example, a 2002 publicly approved revenue bond measure gave the San Francisco Public Utilities Commission authority to borrow over $1.5 billion to finance water infrastructure improvements. Although the measure focused on replacing and upgrading aging gray infrastructure, it also authorized spending funds on “watershed and environmental improvements.” This language allowed the utility to redirect $20 million from this bond to provide the core funding for the Watershed and Environmental Improvements Program.

General obligation bonds are used to fund public projects that do not generate revenue. Such bonds are issued by municipal governments, often require voter approval, and are generally paid off through property tax increases. Because there are limits to the amount a municipality can borrow in this manner, bonds can compete with other borrowing needs. Flagstaff’s program activities are partially funded through a $10 million voter-approved general obligation bond to address pressing fire and flooding risks in watersheds surrounding the community, as well as associated setup and preparation costs (tree inventory, marking, boundary delineation, and so on).

Rate increases, surcharges, and fees: Collecting funds from water consumers is a sustainable way to either repay borrowed money or provide a steady stream of revenue for watershed management activities. Charges to water consumers can take different forms (Table 10). Two utilities in our study funded watershed investments through ongoing rate increases, and two are considering permanent rate increases that would go into effect when their bond funds are exhausted.

Table 10 | **Examples of Programs That Collect Funds from Water Consumers**

PROGRAM	TYPE OF SURCHARGE OR FEE	COST TO THE AVERAGE RATE PAYER	ESTIMATED TOTAL FUNDS MADE AVAILABLE
Central Arkansas Water (AR)	Watershed protection fee	45 cents per meter per month	$1 million per year
Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	Rate increase	Estimated $25 per household over 5 years	$16 million over 5 years
Upper Neuse Clean Water Initiative (NC)	Watershed protection surcharge	1.5 cents per 100 gallons, averaging 60 cents per month per household	$2.25 million per year

Rate surcharges and fees are typically small charges levied at either a periodic flat rate or a percent use rate. The Upper Neuse Clean Water Initiative received a permanent funding source when, in 2011, the city council authorized a watershed protection surcharge of one cent per 100 gallons, which was increased to 1.5 cents per 100 gallons in 2015, providing about $2.25 million each year for land conservation. This surcharge is clearly delineated on water bills as a "watershed protection fee" and averages about 60 cents per month per household (see Table 8 in Gartner et al. 2013 for a summary of fees collected from other utility watershed management programs in the United States).

Collecting funds from water consumers spreads the financial burden across stakeholders, and requires approval by the utility board of directors or sometimes the public. Box 10 describes how public support for watershed-related investments can play a role in voters' approval of bond measures or water user fees.

Federal funding: In all programs working primarily on federal lands, water utility investments have been matched at varying levels with cost sharing, primarily from the U.S. Forest Service and, in one case, the Bureau of Reclamation. The federal agency contribution to these agreements is typically staff time and some amount of resources to conduct forest work. In the case of the Denver Water partnership, the Forest Service committed to a 1:1 match for the watershed partnership. This

BOX 10 | LOCAL SUPPORT FOR FINANCING WATERSHED INVESTMENTS

In the programs that fund activities from municipal bonds or water use fees, water users have not pushed back on investments in watershed health. Denver Water's program and the Raleigh Water Public Utilities Department's Upper Neuse Clean Water Initiative are funded through water rate increases that appear on customers' monthly water bills. In both programs, financing was approved by the utility's governing body rather than through a public vote. Neither program conducts public outreach or education efforts beyond providing information about the watershed work they are conducting on their website and in written reports. Both report receiving minimal feedback—positive or negative—from ratepayers about the watershed protection surcharges.

Two programs in the study relied on voter-approved bond measures to finance natural infrastructure investments: the Flagstaff Watershed Protection Project and San Francisco's Watershed and Environmental Improvement Program. In Flagstaff, a group of community leaders and activists formed "Yes on 405," a political action committee to advocate for a ballot measure that funded the program through a $10 million bond. The organization mailed literature about fire and debris flow risks, including maps showing the parts of Flagstaff that could flood following a fire in the Rio de Flag watershed. In San Francisco, a similar political action committee called "Yes on A" worked to build voter support to approve the bond that funded the Watershed and Environmental Improvements Program (Sward and Finnie 2002). However, Yes on A's campaign emphasized not the benefits of natural infrastructure investments but rather the benefits of water infrastructure more broadly.

match ratio was not used for other partnerships that followed Denver Water; multiple Forest Service interviewees indicated that committing to such a level of match was more challenging in recent years because of declining agency budgets and varied priorities. The agency is finding other ways to pool, leverage and match funds at lower ratios. In some cases, staff time and the in-kind costs of projects in the watershed serve as matches to utility investment. In recognition of the need for innovative financial mechanisms to galvanize more investment in natural infrastructure for water, several federal agencies have established environmental financing centers under the President's Build America Investment Initiative (Box 11).

State funding: Watershed investment programs have been able to leverage a far broader range of funding sources to support work on privately owned lands. In Colorado, Northern Water, on behalf of the Colorado–Big Thompson Headwaters Partnership, has received grants from the Colorado Department of Natural Resources and Colorado State Forest Service to conduct fuels reduction work on private lands. This allows the partners to offer private landowners a funding match to better leverage and/or incentivize the work they are conducting on their lands.

Land trusts: In seven programs, land trusts contributed funds to watershed investments. In the Upper Neuse Basin, land trust partners were able to leverage funds from the utility by 8:1 with contributions from regional municipalities, the North Carolina Clean Water Management Trust Fund, in-kind donations from landowners, and other sources. Upper Neuse Clean Water Initiative representatives attribute this success in part to the fact that Raleigh Public Utilities provides a source of upfront funding that the land trusts can then use to apply for other grants that have matching requirements.

Funding from co-benefits: Several programs are exploring the possibility of tapping into other markets for ecosystem services to fund "co-benefits" produced by watershed investments, such as conservation of open space, improvement of wildlife habitat, sustainable timber production, and wood-to-energy markets (Box 12). In doing so, some programs are also beginning to partner with

BOX 11 | FEDERAL ENVIRONMENTAL FINANCING CENTERS

Through the President's Build America Investment Initiative, federal agencies have been tasked with finding innovative ways to finance infrastructure upgrades, with a particular focus on partnering with the private sector and promoting climate resiliency. The U.S. Environmental Protection Agency, U.S. Department of Agriculture, and U.S. Department of the Interior have each established innovative centers focused on water resource finance. The centers facilitate public-private partnerships and offer a coordinated approach to advance financial structures for a host of traditional and nontraditional water resource investments.

Water Infrastructure and Resiliency Finance Center (U.S. Environmental Protection Agency)–Identifies financing approaches to help communities make better-informed decisions for drinking water, wastewater, and storm water infrastructure that are consistent with local needs. The center encourages effective use of federal, state, and local funds and works with the private sector, where appropriate, to build partnerships to increase drinking water, wastewater, and storm water infrastructure (US EPA 2016).

Rural Opportunity Investment Initiative (U.S. Department of Agriculture)–While urban water projects are often large enough to attract financing from the capital markets, rural projects have more limited options due to their size. A top priority of the Rural Opportunity Investment Initiative is to attract new lenders and investors to rural infrastructure projects by bundling them into assets large enough to attract institutional capital. In conjunction with the Rural Opportunity Investment Initiative, the White House Rural Council announced a $10 billion investment fund to increase access to capital for rural infrastructure projects and speed up the process of rural infrastructure improvements. The new fund will allow a wide variety of new participants (including pension funds, endowments, foundations, and other institutional investors) that have not traditionally had access to these markets to invest in rural development (Office of the Press Secretary 2014).

Natural Resource Investment Center (U.S. Department of the Interior)–Will use market-based tools and innovative public-private collaborations to bolster the Department of the Interior's resource stewardship mission. The three major goals of the center are to: (1) increase investment in critical water infrastructure, (2) increase investment in water conservation and build up water supply resilience in the western United States through water markets, and (3) foster private impact investments and support well-structured markets that advance efficient permitting and conservation of natural resources (US DOI 2016).

conservation groups interested in forest protection and management in order to align activities, engage diffuse stakeholders, and multiply program impacts. To date, very few programs have succeeded in tapping into other ecosystem markets.

The Pinchot Institute, on behalf of the Delaware River Common Waters Fund, has partnered with the Environmental Finance Center on its Delaware River Watershed Innovative Financing Strategy Project to identify innovative and scalable options for financing Delaware River watershed restoration and protection efforts. Funded by the William Penn Foundation, the project convened a financing panel to explore opportunities to engage private capital and the private sector in medium- and long-term financing options. The panel is also investigating potential roles for impact investors, the recreation community, and storm water dischargers (EFC n.d.).

In Colorado, some areas with marketable timber are looking for additional revenue streams by selling wood products to mills. While this is occurring in the Colorado–Big Thompson Headwaters Partnership, it is either a financially unviable option, or it results in a slim profit margin (when considering costs of treatments with income from resulting timber products), particularly on the eastern side of the Rocky Mountains.

Emerging financing mechanisms and investors

Several innovative financing mechanisms and investors are now beginning to enter the watershed investment scene; these were not well captured in the 13 programs studied. Beyond water utilities and government agencies, corporations are showing increased interest in collective-action watershed programs. In many cases, the private sector requires a greater certainty and quantitative understanding of return on investment than has been required by program backers to date. Demonstrating returns on investment will be necessary to shift corporate watershed financing from philanthropic donations to part of a water security strategy and, more generally, to mainstream and scale-up watershed investment programs. Recognizing this need, WRI is working with a range of partners to develop innovative financing mechanisms, with a focus on mechanisms that provide a return on investment, described below.

BOX 12 | WOOD-TO-ENERGY MARKETS

In order to improve the health of forests and reduce catastrophic fire risk, a large volume of forest biomass needs to be removed that is currently of no or extremely low commercial value for traditional wood-based products (e.g., small diameter, disease and insect-killed, slash, and noncommercial species). Currently the byproduct material from forest restoration operations is stacked, dried, and eventually burned in place. The lack of commercially viable markets, combined with the high cost associated with biomass removal, severely hampers forest restoration efforts at scale. However, recent innovations and pilot testing with distributed wood-to-energy markets may provide an economic outlet for these no- or low-value materials, enhancing the financial viability of fuel reduction projects and watershed restoration (Harper 2014a).

Specific initiatives exist to stimulate these wood-to-energy markets. Examples include the following:

- **The Wood-to-Energy Joint Venture I**, spearheaded by the U.S. Forest Service and the U.S. Endowment for Forestry and Communities, runs a competitive grant program to move biomass energy technologies from laboratories to the field, while also building commercially viable and environmentally sustainable models of procuring woody biomass (U.S. Endowment 2014).
- **The Consortium for Advanced Wood-to-Energy Solutions**, a partnership led by the U.S. Endowment for Forestry and Communities, the U.S. Forest Service–Forest Products Laboratory, and Georgia Southern University's Herty Advanced Materials Development Center researches and evaluates the potential of advanced wood-to-energy solutions. The partnership is currently focusing on advancing the technology of torrefaction, a thermochemical process that could enable wider distribution of biomass-based fuels derived from no- or low-value forest restoration byproducts. The partners are establishing an open-platform approach to both research and applied commercial operations of torrefaction, and setting up two "living laboratories" to produce commercial quantities of torrefied material (Harper 2014a).

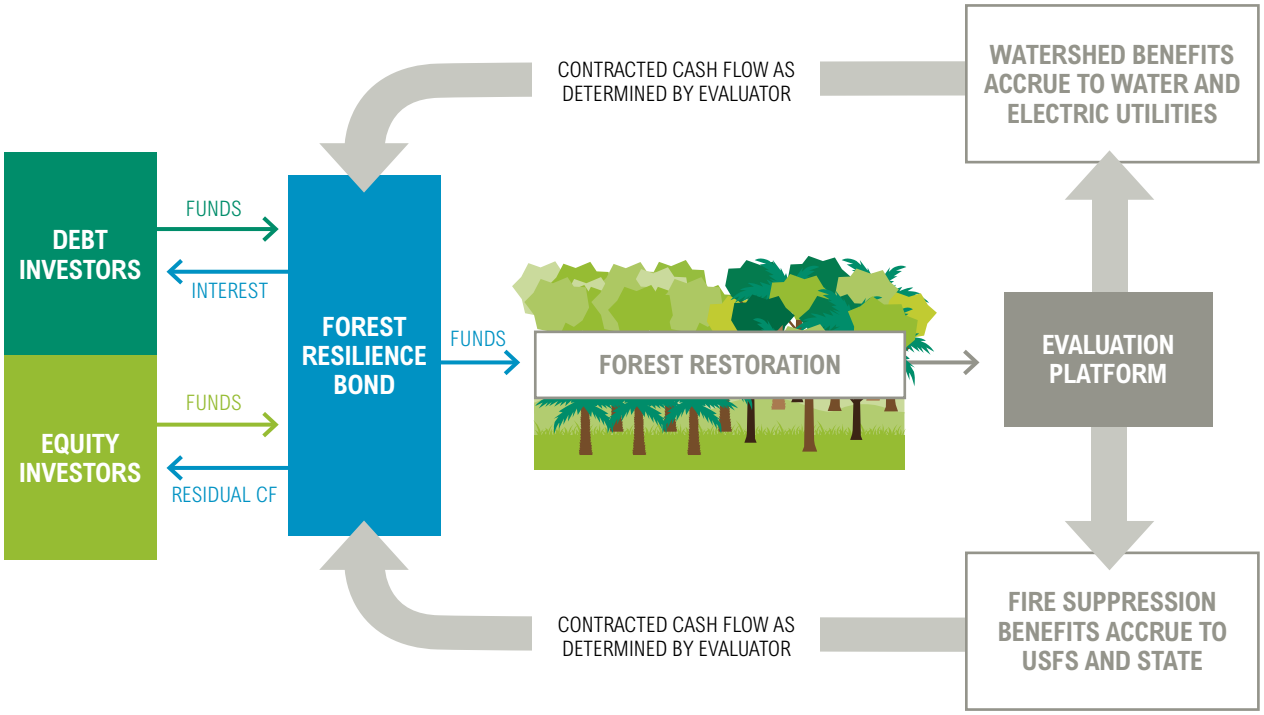
If these and similar initiatives are successful in demonstrating the commercial viability of emerging wood-to-energy technologies and business models, the biomass market could become an important additional revenue stream for watershed investment programs that focus on forest restoration.

Corporate investors: Corporate investors are demonstrating how natural infrastructure bolsters corporate performance. For example, in 2013, the beverage company Anheuser-Busch InBev announced a strategy to engage in watershed protection measures at all of its facilities located in seven countries over five years (AB InBev 2013). Coca-Cola, SAB Miller, and other beverage companies have taken similar measures to protect source water (Bennett and Carroll 2014; Ozment, Ranganathan, and Reig 2015). While funding from food and beverage companies currently represents a small portion of watershed investments in the United States and globally, these companies' commitments have been proven internationally—The Nature Conservancy reported that 15 companies are contributing to TNC-led watershed investment programs in Latin America (TNC 2012). The private sector represents a high potential area for increased engagement with U.S.-based watershed investment programs as well.

Green bonds: Along with conventional municipal bonds, specialized "green bonds" are gaining traction in financing cities' water infrastructure needs. These bonds offer financial returns and positive environmental outcomes. For example, in 2014, the District of Columbia Water and Sewer Authority had little trouble selling $350 million in 100-year green bonds (Cherney 2014) and in May 2016, the San Francisco Public Utilities Commission issued the world's first green bond for water infrastructure certified by the Climate Bonds Initiative (Cox and Whiley 2016). Similar to the DC green bond, proceeds from the San Francisco $240 million Wastewater Revenue Bond will primarily fund built infrastructure. However, there is growing interest in expanding the use of green bonds for natural infrastructure. Led by the Climate Bonds Initiative, a group of experts, including WRI, is developing criteria that distinguish between built and nature-based water investments, which can be used to back green and climate bonds certified under the Climate Bond Standard.

Further, to help build needed frameworks, partnerships, and know-how to issue green bonds for natural infrastructure, WRI and partners were awarded a $500,000 Conservation Innovation Grant in 2015. This project connects investors, utilities, water-dependent companies, municipalities, landowners, and environmental groups to build replicable templates and processes that unlock private-sector financing for conservation, restoration, and enhanced stewardship on America's farms, forests, and ranches. Project partners include the American Water Works Association, the National Association of Clean Water Agencies, Nestlé Waters North America, the Rockefeller Foundation's 100 Resilient Cities, Troutman Sanders, the U.S. Endowment for Forestry and Communities, and the Conservation Finance Network.

Figure 5 | **The Forest Resilience Bond**



Source: Blue Forest Conservation (2016)

Forest Resilience Bond: The Forest Resilience Bond, under development by Blue Forest Conservation in partnership with WRI and Encourage Capital, will provide an additional investment platform to deploy private capital to protect forests and communities in the western United States from drought and wildfire. The Forest Resilience Bond will deploy capital from cost-share payments and pay-for-performance contracts from utilities, companies, and federal land-management agencies to fund proactive forest restoration for protected water quality, avoided sedimentation, and other water benefits (BFC 2016). Figure 5 depicts the expected flow of transactions and outcomes from the bond. Partners are aiming to launch an initial pilot effort in 2017. While the initial focus of the Forest Resilience Bond is on National Forest System land, broadening partnerships with groups such as the American Forest Foundation offers the Forest Resilience Bond team the opportunity to access private landowners and to more closely follow the USDA's call for an "All Lands Approach" to conservation.

These emerging financing mechanisms and investors are setting the stage for the next phase of scaling up natural infrastructure. Establishing the scientific and economic justifications for watershed investments enabled the programs we studied to obtain financial backing through a variety of means. Achieving sustainable long-term funding for watershed investment programs and attracting additional investors will likely require programs to further demonstrate and quantify the value of their programs. During the design phase, programs must establish a business case for investment and develop a plan for initial and long-term financing, taking into consideration the new, emerging financing mechanisms and investors. A scientific and economically viable plan places the program in a favorable position as it moves into the implementation phase.

Phase 3: Implementing the Action Plan

PHASE OF PROGRAM DEVELOPMENT	DESCRIPTION	LESSONS
Implementing the action plan	Actively and adaptively managing the program to make investments; tracking the results of those investments	8. Engage landowners and public managers to conserve, restore, and sustainably manage natural infrastructure 9. Define roles and plans for program administration 10. Monitor and evaluate performance

8. Engage Landowners and Public Managers to Conserve, Restore, and Sustainably Manage Natural Infrastructure

Because watershed investment programs are voluntary, landowner buy-in and commitment are essential to success. Landowners operating in high-priority areas (lands with the greatest potential to impact downstream water supply) may include small-scale private non-industrial forest landowners (especially in the eastern United States); federal or state agencies (administering national forests, state forests, and the Bureau of Land Management land especially in the western United States); or companies (forestry and real estate companies or other companies with significant landholdings).

Interviewees agreed that there is an important distinction between working with public landowners and private landowners: public lands engagement often focuses on administrative needs (e.g., formulating written agreements and complying with regulations and public commenting), while private landowner engagement involves building trust and buy-in. When working across both land types, programs need to keep both realities in mind, while also dedicating time to planning to accommodate the strategic needs of both land types.

Five programs focused solely on public lands, three solely on private lands, and five on both landownership types. Programs approached field implementation in various ways depending on whether they were targeting public or private lands.

Working on private lands

On private lands, landowners implement forest treatments or easement protections to put the watershed management plan into action.

Motivating participation and coordinating efforts across many landowners is complex and difficult, but it is critical for program success. Research shows that private landowners are most open to participating in flexible programs that offer customized participation options and are designed to appeal to the interests of the community (Cantor et al. 2013; Sorice 2013; Sorice et al. 2013; Van Vugt 2009). Compensation for landowner participation may be either financial or in-kind, in the form of technical assistance, certification, or awards that recognize good stewardship.

The programs we studied reported similar experiences in private landowner engagement—they developed assessment frameworks to determine which landowners to target, they worked through existing partnerships with land trusts and other local organizations, and they demonstrated the program benefits to build interest. These approaches are discussed below.

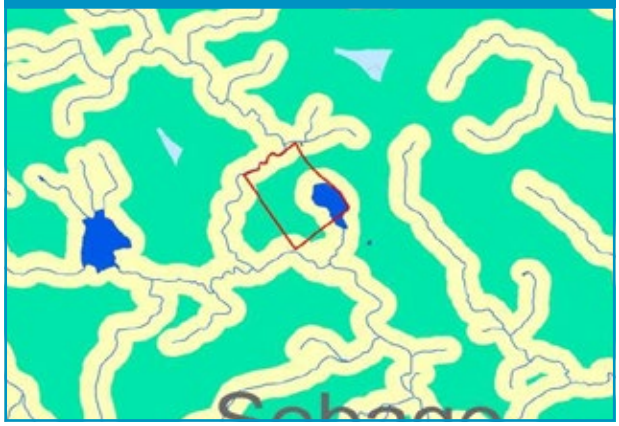
Identifying priority landowners and determining eligibility

In some cases, programs used conservation easements as a tool to protect forests and therefore had to determine the desirability and eligibility of lands for easement programs. In order to connect source water protection targets with the daily operations of the program, three programs have developed formal processes to evaluate proposed conservation easement purchases (the Upper Neuse Clean Water Initiative, the San Francisco Alameda Upper Watershed Partnership, and the Portland Water District). For example, the Portland Water District has developed a "Site-Specific Assessment" tool to systematically recommend funding levels based on a parcel's spatial prioritization ranking and on other factors, including percent forest cover, wetlands, and proximity to aquifers (Figure 6).

Figure 6 | Prioritizing Forest Parcels for Watershed Investment: Portland Water District's "Site-Specific Assessment" Tool

Portland Water District's "Site Specific Assessment" Tool (pictured below) gauges the watershed value of a given property by mapping the parcel and surrounding areas' significance to land use trends, aquifer, and wetlands. This assessment enables program partners to determine if and to what extent a parcel of forest could contribute to program aims, and guides the investment decision.

LOCATION MAP



	acres	percent
Prioritization zone 1	72	48
Prioritization zone 2	78	52
Prioritization zone 3	0	0

LAND COVER MAP

	acres	percent
Forest cover	57	38

AQUIFER MAP

	acres	percent
Forest cover	150	100

WETLANDS MAP

	acres	percent
Forest cover	93	62

Source: Maps courtesy of Paul Hunt.

These environmental assessments and tools capture the ecological dynamics that must be understood if watershed investments are to be effective. Investments must also be informed, however, by the economic and social realities of the local context. While spatial prioritization of forest parcels is a good starting point, understanding forest owners' needs and desires, as well as the cultural acceptability of different practices (e.g., prescribed burns or forest thinning), is important for designing investments and agreements that serve watershed investment programs and landowners alike.

Cultivating an intermediary

Interviewees widely cited the need for an intermediary to act as go-between, connecting program investors with the private landowners targeted for engagement. An intermediary can help mitigate a program's transaction costs by assuming responsibility for individual negotiations, contract development, administration of payments and, in many cases, compliance monitoring and enforcement. Furthermore, in the cases of the Portland Water District and San Francisco Public Utilities Commission, the water providers noted that they have more traction with potential participants in areas of their watersheds where their local land trust partners have preexisting relationships with private landowners. The role of such intermediaries is often filled by NGOs that can act as strong bridges linking federal and state agencies, private businesses, and individuals, such as private landowners.

Demonstrating the benefits, then scaling up

Building trust among landowners relies not only on having a credible intermediary to facilitate contact but also on a proven track record of delivering benefits to the landowner. Depending on program design, these benefits may include monetary compensation, technical assistance, in-kind donations of equipment or supplies, and sustained or improved forest productivity or progress toward habitat management goals. Communicating program benefits to landowners can be challenging at the inception of a program—but practitioners have identified strategies to overcome this potential barrier.

Demonstration projects on a willing landowner's property can show the benefits of participating in the program to other landowners. Some programs noted that the first landowners to participate in watershed investment programs later shared their experiences with other landowners, demonstrating the benefits of the land management actions (e.g., tree thinning or easement protections) and motivating additional landowner participation through field trips and meetings that allow landowners to discuss these benefits. In Colorado, the Colorado–Big

Thompson Headwaters Partnership has supported the creation of demonstration projects to engage private landowners. In one case, many members of an association of private landowners in a heavily forested portion of the watershed were hesitant to thin their trees to reduce fire risk. According to interviewees from the Colorado–Big Thompson Headwaters Partnership, funding obtained by Northern Water for work on private lands helped the State Forest Service create a demonstration thinning project in the area of the forest in question. The demonstration project and outreach events have engaged more landowners in forest thinning work on their properties.

Working on public lands

In the six programs that target source water protection efforts solely on state and federal lands, complying with regulations was a key factor in landowner engagement and program implementation. Programs reported that complying with federal land management regulations required significant coordination and administration between government and nongovernment partners. Interviewees highlighted some approaches that could ease the administrative process, including determining up front if work would be done on acres still requiring National Environmental Policy Act (NEPA) (and if so, how to fund and conduct the assessment work), aligning partnerships goals and priorities within the structure of the MOU, and communicating to stakeholders early on that the NEPA process will take time and commitment, so partners are well-prepared. This section discusses each of these suggested approaches.

Environmental planning with the National Environmental Policy Act

Work on public, federally managed lands must comply with the National Environmental Policy Act (NEPA) of 1969. NEPA requires federal agency decision-makers to consider environmental factors when planning any major federal action (Bass, Herson, and Bogdan 2001; NEPA 1970) and to assess the environmental impacts of the proposed actions.

Often, the U.S. Forest Service has a backlog of projects awaiting environmental assessment and a limited budget with which to conduct these analyses. When water providers or other partners fund the staff time or contractors needed to conduct NEPA assessments, it can help speed the process, resulting in more NEPA "shelf stock" (projects that have already gone through NEPA and are ready to be implemented). Funding for NEPA presents an obstacle for the U.S. Forest Service, particularly in budget cycles where fire suppression and response dominate fund allocations. As one agency employee explained, "The issue at this point in

time is not the actual NEPA process existing, it is just the funding of it. . . . We actually have more on-the-ground project money, treatment money, than we do NEPA [money]."

Managers of the Coconino National Forest have been able to accelerate the NEPA process and take better advantage of the window of opportunity in public awareness through increased agency support, including reprioritized staff time to the NEPA process. Additional factors that are contributing to the U.S. Forest Service's ability to quickly complete the NEPA process in Flagstaff include a dedicated team, a project coordinator, and district specialists who work well together.

In the Aurora Water–U.S. Forest Service and Colorado Springs–U.S. Forest Service partnerships, water providers have allowed some of their partnership funding to be used toward NEPA planning and analysis in order to support large-scale NEPA analysis and staff time needed for environmental analysis prior to forest management actions. In Santa Fe, the city funded a contractor to complete the necessary NEPA studies in a designated wilderness portion of the forest, while other partners worked to educate the community about smoke and controlled burns so that the NEPA process could progress smoothly.

Formalizing federal agency partnerships

Before projects can be implemented on federal lands, formal partnerships such as MOUs and collection agreements must be signed and approved. Federal agencies use MOUs to formalize partnerships; the MOU lays out a framework of shared interests and defines what the project partners seek to accomplish together. MOUs have a 5-year life, after which they must be renewed. MOUs define the relationship, shared vision, and goals between federal agencies and water providers in the Colorado, Santa Fe, Flagstaff, and San Francisco cases.

Interviewees from the U.S. Forest Service described how finalizing the partnerships and setting mutual goals through MOUs have helped set the stage for larger and longer-term investments, build upfront understanding and trust among all parties, and create more sustainable flows of money to even out agency workflow. These longer-term funding agreements are necessary for the agency to be able to plan staff, resources, and management actions appropriately. Institutionally, it is helpful for the U.S. Forest Service to know the levels of funding it will receive from partnerships (such as those with utilities) so it can plan accordingly and determine resources needed for items such as administrative staff, partnership coordination, NEPA, seasonal

employment, and work on the ground. The funding from these partnerships has allowed national forests in the region to increase the scope and scale of work, and to shorten time frames on certain projects. Creating multiyear project plans and adjusting these plans annually for each partnership has helped water providers incorporate partnership investments in their annual and long-term budgets. It also has helped the national forests integrate partnership funds and objectives into their annual programs of work.

Collection agreements are crafted each year and detail the type and quantity of work to be conducted to align with the MOU, as well as anticipated costs, timing, and amount of funding from project partners. Because MOUs do not authorize the giving or acceptance of funds, collection agreements are critical to facilitating implementation. Collection agreements also include specifics on staff time and other expenses at the forest and district levels that are directly connected to project implementation. The U.S. Forest Service and water providers are still reconciling their preferred methods of billing and administration for collection agreements, as the agency and water providers all use different systems, which can cause delays in payment or unpredictable billing cycles.

Considering the similarities between many watershed investment programs, it's helpful for programs and agencies to make their MOUs and other agreements available for others to use as templates. Avoiding the need to create new agreements from scratch for every partnership can save significant time and money.

Working across public and private lands

Five programs we studied work across both public and private lands. For example, the Colorado–Big Thompson Headwaters Partnership began on private lands while partners pursued approval of projects on federally managed lands. The partnership continues to dedicate significant time to planning, to ensure that it meets all partner goals. Since we began our research, other programs, particularly Denver Water, have expanded from their original scope and begun to focus on watershed treatments on private lands.

The "all lands approach" recognizes the value of public and private forests that function as a landscape across property boundaries. It encourages public forest managers to collaborate with multiple stakeholders to assess landscape-level threats and opportunities to forest health and management.

The U.S. Forest Service already strives to align forest management plans with local and regional non-federal landscape management activities. Recognizing that the threats to national forests span property boundaries, the Forest Service has promoted an "all lands approach" to the national forest system planning process in order to better consider how management plans can contribute ecologically, socially, and economically to the broader landscape. The "all lands approach" recognizes the value of public and private forests that function as a landscape across property boundaries. It encourages public forest managers to collaborate with multiple stakeholders to assess landscape-level threats and opportunities to forest health and management, and to take regional data and the perspectives of local private, state, and tribal forest owners into account when developing management plans. The Forest Service therefore is open to collaborating with watershed investment programs when it advances its mission.

9. Define Roles and Plans for Program Administration

Once the program is up and running, an implementation structure must be put in place. Program administration requires frequent decisions and activities, ranging from setting annual work plans to evaluating projects and determining the size of investment, and from contracting with participating landowners to overseeing the program's operating budget. As collaborative partnerships, watershed investment programs often leverage staff time and expertise across multiple organizations to manage and administer the many demands of budgeting, partner engagement, communications, landowner recruitment, contractual agreements, performance monitoring, and other activities.

Interviewees generally agreed that successful program management and administration must include securing staff time and resources for program oversight, as well as formulating an efficient decision-making process that can adapt over time. Beyond that, these programs have adopted such a diverse range of systems for management and administration that only a few patterns emerge. Some notable processes that programs have adopted are discussed in this section.

Formulating decision-making processes

For multi-partner, collaborative programs, an important ingredient in program implementation is devising an efficient decision-making structure where stakeholders share power. Interviewees from the San Francisco, Flagstaff, Santa Fe, and Colorado partnerships indicated that defining a process for outlining activities and responsibilities has helped clarify expectations and roles. Eight programs reported using an annual goal-setting and project-planning process to set near-term work plans while staying focused on long-term goals. Programs have adopted widely varying decision-making processes depending on their individual context.

In Flagstaff, partners coordinate through a multi-committee structure that includes an executive committee, a city bond team, and a communication team. The executive team includes a wildland fire management officer, a city manager, a fire chief, a U.S. Forest Service district ranger, the U.S. Forest Service Flagstaff Watershed Protection Project manager, a State Forestry District forester, the county manager, a U.S. Forest Service lead, and the Arizona State project lead. The executive committee meets monthly to review upcoming work. The city bond team involves the fire, finance, and legal departments and the city manager; it oversees the allocation of dollars and managing agreements.

Both the Upper Neuse Clean Water Initiative and the Portland Water District have developed multi-stage processes to evaluate proposed conservation easement purchases on private lands. In the Upper Neuse, easement purchases are initiated by the initiative's land trust partners, who use the watershed prioritization to identify parcels and begin negotiations with landowners. Once a parcel or easement has been identified for purchase or donation and the landowner has agreed, the land trust develops an initial proposal, which is evaluated by a nine-member project review team consisting of the Conservation Trust for North Carolina, Raleigh Public Utilities, and state and local government representatives. The executive committee draws on this evaluation to approve or deny the proposal. The Raleigh City Council must also approve proposals that pass this initial stage. Following approval, the land trust completes the transaction and bills the Conservation Trust for North Carolina for the portion that the initiative funded. The Conservation Trust for North Carolina in turn bills the City of Raleigh. Once purchased, easements are typically held and monitored by the land trusts.

Securing staff time and resources for watershed investment programs

While program partners may feel a need to dedicate as many funds as quickly as possible to watershed management projects, program administration costs must also be covered. Staff are needed for the many administrative tasks, including coordinating with partners and local land trusts, processing invoices, shepherding new projects through approval processes, communicating with and educating the public, and searching for funding opportunities.

All the programs reported having staff formally dedicated, at least part-time, to the program, averaging about three dedicated staff (full-time equivalent) per program. Five programs reported at least one full-time staff person dedicated to managing their program.

Interviewees indicated that the majority of staff administering these programs is housed within NGO partners such as The Nature Conservancy or local land trusts. However, five water utilities reported that they formally dedicate some of their own staff time to managing their watershed investment program. Central Arkansas Water has created the most full-time positions of any utility in this study, with a team of three specialists dedicated to the program. Also, the utility is currently incorporating program responsibilities into positions in other departments.

Government agency staff time was also cited as critical to day-to-day program management. The U.S. Forest Service has created two positions to help manage the agency's side of the Colorado partnerships, one at the regional level and one at the national forest level. Both positions represent key capacity improvements for the agency's role in these partnerships. The regional position is part-time and is dedicated to facilitating agreements and administrative components of programs with utilities, including communication and reporting on the High Profile Partnerships (which includes the five watershed protection plans in Colorado). The national forest position, partnership coordinator, works on watershed protection plans and other agency partnerships, conducts day-to-day communication, and supports partnership development and communication.

Across the board, interviewees noted serious constraints in dedicating sufficient staff time to managing watershed investment programs. Several water provider employees noted that they have other responsibilities within their organizations; most of these individuals were existing staff members who were assigned partnership work as an additional task. Evaluating employee performance in partnership efforts can be challenging, especially in early stages before outcomes can be measured.

10. Monitor and Evaluate Performance

To ensure a program's long-term success, monitoring and evaluation should be designed at the outset and adapted over time. Many interviewees indicated that monitoring and reporting outcomes are important for setting expectations and communicating success to stakeholders. This can help to create buy-in among program partners and to secure significant and long-term program funding. Examples include the following:

- ***The public:*** To respond to the concerns and priorities of city residents who approved public funding for watershed investments, the Flagstaff Watershed Protection Project monitors three focus areas identified with community input: impacts on catastrophic fire risk; impacts on sedimentation and water quality in drinking water reservoirs; and socioeconomic factors, including dollars spent and impacts on public awareness and support for restoration treatments. Partners have produced a publicly available monitoring plan, which is featured on the program's website (FWPP 2015).
- ***Investors***: Colorado utilities highlighted the importance of monitoring in justifying program funding. These utilities monitor watershed investment project sites and share pictures of completed projects with their board of directors and decision-making bodies to demonstrate successful work on the ground. Denver Water and Colorado–Big Thompson Headwaters Partnership also noted that clear performance indicators appealed to investors by communicating success in terms of avoided costs and reduced risks to water utilities, rather than watershed restoration more generally.

While most programs agreed on the importance of monitoring and reporting program outcomes, their performance metrics and monitoring protocols varied considerably (Table 11). The degree of government involvement influences some monitoring practices. For example, in Colorado, New Mexico, and Arizona (programs on public lands), the U.S. Forest Service conducts contract administration reporting using standard parameters such as the location, type, and acreage of treatments implemented to ensure that projects are completed as expected. The Forest Service then reports this

Table 11 | **Watershed Investment Program Performance Metrics**

	PROGRAM	ECOLOGICAL METRICS	ECONOMIC METRICS	MONITORING ORGANIZATION
Eastern United States	Central Arkansas Water (AR)	■ Acres acquired ■ Water quality (discharge, temperature, dissolved oxygen, pH, turbidity, suspended sediment)	Currently none (plans in place to measure program's return on investment over the next 2–3 years)	Central Arkansas Water, U.S. Geological Survey
	Delaware River Common Rivers Fund (DE)	■ Formal monitoring system not yet in place, although water quality variables of interest include quantity, nutrients, temperature, conductivity, and salinity	Number of grants made, total dollars provided to private forest owners	N/A
	Portland Water District (ME)	■ Drinking water quality	Cost of conservation easements	N/A
	Upper Neuse Clean Water Initiative (NC)	■ Miles of streambanks protected ■ Storm event sampling ■ Fish monitoring ■ Drinking water quality	In progress—a technical advisory committee has been convened to better model the water quality impacts of conservation easement purchases and to better estimate the investment needed to avoid increased water treatment costs	Upper Neuse Clean Water Initiative and Raleigh Public Utilities
Western United States	Flagstaff Watershed Protection Project (AZ)	■ Hazardous fuel loads monitoring ■ Reservoir level and tributary flows monitoring ■ Post treatment fire behavior modeling	Contract administration monitoring	U.S. Forest Service and Greater Flagstaff Forests Partnership
	San Francisco Public Utilities Commission Watershed and Environmental Improvement Program (CA)	■ Acres acquired ■ Amphibian and fisheries surveys ■ Sediment transport ■ Water temperature	Funds leveraged, dollars spent	San Francisco Public Utilities Commission
	Aurora Water–U.S. Forest Service Watershed Protection Partnership (CO)	■ Acres treated for fire risk ■ Restoring acres recovering from fire to reduce reservoir sedimentation and erosion ■ Acres of NEPA analysis	Contract administration monitoring, dollars spent	U.S. Forest Service
	Colorado–Big Thompson Headwaters Partnership (CO)	■ Acres treated for fire risk ■ Restoring acres recovering from fire to reduce reservoir sedimentation and erosion	Contract administration monitoring, dollars spent, fire hazard mitigation effectiveness	U.S. Forest Service, Colorado Forest Restoration Institute
	Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership (CO)	■ Acres treated for fire risk ■ Restoring acres recovering from fire to reduce reservoir sedimentation and erosion ■ Acres of environmental analysis and wildlife surveys	Contract administration monitoring, dollars spent	U.S. Forest Service
	Denver Water–U.S. Forest Service Watershed Protection Partnership (CO)	■ Acres treated for fire risk ■ Restoring acres recovering from fire to reduce reservoir sedimentation and erosion	Contract administration monitoring, dollars spent, fire hazard mitigation effectiveness	U.S. Forest Service, Colorado Forest Restoration Institute

Table 11 | **Watershed Investment Program Performance Metrics (continued)**

	PROGRAM	ECOLOGICAL METRICS	ECONOMIC METRICS	MONITORING ORGANIZATION
Western United States	Pueblo Board of Water Works–U.S. Forest Service Watershed Protection Partnership (CO)	■ Acres treated for fire risk ■ Restoring acres recovering from fire to reduce reservoir sedimentation and erosion	Contract administration monitoring, dollars spent	U.S. Forest Service
	Rio Grande Water Fund (NM)	■ Acres treated for fire risk ■ Restoring areas damaged by fire ■ Acres of restored streams	Funds raised, created, cords of firewood produced	The Nature Conservancy and fund advisory board (tracking fundraising and applications to the fund)
	Santa Fe Municipal Watershed Investment Program (NM)	■ Acres treated for fire risk and restored from fire damage ■ Water quality and restoration monitoring ■ Fire breaks added to watershed	Contract administration monitoring	U.S. Forest Service

standard information to water utilities that invest in watersheds.

Many interviewees explained that they face challenges in linking forest treatments to drinking water quality outcomes. Since the ecosystems in which watershed investment programs work are complex and dynamic, estimating the change in in-stream turbidity and nutrient levels due to environmental stewardship activities often cannot be done with precision. While best available science generally offers clarity on the *trend* of impact of given management intervention, the precise *marginal* impact is inherently variable, especially when dealing with heterogeneous forested systems across a watershed.

Interviewees expressed concern that this uncertainty poses a barrier to mobilizing further watershed investments from current and potential funders. In order to strengthen the linkages between forest management and water quality, many programs in this study are developing new approaches to program monitoring and evaluation and engaging scientific research institutions. Some programs have built on their monitoring programs by adding computer modeling components that estimate water quality improvements from program activities. These models can account for a portion of the inherent variability that exists in ecosystems and are increasingly reliable predictors of the outcomes of forest management practices.

Other programs stated that proxies offer a sufficient measure of progress for the time being, relying on expert opinion, scientific literature, and the use of conservative assumptions. For example, the Portland Water District measures progress in terms of acres under contract, because water quality is already high and the goal of the project is to protect current quality.

Depending on the environmental, social, or economic issues of importance to stakeholders, programs may choose to measure performance of other ecosystem services. Often, the protection or restoration of forestland not only secures water-related ecosystem services but also enhances habitat, carbon sequestration, fish populations, or other services. In other cases, managing forests as natural infrastructure may diminish the value of important ecosystem services, like revenue from timber harvest or acres where outdoor recreation can occur. These synergies and trade-offs should be tracked and reported as well as possible, in balance with the program's main priorities. Financial models are still needed to forecast the impacts of land-use change on water quality and better connect those financial impacts to the needs of different sectors and water users who rely on water quality. Program stakeholders expected that going forward, the public and government entities are likely to demand more direct evidence of programs' economic benefits.

Conclusions on Watershed Investment Program Development

This discussion provides an evaluation of the 13 case studies for the insights and guidance they can offer on watershed investment programs. It also recommends actions to overcome some prevalent and persistent challenges.

Consistent with other studies (Bennett and Carroll 2014; Gartner et al. 2013; Huber-Stearns et al. 2015), our comparison of cases suggests that a new viable model of drinking water management has emerged in response to growing environmental threats. While most of the 13 programs featured in this study are relatively young, they have already successfully demonstrated watershed protection activities, justified their programs to investors, and built meaningful partnerships across sectors. Adding to the well-studied examples of New York City, Boston, and other historic watershed investment programs (Postel and Thompson 2005), these watershed investment programs share the following characteristics:

- Uniting people across sectors and geographies around a goal of securing water supply through healthy watersheds.
- Targeting behavior changes in land use and land management, with the understanding that environmental and climate trends pose serious threats to water supply.
- Expanding the scope of water risk management to consider the hydrological functioning of a watershed and building connections between urban centers and rural forestlands.
- Applying science and technology to educate stakeholders, guide decisions, and quantify the multiple impacts of their efforts.
- Offering a business rationale and thoughtful evaluation of watershed management options that can be monitored and evaluated with regard to stakeholder benefits.

Clarifying a Pathway for Watershed Investments

As one of the first comparative studies examining the strategies leading to watershed investment program growth in the United States, this report collected and synthesized new data on program dynamics, partnership structures, challenges, and aspirations. The fact that program staff identified the 10 lessons cited in this study despite differences in program size, location, and other factors suggests that these issues may apply generally across the country.

One of the most common threads among the lessons identified in this study is that **building momentum** and enabling the convergence of ideas among disparate groups takes an immense effort. The programs we studied have poured much of their effort to date into gaining buy-in from stakeholder groups and setting a course for their program. Across the board, study participants consider partnership building to be one of the most important and immediate benefits of the programs. These programs have successfully linked downstream water users like water utilities with upstream land managers such as the U.S. Forest Service and private forest owners to work jointly toward improved watershed management. And, as these programs grow and new and larger audiences are engaged, presenting a clear engagement message and vision for the watershed is likely to remain an essential element for success.

While all the programs tried to build a shared vision of success, they also struggled to describe just how their program would create meaningful change across a massive landscape in a way that recognized scientific uncertainty and aligned the interests of multiple stakeholders. Yet, without a clear vision of success, building a strong partnership, designing an effective program, and monitoring program performance can be challenging. Questions that programs may consider when developing and refining their visions of success include the following:

- How will the program impact the watershed and what will the watershed look like if the program is successful?
- Does the vision entail clear, measurable results?
- Is the vision based in a clear understanding of the best available science?
- Does the vision unify the distinct voices of all partners?

To build and refine a vision of success, it is important for programs to test ideas with peers and experts to solicit feedback. Program partners can practice articulating their own progress and success, and discuss how others can replicate it. Partners could present at conferences, engage in social media, or tap into traditional media outlets. They can also collaborate with other watershed investment programs.

In the **design phase**, the programs depended on applied science and technology to guide decision-making and plan interventions with high potential for positive impact. These tools also helped the programs engage stakeholders, including investors and regulators who may focus on the direct outcomes of program activities. These programs have provided evidence that investing in working landscapes can be a low-cost alternative or complement to built infrastructure options, while also increasing resilience to water-related climate changes impacts, both upstream and downstream.

A state of watershed investments report (Bennett and Carroll 2014) found that the biggest challenges facing the establishment and growth of watershed investment programs worldwide are lack of buyers, managing funds (in part due to unpredictable funding sources), and raising capital. The programs in this study echoed these challenges, often explaining that key decision-makers, be they potential partners, policymakers, or potential investors, are not yet convinced that watershed investment makes sense for them. Therefore, it seems that building a business case, and measuring against it, is key to overcoming some of the most existential challenges these programs face.

Questions that potential investors may ask to determine whether these programs are smart risk-reduction strategies include the following:

- What are the water supply risks caused by watershed degradation?
- How can I be certain that the program will address these risks?
- How much will it cost?
- What benefits can I expect in return if I invest?
- What are the factors of uncertainty and how can they be factored into decision-making?

In addressing the need for an economic and social evidence base, programs are challenged to select an appropriate analytic approach. Indeed, a potential investor's objectives will influence the type of study that is chosen. Are the investors interested in minimizing the costs of their operations (in which case a cost-effectiveness study might be most suitable), or are they interested in maximizing the social benefits of a planned and approved investment (in which case social benefit assessment and valuation of multiple ecosystem services might be more appropriate)? Answering these questions can bring new legitimacy to natural infrastructure, and can help shift the model from mainly philanthropic donations to strategic core investments that are likely to be larger and sustained over time.

In the **implementation phase**, while their cumulative impacts are not yet fully understood, these programs have offered significant water, wildlife, recreation, climate, and rural economic development benefits to communities. Even so, programs face ongoing challenges with monitoring and evaluating program performance, especially in terms of quantifying the water benefits of program activities. In fact, it seems that in more cases than not, there is a mismatch between the impetus of the program as a viable water security strategy and concrete evidence of results. Most programs do not track water quality and attribute it to program activities, owing to technological and cost constraints. As monitoring improves, it may be possible to shift to a "pay for performance" model, where water utilities and other beneficiaries pay for real, verifiable hydrological outcomes. Until that shift is possible, programs must emphasize the inherent variability of impacts and uncertainty of the science, while also promoting an understanding that these programs set stakeholders in the direction of safeguarding water supplies against environmental threats.

Leveraging achievements from other programs, like those cataloged in our case studies, is one way to make the case for action despite the imperfect ability to predict the hydrological impacts of watershed investments.

Programs need funding sources that support monitoring and communications. These activities not only help guide a program's efforts to optimize impact but also can multiply the impact of an investment by transferring knowledge to other programs, allowing them to overcome similar challenges.

While many of these programs have set a course for success over the past 3 to 6 years, they will face a new set of challenges in the future, especially around **maintaining and scaling up the program** to achieve results. Aside from some programs operating in smaller watersheds (Santa Fe, Flagstaff), programs face a common challenge of scaling up so that they are impacting enough land and engaging enough stakeholders to have a meaningful impact at a watershed scale. They may run into challenges regarding accessing greater amounts of funding, as well as working across public and private lands, as their activities expand. At the same time, programs face a wide range of risks to their existing funding—programs dependent on government funds face diminishing non–fire suppression budgets and other trade-offs. Those dependent on grants will likely run into funding cliffs as they mature. And programs leveraging water utility or municipal funding sources face a challenge of demonstrating results and proving that investors are getting a return on investment. In the face of these challenges, broad partnerships are converging on exciting and innovative developments in project financing, monitoring, and evaluation. Though in the early stages, these developments and the increasing emphasis on making the business case for watershed investment offer significant promise for obtaining the long-term sustainable funding necessary for scaling-up watershed investments.

Because of the age and status of the programs in this study, we did not identify lessons on the challenges of program maintenance. However, it is clear that monitoring outcomes and collecting economic performance data will be essential to garnering sufficient funds to ensure the programs' longevity and impact. This may be especially true for unlocking and sustaining funding from program beneficiaries, such as downstream water utilities and municipalities.

Building Communication among Watershed Investment Program Stakeholders

The similarities among the studied programs, despite important geographic and contextual differences, suggest that it is possible to transfer knowledge and lessons learned across programs to help overcome challenges and promote efficient program development. Watershed investment program staff and partners may not see themselves as experimental test beds for future sustainable water security measures, but their pioneering work could one day serve as a roadmap for others establishing watershed investment programs.

The federal government has several roles to play in mainstreaming watershed investment programs. Considering how the federal government has shaped these programs from the outset, the public sector's continued support of watershed investment programs is likely to be essential to their growth across the United States. The realities of landownership and difficulties in obtaining initial seed funding mean that government funding has been key to many programs. The U.S. Forest Service is a lead partner of many programs in this study, USDA Conservation Innovation Grants supported several programs, and state funding assisted in the initial stages in other programs. Some programs required predictable regulatory signals to assure partners that watershed investments were a legitimate strategy to meet regulatory requirements. These programs' achievements in engaging small-scale forest owners and leveraging non-federal funding have aligned with and magnified the USDA's sustainable forest management efforts and "all lands approach." Government support of watershed investment programs in other places could further support the USDA's goals of combatting forest loss and degradation, reducing risk of wildfire, and promoting a sustainable rural economy.

To encourage the spread of watershed investment programs, we must shift the discourse from the environmental realm to the water utilities, water-dependent companies, and city planning departments that can champion programs and spread the word with investors and government decision-makers. For example, the America Water Works Association's network of 50,000 members already hosts forums for sharing knowledge on watershed investment programs. Continued communication of success stories and challenges is critical to developing a learning platform that can help existing and future programs scale up watershed investment programs.

To encourage the spread of watershed investment programs, we must shift the discourse from the environmental realm to the water utilities, water-dependent companies, and city planning departments that can champion programs and spread the word with investors and government decision-makers.

PART III

CASE STUDIES

In this part of the report, we present the 13 case studies that underpin our findings. Each case study describes the context and drivers of the program's development, the analyses or collaborative planning processes conducted during the program's development, the individuals and organizations that played key roles in the program, and the program's accomplishments as of mid-2016. The 13 programs include four from the eastern United States and nine from the western United States.

Case 1: Central Arkansas Water

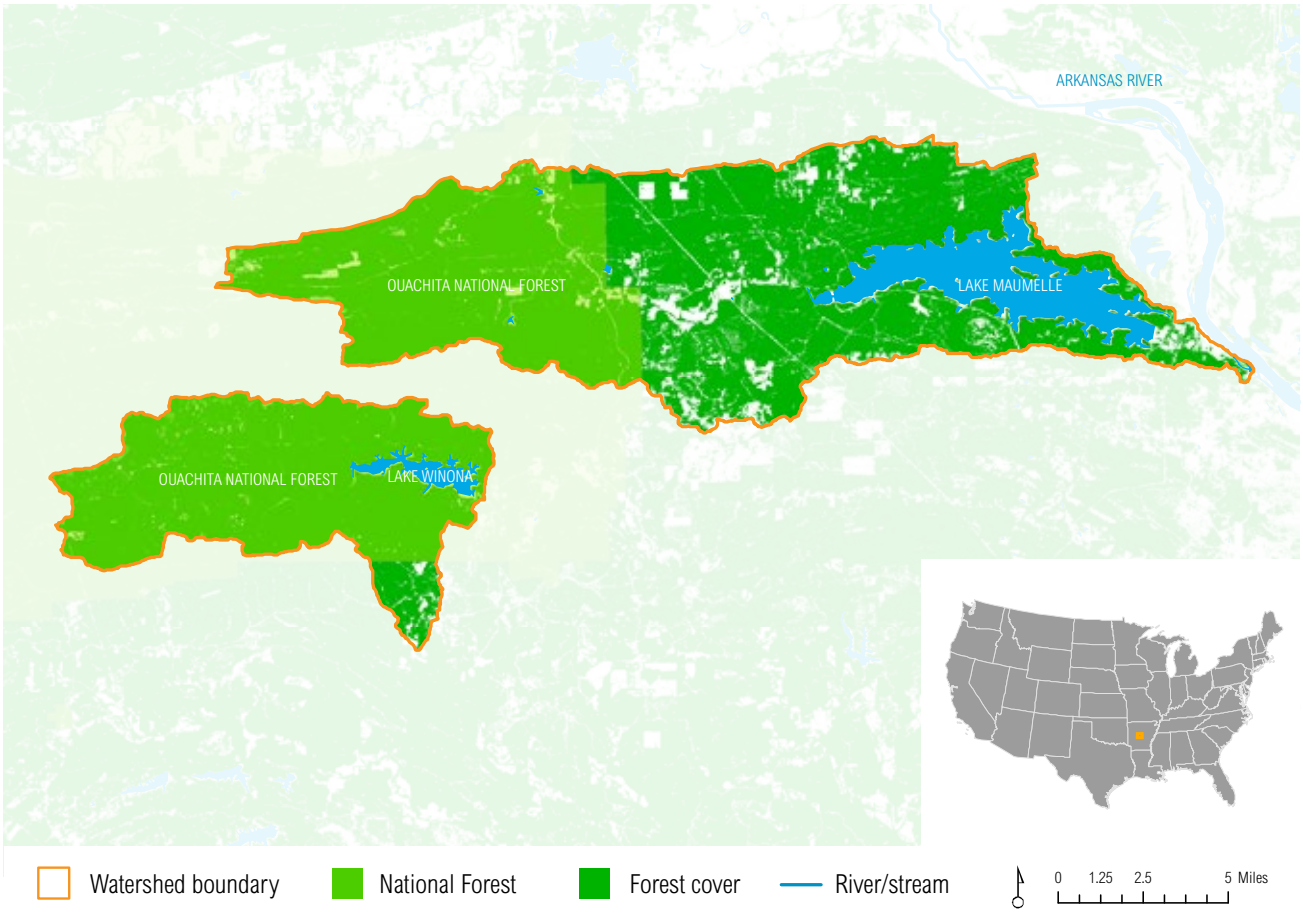
Background

Central Arkansas Water serves 400,000 people through two water sources: Lake Maumelle and Lake Winona (Figure 7). Under current population growth projections, Central Arkansas Water estimates that it will provide water to more than 575,000 people by 2050 (Tetra Tech 2007).

Lake Maumelle reservoir was built in the late 1950s, with the watershed encompassing approximately 137 square miles (88,000 acres). Approximately 91 percent of the Lake Maumelle Watershed is forested; 53 percent of the land is privately owned and subject to potential development (Tetra Tech 2007). Lake Winona's watershed, almost completely forested, is considerably smaller at 43 square miles (approximately 28,000 acres). All land within the Lake Winona watershed is either owned by Central Arkansas Water or located within the Ouachita National Forest, which is managed by the U.S. Forest Service. Consequently, the Lake Winona area does not face the same development pressure as the Lake Maumelle watershed (CAW 2015).

Concerns about water quality degradation in Lake Maumelle date back to 1985, when the University of Arkansas at Little Rock released a study predicting that Lake Maumelle's watershed would face development pressures within 25 years and advocating for protection measures. A 1988 study by the Benham Group recommended long-term water quality monitoring and a watershed protection program. In 1989, the Little Rock Municipal Water Works and the U.S. Geological Survey partnered on a long-term program to monitor water quality, provide

Figure 7 | **Map of Central Arkansas Water Program Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

CASE AT A GLANCE

Watersheds: Lake Maumelle and Lake Winona, Arkansas (Figure 7)

Water provider: Central Arkansas Water

Population served: 400,000

Program established: 2007

Key concerns: Development threats, water quality degradation, legislative threats

Partners: Central Arkansas Water, local county government, Arkansas Forestry Commission, Arkansas Game and Fish Commission, The Nature Conservancy

Funds spent: $27.7 million on land acquisition

Accomplishments:

- Developed a long-term plan and watershed management program in 2007 in response to significant development and legislative threats
- Acquired approximately 2,500 acres of conservation land in the watershed and placed conservation easements on another 240 acres
- Implemented a watershed protection fee of $0.45/month/meter starting in 2009, generating approximately $1 million per year
- Leveraged over $9.1 million in additional funding from state and federal agencies for multiple watershed management activities

Takeaways:

- Sound science has been a critical component of proactive watershed planning and monitoring for the program.
- Galvanizing community support to respond to water supply threats was important for developing a broadly supported watershed protection plan.
- Support from the governing board and senior management was important to establish and fund a watershed management program.

data for future reservoir protection and modeling, and monitor the impact of land-use change on water quality and sediment deposition. The program continues today and has expanded over time to include additional sampling locations as well as real-time monitoring. Little Rock Municipal Water Works adopted its first formal watershed protection program in 1992, identifying lands for acquisition in areas close to the water intake.

In the early 2000s, concerns about development near the Lake Maumelle intake, along with the continuing westward expansion of Little Rock, prompted Central Arkansas Water to evaluate options for the long-term protection of water quality in Lake Maumelle. It convened a Task Group for Watershed Management in 2004 to evaluate its watershed protection program and to determine whether development close to the Lake Maumelle intake would degrade water quality.

In response to Central Arkansas Water 's seeking to condemn property near the Lake Maumelle intake, a bill was filed in the Arkansas Senate in 2005 that would have stripped the utility of the authority to use eminent domain to protect drinking water supplies. The Senate bill galvanized strong community support for protecting the water supply, leading to the formation of an independent citizen's group, Citizens Protecting Maumelle Watershed, and the eventual defeat of the bill. That same year, Central Arkansas Water approved the task group's recommendations, including one calling for a comprehensive, science-based watershed management plan. Central Arkansas Water contracted with Tetra Tech and began developing the Lake Maumelle Watershed Management Plan, which its board adopted in 2007. The plan continues to guide Central Arkansas Water's watershed management efforts today.

Since the adoption of the Lake Maumelle Watershed Management Plan, Central Arkansas Water's watershed management efforts have consisted of land acquisition, land-use planning and regulation in collaboration with the county, water quality monitoring and assessment activities, other pollution control and management measures, and public education. Central Arkansas Water funds its activities through a combination of rate-based operation and management revenues, and capital funds garnered through a graduated-scale watershed protection

fee based on meter size, with the great majority of residents paying $0.45 per meter per month (effective in 2009). The watershed protection fee appears as a line item on customer water bills to provide transparency and raise community awareness of watershed protection (CAW 2012). The watershed protection fee account was originally capped at $3 million, but in 2012 the cap was removed at the urging of community members supportive of watershed protection efforts. Active citizen groups continue to request increases in the fee.

Assessments and Collaboration

To address water quality threats from development on private land, Central Arkansas Water has partnered with the county government to adopt and implement subdivision and zoning regulations to guide development in the Lake Maumelle Watershed. It worked with the county to adopt regulations establishing site-specific nutrient and sediment loading limits, requiring conservation areas to be established when engineered techniques are used to comply with pollution loading limits, prohibiting uses detrimental to water quality, restricting development in riparian zones, and establishing density limitations in the Lake Maumelle Watershed.

Central Arkansas Water has also partnered with Arkansas state agencies, including the Arkansas Forestry Commission and the Arkansas Game and Fish Commission. Areas of cooperation include forest management, forest road stabilization, funding for property acquisitions, and monitoring and enforcement of recreation rules and regulations through enrollment of 18,000 acres of utility-owned property into a wildlife management area. Central Arkansas Water has also received over $9.1 million in grant funding from state and federal agencies for property acquisition and restoration, and collaborates with the U.S. Geological Survey on jointly funded water quality monitoring.

Currently, Central Arkansas Water engages directly with landowners rather than through intermediaries for its conservation easement efforts, but it is considering future partnerships with land trusts. It is also considering partnerships with local conservation districts in order to increase private landowner engagement in watershed protection activities.

Key Leadership and Champions

Central Arkansas Water's board of commissioners championed actions to protect the watershed. According to a 2014 statement by John Tynan, former watershed protection manager and director of customer relations and public affairs for the utility, "Board level and senior management supported [Central Arkansas Water's] watershed protection actions from day one. Their support for the watershed protection fee and their commitment to go through all the political steps to get to where we are now are major factors in our program's continued success." Citizen groups have also consistently championed watershed protection measures and were key to the development and implementation of the Watershed Management Plan.

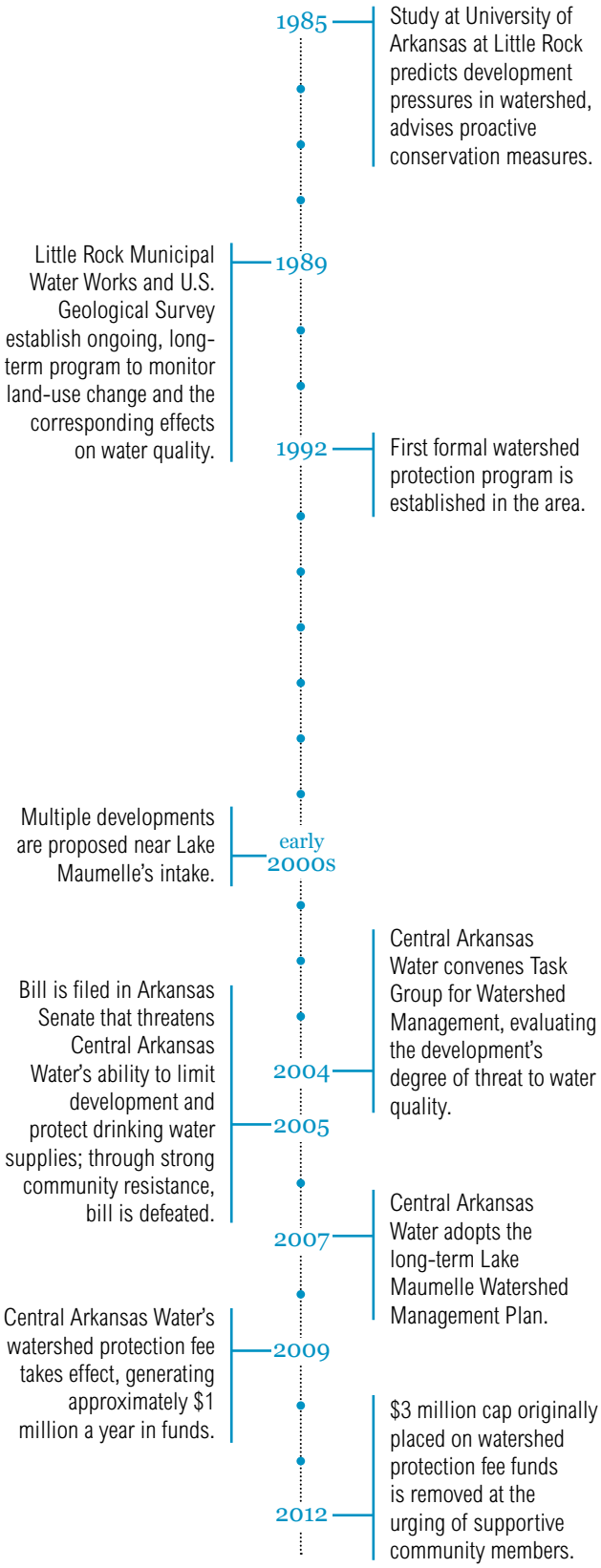
For day-to-day management, Central Arkansas Water created three staff positions to manage the watershed protection program and engage partners. The watershed protection manager is responsible for building watershed protection programs, including managing and monitoring the watershed land assets owned by Central Arkansas Water in the vicinity of the two source water lakes, and leading public education and engagement events on land stewardship. The conservation coordinator oversees Central Arkansas Water's watershed land management activities. Watershed stewardship is being more fully integrated into other staff roles as well. For example, Central Arkansas Water's recent director of customer relations and public affairs, who was previously the watershed protection manager, served as the utility's primary policy and media contact for its programs and initiatives and oversaw marketing and government-relations efforts. Many of these efforts relate closely to Central Arkansas Water's watershed protection work, especially as watershed land protection and stewardship become a more integral part of Central Arkansas Water's operations and public relations efforts.

Accomplishments to Date

The watershed protection fee has enabled Central Arkansas Water to acquire over 2,600 acres at a cost of $28.2 million for watershed protection purposes in the Lake Maumelle watershed. Central Arkansas Water leveraged a $4 million Forest Legacy Grant from the U.S. Forest Service, a $4 million state appropriation, and $1 million from the wildlife management area lease for several of these purchases. In addition, it has worked with private landowners to place 295 acres under conservation easements at a cost of $600,000. It also obtained $120,000 from the U.S. Fish and Wildlife Service for a low-water crossing removal and stream bank restoration projects on the Maumelle River that seek to reduce sediment inputs to the lake.

To address water quality threats from development on private land, Central Arkansas Water has partnered with the county government to adopt and implement subdivision and zoning regulations to guide development in the Lake Maumelle Watershed.

Figure 8 | **Central Arkansas Water Timeline**



As of 2015, Central Arkansas Water had completed prescribed burns on approximately 1,221 acres in the watershed and thinned 182 acres. In 2016, it will continue to add acreage to the prescribed burning efforts, thin an additional 478 acres, and reforest 140 acres. Central Arkansas Water also created a comprehensive land purchasing assessment to prioritize and establish guidelines and limitations for purchasing acres in the watershed. Watershed program staff members attribute the program's accomplishments to successful partnerships and the ability to leverage diverse funding sources to supplement utility funding. Figure 8 depicts a timeline of these accomplishments and related events.

Central Arkansas Water believes that identifying the benefits of continued investment in watershed protection activities will help with assessing the cost-effectiveness of natural infrastructure relative to a pure gray infrastructure approach in order to develop an optimized hybrid investment approach for future infrastructure projects. Clearly identifying the benefits of watershed protection can also help justify rate or watershed protection fee increases. Accordingly, Central Arkansas Water is participating in broader efforts to quantify the benefits of source water protection and anticipates additional data regarding these benefits in the next 3 years. A more comprehensive public education effort is planned, including a State of the Watershed Report in 2016.

A significant number of Central Arkansas Water's senior managers are expected to retire in the next 5–10 years, raising concern about the loss of institutional knowledge and community relationships. Staff changes and retirements, however, have also enabled restructuring of departments within the utility, including the integration of the watershed program within the department for water quality treatment. This restructuring enabled Central Arkansas Water to establish an integrated approach to provide safe, high-quality water to its customers through the protection of water sources, laboratory analyses, treatment, and compliance at the tap.

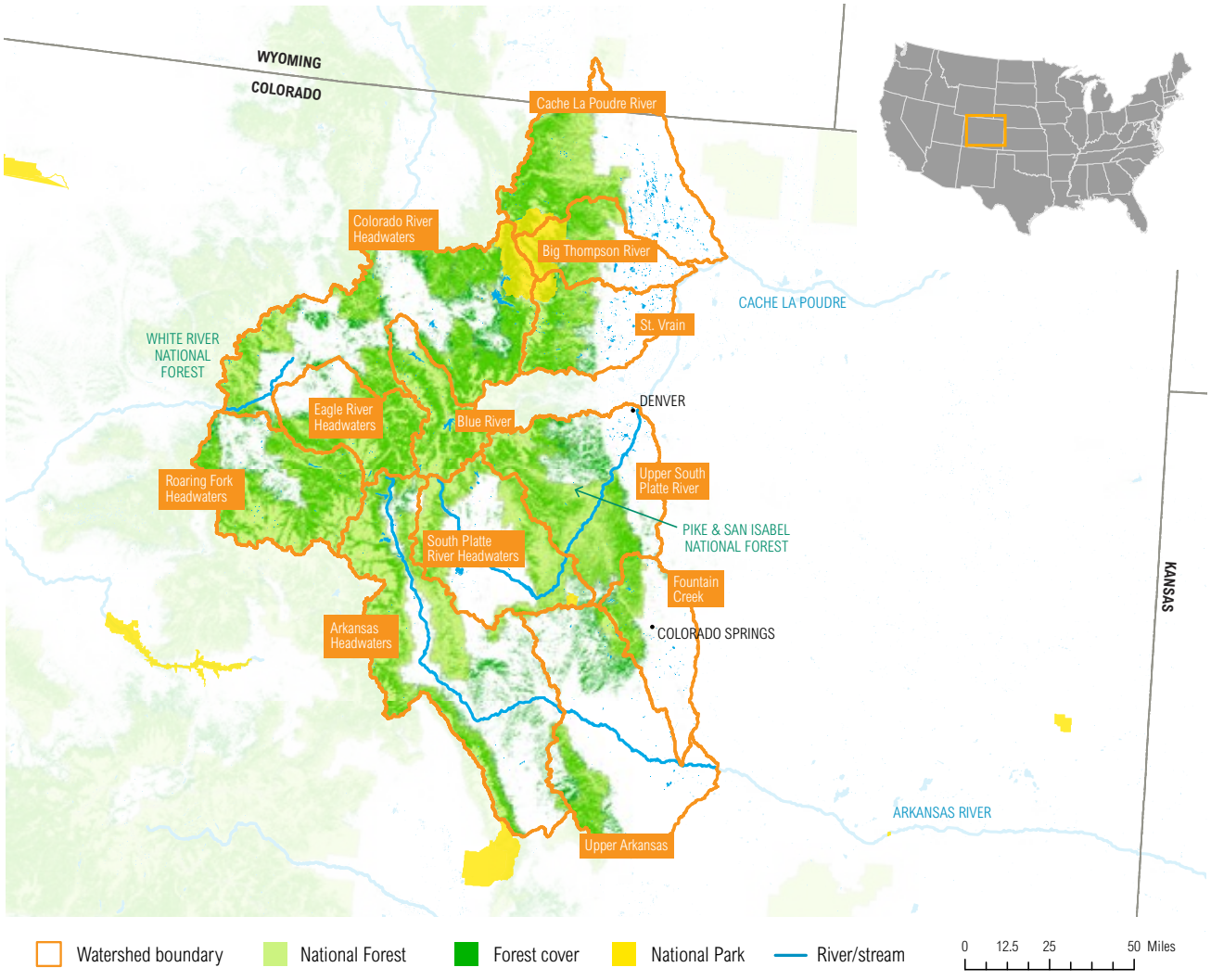
Cases 2–6: Five Colorado Watershed Protection Partnerships: Overview

More voluntary partnerships between the U.S. Forest Service and local water providers seeking to reduce wildfire risk have been established in Colorado than in any other western state (Bennett and Carroll 2014; Huber-Stearns 2015). The five Colorado partnerships are motivated by the same risks and considerations, were developed similarly, and include many of the same actors. They are, therefore, best understood as interlocking parts of an overarching Colorado case study. To avoid repetition, this case study has two parts: an overview of the Colorado programs, and individual case studies with partnership-specific background and accomplishments to date. The individual case studies are Denver Water, Aurora Water, Colorado–Big Thompson Headwaters Partnership, Pueblo Board of Waterworks, and Colorado Springs Utilities. Figure 9 provides a map of the key program areas for these five partnerships. Figure 10 depicts a timeline of the development of these partnerships.

Background

Colorado is a headwaters state, relying primarily on surface water from snowmelt that flows from the Rocky Mountains into the Arkansas, Colorado, and South Platte Rivers, and the Rio Grande. Public

Figure 9 | **Map of Colorado Watershed Protection Partnerships Program Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

lands play a prominent role in the state because federal agencies, primarily the U.S. Forest Service, manage 68 percent of forested land in Colorado. Another 30 percent of land is private, managed by 186,000 landowners (CSFS n.d.). Eighty-three percent of the state's population resides in the Front Range region, which runs east and west of the Interstate 25 corridor, stretching from north of Fort Collins to Pueblo at the southern end of the state (DeGroen 2012).

Over the past two decades, Colorado experienced a string of severe wildfires that resulted in the loss of human lives, houses and property, and wildlife. The fires affected the air quality and damaged drinking water sources and infrastructure. The Buffalo Creek (1996) and Hayman (2002) Fires together burned almost 150,000 acres in one of Denver Water's most critical watersheds, the South Platte. This watershed not only supplies about half of Denver's water but is also the watershed through which 80 percent of Denver's water moves to the city (Kennedy 2014). Together, the two fires resulted in 1 million cubic yards (equivalent to 40 years' worth) of sediment deposition in Strontia Springs Reservoir, a major reservoir managed by Denver Water (Le Master, Shao, and Donnay 2007).

Since the Buffalo Creek and Hayman Fires, Denver Water has spent over $26 million on water quality, reclamation, and restoration treatments in the South Platte Watershed, as well as on dredging sediment from Strontia Springs Reservoir (Kennedy 2014; Harper 2014b). Even after dredging, the reservoir was unable to return to its previous capacity (Kennedy 2014).

The Buffalo Creek and Hayman Fires were a wake-up call, alerting Denver Water and other water providers in the region to the importance of watershed management (Harper 2014b). Claire Harper, U.S. Forest Service, described how these post fire events sparked a rallying cry along the Front Range, of "Not another Strontia Springs." The fires also demonstrated the potentially massive costs of using built infrastructure to address sedimentation issues resulting from post fire rain events in the watersheds. These events caused water providers to look upstream to their source watersheds in the forested mountains, highlighting the potential value of investments in natural infrastructure as preventative measures.

Assessments and Collaboration

The Front Range Fuels Treatment Partnership (FRFTP) formed in the aftermath of the severe 2002 fire season to "reduce wildland fire risks through sustained fuels treatment along the Colorado Front Range" (FRFTP 2013). FRFTP now includes federal, state, and local governments; land management agencies; private landowners; conservation organizations; and other stakeholders.

A key role of the FRFTP was to fund an assessment report, *Protecting Front Range Forest Watersheds from High-Severity Wildfires*, released by the Pinchot Institute for Conservation in July 2007 (Le Master, Shao, and Donnay 2007). The study concluded that climate factors and forest conditions placed Front Range source watersheds at high risk from severe wildfires, threatening water supplies and the integrity of reservoirs with damage from erosion and floods (Le Master, Shao, and Donnay 2007). The report prompted a series of meetings among Front Range water providers and state and federal agencies to explore opportunities for joint action.

The result of these meetings was the formation of the Front Range Watershed Wildfire Protection Working Group, with the goal of collaboratively developing and implementing a strategy to protect critical Front Range watersheds from high-severity wildfires (JW Associates n.d.). In August 2009, the working group released a report providing a standard methodology for prioritizing and locating hazardous fuel treatment projects in municipal watersheds (JW Associates 2009b). Since the original report, watershed assessments have been conducted for every major watershed that supplies water to Colorado Front Range cities and communities (see JW Associates 2009a, 2009b, 2010b, 2010a, 2011, 2013). The assessments focused on key risks to water providers and their systems: wildfire risk on the eastern side of the Rocky Mountains and beetle infestation and dead tree concerns on the western mountain slope. The watershed assessments were funded by the water providers and other stakeholders for each respective watershed and conducted by JW Associates of Breckenridge, Colorado.

Among the Colorado programs, the Colorado State Forest Service and a regional NGO, the Coalition for the Upper South Platte, were cited as playing key roles in facilitating watershed work. Both the Colorado State Forest Service and the Coalition for the Upper South Platte have broad networks of established contacts and can transfer funding to individual projects, support grants, and pursue opportunities on land in high priority areas. Through their history of working with local land stewards, both organizations had established trust and social capital, which can be difficult for water providers and federal agencies to establish independently. The National Forest Foundation was also noted for its support and related work in fire-impacted watersheds with water utilities such as Aurora Water, directing efforts to key Hayman burn recovery areas.

To better quantify and track the impact of treatments on water quality and quantity (and to inform questions of return on investment) some Colorado programs are partnering with local research organizations to supplement their monitoring and evaluation programs. For example, the Colorado–Big Thompson Headwaters Partnership has tapped into the expertise of the Colorado Forest Restoration Institute at Colorado State University, which evaluates the fire hazard mitigation effectiveness of Wildfire Risk Reduction Grants awarded by the Colorado Department of Natural Resources on state and private lands. The institute analyzes pre- and post treatment measures of ground, surface, and canopy fuels using the Fuels Characteristic Classification System. This system creates easily interpreted indices of relative fire hazard. By systematically quantifying changes in fuels from the forest floor to the treetops, monitoring data provide an objective assessment of the value of acres treated and invested funds for the funding agency. This partnership provides Northern Water and its partners with a unique opportunity to see detailed monitoring results of their forest treatments and could be used to inform the work they are doing with their public lands partners as well. More recently, Denver Water has also embarked on similar work, engaging the Colorado Forest Restoration Institute on private land.

Landowners have also been integral to the assessment process. They often participate in data collection and tweak treatments based on what they learn, strengthening their future funding requests. Fuel measurement methods require low equipment investments and are easily implemented by groups with minimal technical training, such as volunteers. Resources to implement this monitoring strategy, including detailed step-by-step fuels measurement protocol, data sheets, links to the Fuels Characteristic Classification System (free download), and a sample results reporting template are available on the Colorado Forest Restoration Institute website: http://coloradoforestrestoration.org/.

The knowledge and momentum provided by these initial Front Range partnerships laid the groundwork for later source water protection partnerships in Colorado, as detailed throughout this case study.

Key Leadership and Champions

Key champions were instrumental in the creation and continuing success of the Watershed Protection Partnerships, including staff and decision-makers within water providers, federal and state agency staff and managers, and consultants.

In May 2010, leaders from the U.S. Forest Service and the Denver Water Board formed a jointly funded program to accelerate forest health projects in key watersheds to reduce wildfire risks to Denver's reservoirs and other critical infrastructure. Colorado was fortunate to have champions in place within water providers and federal and state agencies, all of whom began considering potential collaborative solutions to the increasing risk of wildfire years before the first partnership was formed. These champions were able to initiate conversations, bring key stakeholders to the table, and support relevant assessments, creating a foundation on which to build the partnerships.

Rick Cables, the former regional forester for the Rocky Mountain Region (now vice president for natural resources and conservation at Vail Resorts), provided ongoing leadership support for increased partnerships around supporting and enhancing water resources in national forests. He also helped establish dedicated staff at the regional level to raise awareness of the wildfire-watershed connection and develop key partnerships.

Harris Sherman, former USDA undersecretary of natural resources, personally requested leaders from each major water provider in the state to consider working more closely with the Forest Service. He also consistently shared his vision for participation by all Front Range water providers.

Cables and Sherman attended water conferences, and other meetings where water providers were present, to help share their vision for watershed partnerships (Cables 2014).

On the water provider side, key decision-makers within Denver Water joined discussions early about what could be done to address risks to their water system on public lands (Cables 2014; Harper 2014b; Kennedy 2014). Chips Barry, the former CEO and manager of Denver Water, had championed the idea of Denver Water's working more closely with the U.S. Forest Service to improve watershed health. In May 2010, leaders from the Forest Service and the Denver Water Board convened in advance of a memorial service for Barry and decided to forge ahead in his memory to form a jointly funded program to accelerate forest health projects in key watersheds to reduce wildfire risks for Denver's reservoirs and other critical infrastructure.

Following the formalization of the Denver Water partnership, other major water providers for the Front Range followed Denver Water's lead. They formalized partnership agreements to work with the Forest Service and other partners to reduce catastrophic wildfire risk in source watersheds, improve water quality, mitigate the effects of the pine beetle epidemic, and restore post fire areas in critical watersheds along Colorado's Front Range.

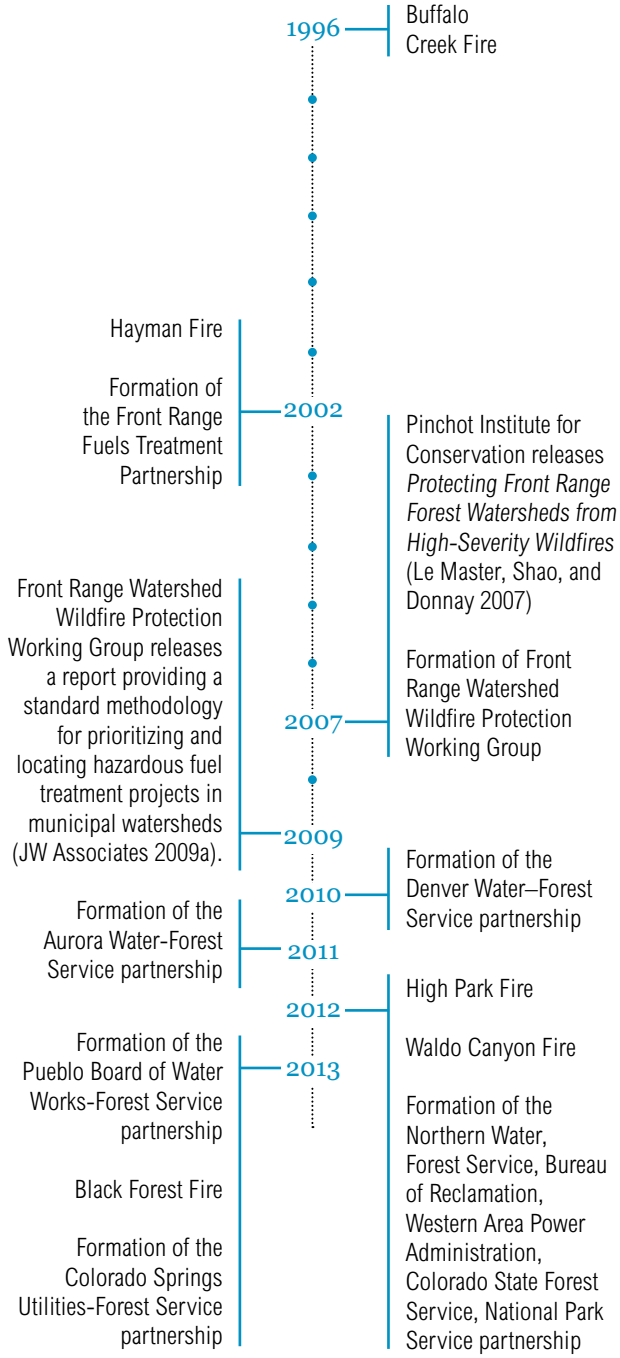
The Colorado partnerships involved champions who seized a window of opportunity presented by increased wildfires, elevated on the political agenda by national and regional attention, and made tangible by the work of individuals in the Front Range Fuels Treatment Partnership and Watershed Wildfire Protection Working Group. This resulted in the formalization of five water provider–federal agency partnerships within a 3-year timespan. The relationship building, conversations, and collaborations of the previous years and decades provided the foundation that allowed the program to be built.

Accomplishments to Date

Many of the accomplishments in Colorado have built on lessons learned from other programs in the state. Water providers in Colorado initially expressed reluctance to fund work that would include prescribed burning, mainly because they were not willing to take on the potential risk or liability of possible unintended effects of the burn. Mike McHugh of Aurora Water explained: "It's sometimes difficult to demonstrate to city council or to the engineering side of the house that these things work, because it's very hard to get a very clean cost-benefit analysis… [The] biggest challenge for us is how do you compare the green infrastructure, the gray infrastructure, and how do you get that across to the engineering [side]." This was particularly challenging when faced with seemingly competing interest for built infrastructure investments. Several of the Colorado programs have overcome these challenges and identified long-term funding for natural infrastructure.

Another key accomplishment for programs was allocating staff time and funding for administrative support of the partnerships. Although program partners may feel a need to dedicate as many funds as quickly as possible to watershed management projects, Colorado interviewees noted that program administration costs must also be covered. Two programs noted that dedicating a full-time staff position to raising support for passage of a natural infrastructure bond was critical to unlocking large-scale funding, and was therefore a worthwhile program investment early on. As collaborative partnerships, watershed investment programs often leverage staff time across multiple organizations to manage and administer the many demands of budgeting, partner engagement, communications, landowner recruitment, contractual agreements, performance monitoring, and other activities.

Figure 10 | **Colorado Watershed Protection Partnerships Timeline**



Case 2: Denver Water–U.S. Forest Service Watershed Protection Partnership

Background

In July 2010, the U.S. Forest Service and Denver Water signed a 5-year MOU and a $32 million cost share, followed by a signed collection agreement to transfer the first installment of funds to begin project implementation. The partnership focuses on "restoring forest and watershed health to protect the city and county of Denver's municipal water supplies and infrastructure" through reducing wildfire risk (forest thinning, prescribed fire, other treatments), restoring areas recovering from fires to reduce reservoir sedimentation (tree planting, riparian improvements), and minimizing erosion and sedimentation of reservoirs (decommissioning roads, mine reclamation, stream improvements) (USFS 2010b).

Denver Water paid for the partnership through a mandatory rate increase on water customers' bills, at an average monthly cost of $0.14 per residential household, totaling approximately $27 per household over the five-year partnership (Harper 2016).

Accomplishments to Date

In the first 5 years of their partnership (the original MOU ended in 2015), Denver Water and the U.S. Forest Service treated 32,553 acres (another 6,880 acres are under contract and pending completion) to reduce wildfire risk and restore burned acres in critical watersheds located within the Arapaho-Roosevelt, Pike–San Isabel, and White River National Forests. Denver Water invested $11.5 million and the U.S. Forest Service $21.6 million during this initial 5-year period in forest health and watershed projects on National Forest Service lands (Harper 2016). Approximately $3 million in remaining Denver Water funds will be rolled over into FY2016 to fund additional projects on an estimated 4,300 acres. In addition, Denver Water provided $1.65 million in funds in 2015 to the Colorado State Forest Service to help fund work on private lands—that work is still being assessed and prioritized, with work to be implemented over a 5-year period. Total Denver Water investment to date (including rollover funds and private land agreements) is more than $16 million.

CASE AT A GLANCE

Watersheds: Upper South Platte, St. Vrain, South Platte headwaters, Colorado River headwaters, and Blue River (Figure 9)

Water provider: Denver Water

Population served: 1.3 million

Program established: 2010 (ended in 2015, developing new partnership agreement)

Key concerns: Wildfire and flooding risks, ecological threats, water quality deterioration

Funds spent: $21.6 million by U.S. Forest Service, $16 million by Denver Water

Accomplishments: 39,433 acres treated to reduce wildfire risk and restore burned acres in critical watersheds

Takeaways:

- The 1996 Buffalo Creek and 2002 Hayman Fires served as a rallying cry for addressing wildfire risk across the state. Post fire water quality, reclamation, and restoration treatments and sediment dredging cost was over $26 million.
- The partnership was a model for other utilities considering partnering with the U.S. Forest Service in the state.
- A key watershed assessment identified the region as at high risk from severe wildfires that threaten water supplies and reservoir integrity.
- Denver Water has expanded to working on private lands as well, partnering with the Colorado State Forest Service, the Colorado Forest Restoration Institute, and others to quantify the impacts of forest treatments and work across landownerships.

The U.S. Forest Service Region is currently working with Denver Water to renew the partnership agreement and develop a FY2016–FY2020 action plan to guide partnership activities for the next 5 years. Federal partnership documents and their limited (1–5-year) life span can help facilitate this adaptive planning. The Colorado programs meet routinely and hold annual planning meetings to review the plan and collection agreement for the upcoming year. This provides an opportunity to discuss progress from the past year and goals and priorities for the upcoming year.

Case 3: Aurora Water–U.S. Forest Service Watershed Protection Partnership

Background

Like the Denver Water MOU, the Aurora Water MOU with the U.S. Forest Service focuses on forest and watershed health. However, the Aurora Water MOU omitted the language used in the Denver Water MOU stating that the water provider would not pay for the NEPA analysis (USFS 2011a). The decision to pay for environmental analyses and other NEPA-related processes is an important one for water providers, particularly when their key areas of identified risk on public lands are areas where NEPA processes have not yet been completed. Forest Service and water provider interviewees alike noted that funding to move through environmental analyses can provide more flexibility for project time frames, selecting acres to treat and performing environmental impact assessments on a timeline that meets partner goals (details in Part II, Lesson 8, page 58). Aurora pays for its portion of the partnership through funds from its operating budget.

Accomplishments to Date

Aurora Water contributed approximately $1.2 million over 5 years (2011–2015) for projects in priority watersheds in the Pike–San Isabel and White River National Forests. From 2011 to 2015, it contributed $955,000 to the Pike–San Isabel National Forest and the National Forest Foundation for NEPA planning, hazardous fuel treatments, and watershed restoration projects. Accomplishments include NEPA analysis on 15,000 acres and 55 acres of treatments in the Pike–San Isabel National Forest, as well as contributions to the Hayman Restoration Partnership, and watershed restoration work along Trail Creek in the Hayman Burn area. Work underway includes 60 acres of fuel reduction near Turquoise Reservoir. A new 5-year collection agreement was signed between the U.S. Forest Service and Aurora in 2014 with an initial contribution of $100,000 for fuel reduction at Turquoise Reservoir, an important reservoir in the water system.

CASE AT A GLANCE

Watersheds: Upper South Platte River, South Platte River headwaters, Roaring Fork headwaters, Frying Pan headwaters, Eagle headwaters, Upper Arkansas, and Arkansas headwaters watersheds (Figure 9)

Water provider: Aurora Water

Population served: 300,000

Program established: 2011

Key concerns: Wildfire and flooding risks, ecological threats, water quality deterioration

Funds spent: $955,000

Accomplishments:

- Contribution to Hayman Restoration Partnership
- NEPA analysis on 15,000 acres
- 55 acres of treatment, environmental analyses, and watershed restoration along the Hayman burn area

Takeaways:

- The partnership provided funding to the U.S. Forest Service for watershed work years before formalizing the arrangement through an MOU.
- Learning from the Denver case study, Aurora Water and the U.S. Forest Service omitted partnership language used in the Denver Water MOU stating that funds would not pay for NEPA.
- Partnership funds partially support the Hayman Restoration Partnership, facilitated by the National Forest Foundation, to address restoration in key burned areas of national forest.

Case 4: Colorado–Big Thompson Headwaters Partnership (Northern Water)

Background

In December 2012, Northern Colorado Water Conservancy District (Northern Water) signed an MOU with the U.S. Forest Service, the Bureau of Reclamation, and Colorado State Forest Service to form the the Colorado–Big Thompson (C-BT) Headwaters Partnership. Additional partners include the Western Area Power Administration (Western), a U.S. Department of Energy agency with major transmission lines in the region, and the National Park Service, which operates Rocky Mountain National Park in the heart of C-BT watersheds.

Northern Water and the Bureau of Reclamation operate what is known as the C-BT Project, which transports water to eight counties through 12 reservoirs, seven hydroelectric plants, 95 miles of canals, and 35 miles of tunnels, including a 13-mile tunnel beneath Rocky Mountain National Park (through the Rocky Mountains from the west to east side) and seven hydroelectric generation power plants with three very large water pumping stations essential to water supply, storage, and delivery. Western owns and operates the associated electrical transmission system needed to transmit and market the electrical energy generated, and to supply the electrical power required to run the water pumps. The large pumping stations are needed to transfer storage water in the Colorado River drainage on the western slope under the Continental Divide (by tunnel) into the eastern slope water drainages. The water delivery and electrical power facilities are of equal importance, as one aspect of the project cannot function without the other.

Like Aurora and Denver, the C-BT Headwaters Partnership is focused on forest and watershed health, but with the addition of a fire preparedness or preplanning component (e.g., prepositioning materials in the watershed in order to expedite post fire response) (USFS 2012). The inclusion of electrical power generation and transmission facilities adds complexity as the associated transmission lines are long linear features that, while having a small footprint, are exposed to hazards across the much broader forested landscape. The electrical power component of the C-BT project also presents a double jeopardy situation where both water and power resources critical to the economies and well-being of dependent communities can be negatively

CASE AT A GLANCE

Watersheds: Upper Colorado River, Big Thompson River, and Cache la Poudre River watersheds (Figure 9)

Water provider: Northern Water

Population served: A major transmountain diversion, Colorado–Big Thompson water is delivered to 895,000 people, including more than 30 municipal water providers and 640,000 acres of irrigated farm and ranch land.

Program established: 2012

Key concerns: Wildfire and flooding risks, ecological threats, water quality deterioration

Funds committed 2014–2017:

- U.S. Forest Service: $442,600 in implementation, $75,000 in planning/analysis
- Colorado State Forest Service: $77,000
- Colorado Department of Natural Resources Grant funding administered through Northern Water: $333,700
- U.S. Bureau of Reclamation: $439,000
- Northern Water: $319,400 in implementation, $207,000 in planning/analysis

Accomplishments: The partnership has completed, or is in the process of completing, over 890 acres of fuel reduction treatments on public and private lands.

Takeaways:

- The partnership is part of the Western Watershed Enhancement Initiative, a project supported by an MOU between the U.S. Departments of Agriculture and Interior to achieve common goals related to water quality, supply, conservation, and watershed function.
- The partnership includes public and private lands, and a wide range of partners, including the U.S Forest Service, the Bureau of Reclamation, the Colorado State Forest Service, the National Park Service, and the Western Area Power Administration.
- The partnership structure has similar goals to those of Denver and Aurora but also includes a fire preparedness or preplanning component.

impacted. The partnership focuses on restoration and planning activities to protect Northern Water's municipal and agricultural water supplies and infrastructure, as well as the Bureau of Reclamation's and Western's C-BT Project facilities for water delivery and hydroelectric power generation, transmission, and utilization (USFS 2011c).

Assessments and Collaboration

An additional complexity of this partnership is the variety of land jurisdictions involved, requiring inclusion of a wide range of partners. This can allow flexibility in the planning and implementation process, when different members of the partnership are able to focus their strategies and efforts toward activities specifically on public or private lands. To help prioritize lands, Northern Water hired JW Associates to conduct assessments and to consult as needed when planning projects with their partners.

Northern Water administers funds provided through its operating budget, Colorado Department of Natural Resources grants, and Colorado State Forest Service grants. This funding matches in-kind work completed by landowners on private lands, and expanded treatments on Northern Water's lands and county lands within critical watersheds. The Colorado State Forest Service manages individual projects on behalf of Northern Water. Northern Water and the U.S. Forest Service, the Bureau of Reclamation, and Western are working together to prepare and treat federal public lands around identified C-BT infrastructure and critical watersheds within the national forests and parks on both the east and west sides of the Rocky Mountains. Although not an official partner on the MOU, Northern Water has also worked closely with Larimer County on several projects, and the National Park Service and Western Area Power Administration have been active participants in the partnership.

As noted on page 81, the C-BT Headwaters Partnership works with the Colorado Forest Restoration Institute at Colorado State University, which evaluates fire hazard mitigation effectiveness and provides monitoring data to assess the value of acres treated and invested funds.

Accomplishments to Date

The partnership has used a combination of funds to pay for work completed to date, including funds from Northern Water's operating budget; cost shares from the U.S. Forest Service, Bureau of Reclamation, and Western Area Power Administration; and Colorado Department of Natural Resources and Colorado State Forest Service grants used on private lands with management by the Colorado State Forest Service. The partnership has completed, or is in the process of completing, over 890 acres of fuel reduction treatments on public and private lands. In 2013, Northern Water contributed $90,000 toward the implementation of the 150-acre Kawuneeche Fuel Treatment Project in the Upper Colorado River headwaters area. This funding accounts for approximately half the implementation cost for the project; the U.S. Forest Service is funding the remaining cost. Project implementation has been delayed by contractor-related issues but is expected to begin soon.

The Bureau of Reclamation has contributed approximately $439,000 to hazardous fuel treatment projects on approximately 100 acres of Bureau of Reclamation and National Forest System lands near critical C-BT water infrastructure. The West Portal Project (8 acres), located on Bureau of Reclamation lands around the tunnel entrance that delivers water from the west slope to the Front Range, is complete. The East Portal and Mary's Lake Project (65 acres), on Bureau of Reclamation lands adjacent to Front Range water delivery infrastructure, is scheduled to be implemented during summer 2016. The Thompson River 4 Project (800 acres), on National Forest Service lands, is in the planning phase and would protect watersheds surrounding critical C-BT infrastructure in the Big Thompson Basin. Bureau of Reclamation funding accounts for approximately half of the implementation costs, the U.S. Forest Service is funding the remaining cost.

The C-BT partnership is part of the Western Watershed Enhancement Initiative, a partnership between the U.S. Department of Agriculture and the U.S. Department of the Interior. The initiative highlights federal cooperation in improving watershed function and reducing wildfire risk across jurisdictional boundaries through six projects in the Northern, Rocky Mountain, Southwestern, Intermountain, Pacific Southwest, and Pacific Northwest U.S. Forest Service Regions (USFS Partnership Resource Center 2016).

Case 5: Pueblo Board of Water Works–U.S. Forest Service Watershed Protection Partnership

Background

Following closely on the heels of the C-BT Headwaters Partnership, the Pueblo Board of Water Works also established an MOU with the U.S. Forest Service in 2013. Pueblo's partnership is structured like Aurora's, with forest and watershed health goals and activities, and without specific limitations regarding NEPA funding (USFS 2013a). The decision to enter an MOU was jointly driven by former USDA undersecretary for natural resources Harris Sherman and the recently retired director of the Pueblo Board of Water Works, both of whom believed that Pueblo should take a more active role in watershed work.

Accomplishments to Date

Pueblo worked with the U.S. Forest Service at the Pike–San Isabel National Forest level to find a shelf-ready NEPA project that best aligned with Pueblo's priorities and connections to their water system. Pueblo did not want to fund NEPA as its first project; instead, it wanted to fund a project that would lead to results on the ground, in order to demonstrate a tangible impact. Pueblo also is considering adding fire preparedness preplanning to its partnership work, similar to the C-BT Headwaters Partnership.

CASE AT A GLANCE

Watersheds: Roaring Fork headwaters, Frying Pan headwaters, Eagle headwaters, Upper Arkansas, Arkansas headwaters watersheds (Figure 9)

Water provider: Pueblo Board of Water Works

Population served: 109,260

Program established: January 2013

Key concerns: Wildfire and flooding risks, ecological threats, water quality deterioration

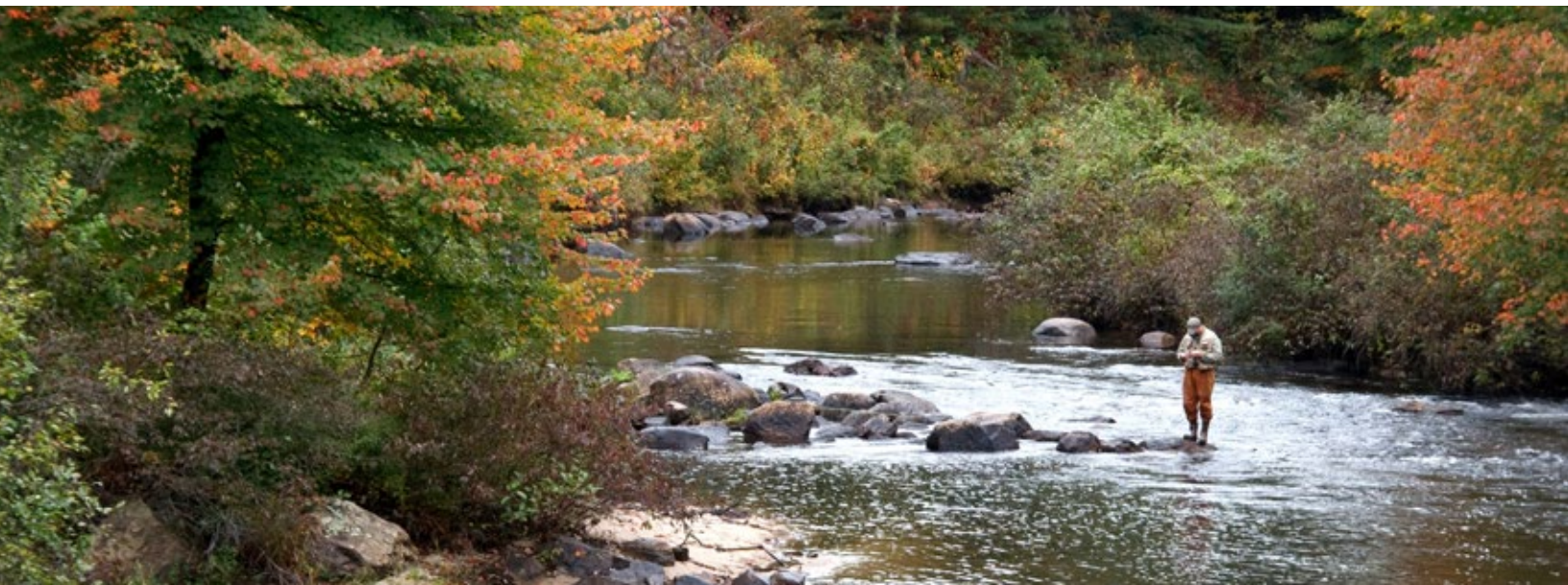
Funds spent: $50,000

Accomplishments: 81 acres of hazardous fuel treatment

Takeaways:

- The partnership conducted one project in an area with difficult access, warranting more expensive treatments by hand.
- The partnership developed post fire plans for inaccessible or hard-to-treat regions in the watershed.
- The partnership has not funded NEPA activities but instead has focused on finding a shelf-ready NEPA project to allow funds to be spent on tangible, on-the-ground results.

Pueblo pays for its portion of the partnership through its operating budget. Most significantly, the partnership resulted in 81 acres of hazardous fuel treatment in a hard-to-access area that required expensive treatments by hand.



Case 6: Colorado Springs Utilities–U.S. Forest Service Watershed Protection Partnership

Background

In 2013, following the 2012 Waldo Canyon Fire, Colorado Springs Utilities formalized a long-standing relationship with the U.S. Forest Service by signing an MOU committing to an estimated 5–10 year contribution of $6 million (USFS 2013b). In 2013, The Black Forest Fire in Colorado Springs surpassed the destructive record set by the Waldo Canyon Fire, further reinforcing the urgency of post wildfire response and risk reduction in the forests.

Colorado Springs' watershed and forest health goals and activities followed Denver's and Aurora's. Like all the partnerships after Denver Water, the Colorado Springs MOU omitted language that prevented the partnership from paying for NEPA activities; it also included fire-planning components like the C-BT Headwaters Partnership. The preplanning components specifically include wildland fire pre-suppression planning and incident response plans for protecting priority watersheds and National Forest System lands in their management activities (USFS 2013b).

Accomplishments to Date

Colorado Springs pays for its portion of the partnership through funds from its forest management budget, which has increased significantly since the 2012–2013 fire season. Colorado Springs plans to contribute $6 million over 5–10 years to support hazardous fuel and forest health treatments, watershed restoration, wildland fire pre suppression planning, invasive aquatic species mitigation, and other projects of mutual interest in the Pike–San Isabel and White River National Forests. It invested $1.8 million between 2009 and 2015. Accomplishments so far include 716 acres of hazardous fuel treatments near Crystal Creek Reservoir in the Pikes Peak watershed and 7,724 acres of wildlife surveys for threatened and endangered or sensitive species. Work underway in 2016 includes 550 acres of mechanical hazardous fuel treatments, 300 acres of broadcast prescribed burns, and environmental analyses on 67,000 acres and wildlife surveys in key watersheds.

CASE AT A GLANCE

Watersheds: Fountain Creek (Pikes Peak focus), Upper Arkansas, Arkansas headwaters, South Platte headwaters, Blue River, Roaring Fork headwaters, Frying Pan headwaters, Frying Pan and Eagle River watersheds (Figure 9)

Water provider: Colorado Springs Utilities

Population served: 480,000 (Most water supplies developed 100–200 miles away)

Program established: April 2013

Key concerns: Wildfire and flooding risks, ecological threats, water quality deterioration

Funds spent: $765,000 (includes 2009 and 2011 support) (USFS 2014a)

Accomplishments:

- 716 acres of hazardous fuel treatments near Crystal Creek Reservoir in the Pikes Peak watershed
- 7,724 acres of wildlife surveys for threatened and endangered or sensitive species (USFS 2016b)

Takeaways:

- The partnership provided funding to the U.S. Forest Service for watershed work years before the MOU was formalized.
- After the 2012 Waldo Canyon Fire, Colorado Springs Utilities shifted priorities, resulting in a sixfold increase in its forest management budget.
- Program goals include wildland fire pre suppression planning and incident response plans for protecting priority watersheds and national forestlands in Colorado Springs Utilities' management activities.

New Colorado Partnership: Southeastern Water Conservancy District

As of 2016, a sixth partnership was in formation through an MOU between the Southeastern Water Conservancy District, the Bureau of Reclamation, the Colorado State Forest Service, and the U.S. Forest Service. This partnership had not yet begun work on the ground at the time of this research, so we include it here for descriptive purposes only.

The Southeastern Water Conservancy District provides water to approximately 932,000 people (USFS 2014b). The MOU for the partnership is modeled after the C-BT Headwaters Partnership. It focuses on forest and watershed health, post wildfire response, preplanning to protect the district's water supplies and infrastructure and the Bureau of Reclamation's Frying Pan–Arkansas facilities, water delivery, and hydropower systems (USFS 2014b).

Case 7: Delaware River Common Waters Fund

CASE AT A GLANCE

Watershed(s): Upper and Middle Delaware River Basin: Delaware, New York, New Jersey, and Pennsylvania (Figure 11)

Water provider(s): Multiple in the region, but none engaged in the Common Waters Partnership

Population served: 15 million people, including parts of New York City and Philadelphia

Program established: 2010, supported by the Common Waters Partnership (established in 2007) and led by the Pinchot Institute for Conservation

Key concerns: Development threats, increases in water demand, forest cover loss, water quality deterioration

Partners: Pinchot Institute for Conservation, Common Waters Partnership members, state agency representatives, county conservation districts, consulting foresters

Funds spent: $1.9 million from the U.S. Endowment for Forestry and Communities, of which half was provided by a USDA Conservation Innovation Grant

Accomplishments:

- Financed the development of forest management plans and the implementation of other forest management practices on over 50,000 acres of private forests belonging to more than 100 landowners
- Supported the establishment of conservation easements on 1,300 acres of priority forestlands

Takeaways:

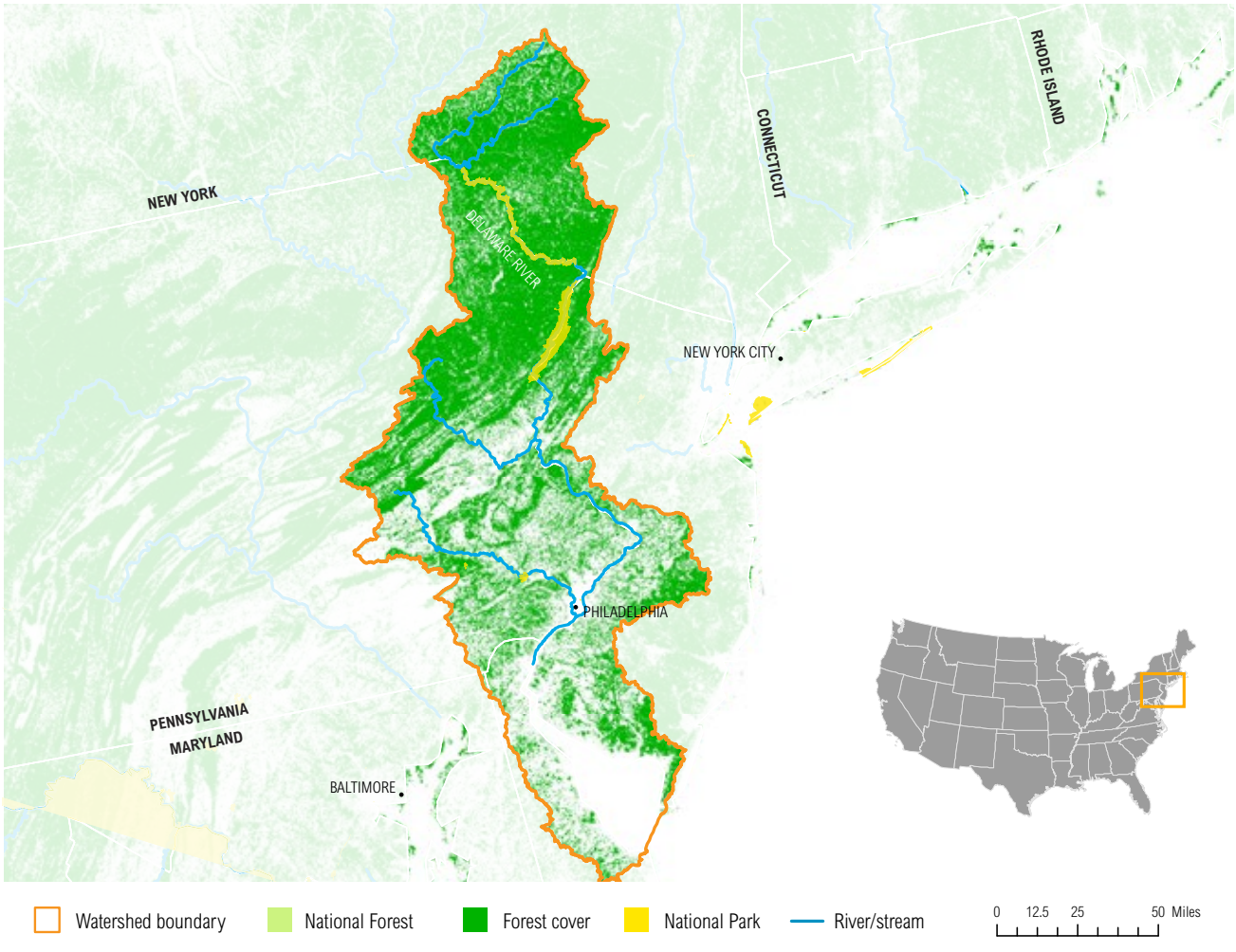
- Working with local partners on the ground was key to recruiting sufficient landowner participation.
- Most water users understand and support source protection, but scientific, financial, and legal barriers prevent them from making significant investments in the Upper Delaware.
- The program's design demonstrated how to stretch funding for source water protection across a large geographic area and paved the way for additional investments in forest protection and management in the headwaters.

Background

The Upper Delaware River basin—encompassing nine counties across three states—spans 2.8 million acres, most of them forested. Historically, these forests have provided high-quality water to downstream communities, including Philadelphia and New York City. However, several factors threaten the ability of this watershed to continue to provide high-quality water and reliable flows. For one, water withdrawals are projected to increase steadily through 2030, primarily due to increased demand from the thermoelectric sector (Sayers and Barr 2012), although this may change in the long term as older coal plants are decommissioned and dry cooling systems are installed. In addition, about 20 acres of forest are lost each day in the upper basin (Pinchot Institute 2015), although this concern diminished temporarily when building slowed during the Great Recession.

Partners of the Delaware River Common Waters Fund assert that the gradual and non-point nature of residential development makes it difficult to rapidly mobilize support for source water protection (Pendergrass Dalke 2014). Accordingly, the Pinchot Institute and Common Waters Partnership members adopted a proactive approach to conservation, forming the Delaware River Common Waters Fund in 2010 to mobilize investments in conserving forests in the upper basin.

Figure 11 | **Map of Delaware River Common Waters Fund Program Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

Assessments and Collaboration

The Delaware River Common Waters Fund drew on the expertise of the Common Waters Partnership, "a regional partnership . . . focused on supporting the development of sustainable communities and working landscapes in the Delaware River watershed" (Pinchot Institute 2015). Consisting of more than 40 organizations, ranging from federal agencies and statewide planners to local land trusts and watershed associations, the Common Waters Partnership represents entities interested in and capable of participating in watershed conservation programs. With this expertise, Delaware River Common Waters Fund members sought to design a program that would financially support forest conservation and management. The Pinchot Institute, a forest conservation research organization, convened a working group of Common Waters Partnership members, state representatives, county conservation districts, and consulting foresters to provide input throughout the design of the program.

Working group members defined forest management planning and management practices eligible for support, developed a program application process, and conducted outreach to private landowners in the upper basin. The program works directly with landowners and provides grants and other incentives to implement forest stewardship plans, forest management practices, and conservation easements. Delaware River Common Waters Fund partners emphasized the importance of outreach in priority areas in order to focus efforts on those who owned the land with the highest conservation value.

Common Waters Partnership members with GIS expertise conducted a spatial prioritization for protecting land within the basin according to a range of conservation priorities, including water quality impacts. The Delaware River Common Waters Fund used these maps to determine the areas in which it would accept proposals from landowners requesting financing for management actions; it then ranked proposals according to their contributions to water quality (Pinchot Institute 2013).

A significant portion of funding from the Delaware River Common Waters Fund is dedicated to engaging stakeholders and establishing partnerships. This has spurred a greater level of collaboration and stakeholder engagement within the Common Waters Partnership, which, up until April 2015, hosted quarterly meetings and was engaged in sporadic, small-scale projects. Building on the momentum, a series of new conservation projects emerged from the group strategizing sessions.

Key Leadership and Champions

The Delaware River Common Waters Fund was coordinated by the Pinchot Institute for Conservation, which planned the project, provided administrative support, and coordinated the efforts of Common Waters Partnership members and other collaborators. The Pinchot Institute served as the primary advocate for the project, with at least 1.5 staff members working on the project at any given time (Pendergrass Dalke 2014).

No clear individual champion emerged in the Delaware River Common Waters Fund case. Rather, the Pinchot Institute as a whole remained the driving force behind the project.

Accomplishments to Date

The Delaware River Common Waters Fund developed a program to provide financial support for landowners seeking to permanently protect their land or implement forest management practices. Modeled after a U.S. Department of Agriculture Natural Resources Conservation Service program with similar objectives, this program was introduced during a period of diminishing federal and state-level financing. Landowners viewed the program as a substitute for similar government programs and greeted it with considerable interest (Pendergrass Dalke 2014). The program development process (depicted in Figure 12) also led to deeper relationships and greater communication among members of the Common Waters Partnership, giving rise to a range of other conservation projects.

Between 2010 and 2013, the Delaware River Common Waters Fund succeeded in financing protection and management practices on over 50,000 acres of private forests, managed by more than 100 landowners (Pinchot Institute 2013). The fund's strategy of providing small grants to land trusts to cover costs associated with donated easements proved particularly successful, as seven projects protecting more than 1,300 acres were completed within three years.

The project received a $1.9 million grant from the U.S. Endowment for Forestry and Communities, half of which was provided by a Conservation Innovation Grant from the U.S. Department of Agriculture Natural Resources Conservation Service. Organizers engaged over 20 public and private water providers in the basin but were unable to recruit a utility or other water quality beneficiary to make sustained financial contributions to the fund. Many water users have remained in touch with the Common Waters Partnership, however, and have participated in meetings about science and modeling in the basin.

BOX 13 | DELAWARE RIVER WATERSHED INITIATIVE

The Delaware River Watershed Initiative is an active collaboration of more than 50 nonprofits that play a coordinated role in reducing non–point source threats to water quality in the Delaware River basin from forest loss, storm water, agricultural runoff, and aquifer depletion. Launched in January 2014 with a 3-year, $35 million investment from the William Penn Foundation, the initiative supports aligned efforts to protect and restore sub watersheds of critical value to the watershed overall. Money is dedicated to eight targeted areas where there are both significant threats to water quality and significant opportunities for successful intervention. The 3-year investment will enable participating organizations to permanently protect more than 30,000 acres of priority land; complete about 40 restoration projects to improve water quality; and pilot new protection and restoration incentives for landowners, businesses, and drinking water providers, all while fostering new relationships among themselves to enable deeper collaboration. To date, the initiative has worked to restore degraded areas, protect more than 14,000 acres of important landscapes, encourage innovations in green infrastructure and financing, and measure the scientific impact of the work in over 300 locations.

The Delaware River Watershed Initiative emphasizes science-based interventions that measurably improve water quality and quantity. A significant portion of the initial support from the William Penn Foundation is dedicated to establishing and maintaining an expansive monitoring program to assess the water quality impact of interventions. The comprehensive monitoring approach is carried out by universities, conservation professionals, and citizen scientists, coordinated by the Academy of Natural Sciences of Drexel University.

The initiative relies on a committee of four organizations, including the Academy of Natural Sciences, the National Fish and Wildlife Foundation, the Open Space Institute, and the Institute for Conservation Leadership to inform and support the on-the-ground work of partnering organizations active across the eight regions. Coordinating committee organizations have prioritized this work in the Delaware River basin from among their existing national and international portfolios and, for the first time, are collaborating with each other and providing essential support for conservation in the context of a single watershed system.

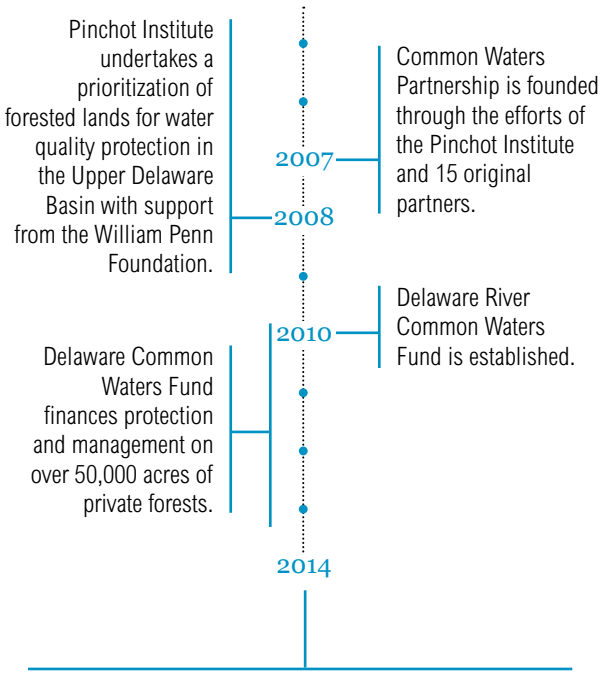
The initiative is intentionally organized so that partnering organizations can share process and findings for increased synergy; it intends for sub watershed clusters to act "as a laboratory to test and refine interventions and measure impacts over time" (William Penn Foundation 2015). The sharing of results will help build momentum for replication and increased conservation throughout the larger watershed.

Source: William Penn Foundation 2015.

Thanks in part to the groundwork laid by the Common Waters Fund, in 2014, the William Penn Foundation launched the three-year, $35-million Delaware River Watershed Initiative to protect and restore water quality in the Delaware River watershed (Box 13). The Pinchot Institute received $400,000 from the Delaware River Watershed Initiative to pursue protection and stewardship in targeted areas in the Upper Delaware Basin through the Common Waters Fund.

In 2015, the Common Waters Fund focused on allocating funds from other sources, such as the Upper Delaware Department of Agriculture's Natural Resource Conservation Service, to priority areas. The Pinchot Institute (on behalf of the Common Waters Fund) sought new sources of funds for the program by participating with the Environmental Finance Center on its Delaware River Watershed Innovative Financing Strategy Project. Funded by the William Penn Foundation, this project's goal was to further identify innovative and scalable options for financing Delaware River watershed restoration and protection efforts. The project explored opportunities to engage private capital and the private sector in medium- and long-term financing options, and it also informed partners about how private foundations invest in innovative financing mechanisms in early stages of program development (EFC n.d.).

Figure 12 | **Delaware Common Waters Fund Timeline**



The William Penn Foundation commits to a $35 million investment to protect and restore water quality throughout the Delaware Basin, including at least $10 million for the protection of forested headwaters and $400,000 specifically for the Pinchot Institute to advance protection and stewardship in targeted areas in the Upper Delaware Basin (William Penn Foundation 2014).

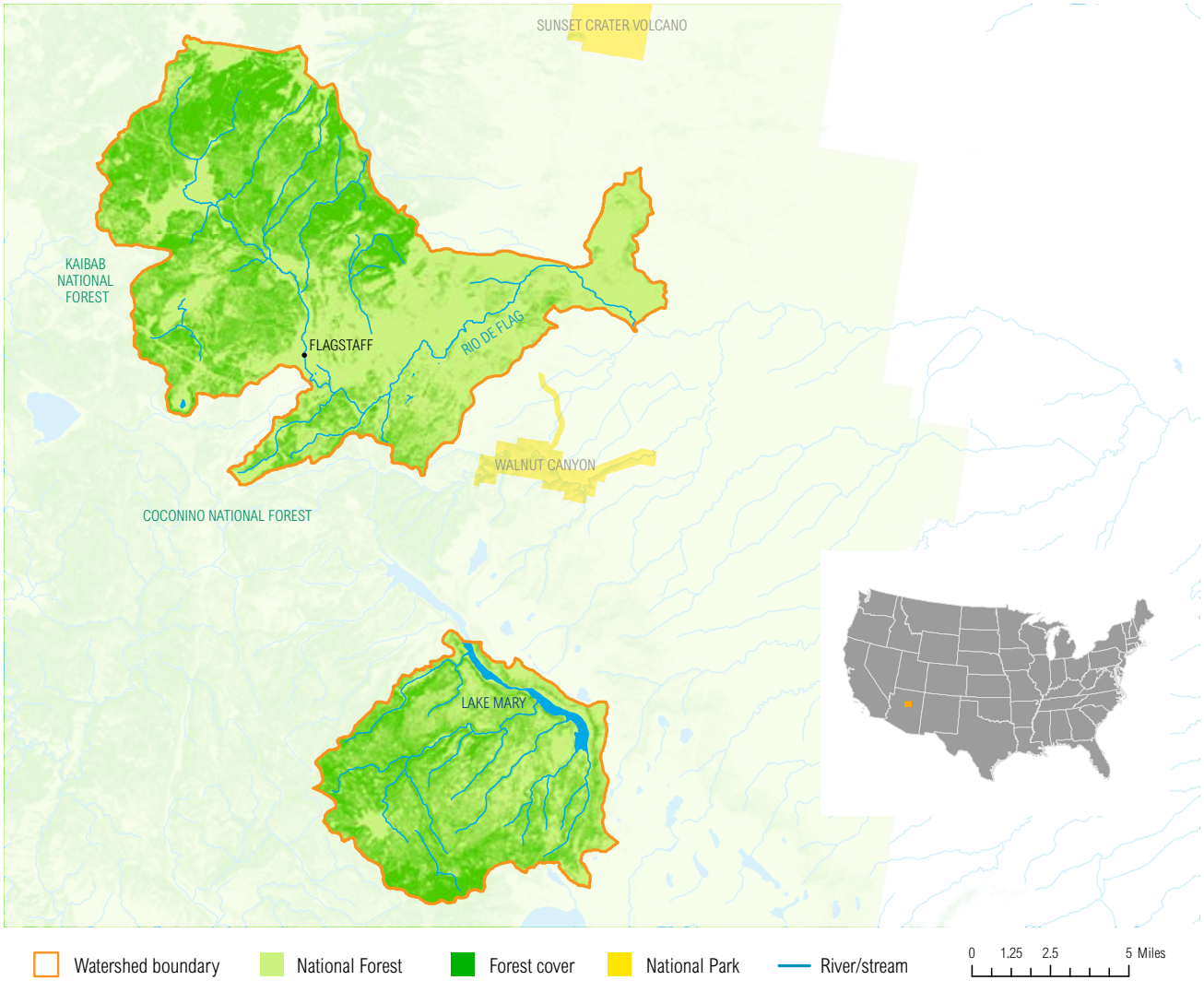
Case 8: Flagstaff Watershed Protection Project

Background

The Schultz Fire burned over 15,000 acres in the Coconino National Forest northeast of Flagstaff in 2010. In the aftermath, heavy flooding in a suburban neighborhood caused extensive property damage and one death (Combrink et al. 2013). City officials and land managers realized that, had the fire occurred on the other side of a ridge and thus within the Rio de Flag watershed, it would have led to flooding throughout much of Flagstaff's downtown. They also determined that a fire on forested slopes above the Lake Mary Reservoir to the south could result in sedimentation that would render the reservoir, which provides about 50 percent of Flagstaff's water, unusable (FWPP 2015).

These realizations spurred interest in investments in forest restoration to improve watershed management in order to protect the municipal water supply from fire risk. The subsequent collaborative efforts among the city of Flagstaff, the state of Arizona, the U.S. Forest Service (Coconino National Forest), and community groups led to the formation of the Flagstaff Watershed Protection Project in 2012 and a $10 million, voter-approved municipal bond to fund forest treatments.

Figure 13 | **Map of Flagstaff Watershed Protection Project Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

CASE AT A GLANCE

Watersheds: Rio de Flag (Dry Lake Hills) and Lake Mary (Mormon Mountain), Arizona (Figure 13)

Water provider: N/A – partnership involved the state, the city, and Coconino National Forest

Population served: 66,000

Key concerns: Wildfire and flooding risks

Program established: 2012

Partners: City of Flagstaff, U.S. Forest Service, researchers at Northern Arizona University, business interests, and conservation nonprofits

Funds spent in partnership: $12 million committed, of which $10 million through a voter-approved municipal bond measure

Accomplishments:

- Estimate of avoided costs: $573 million to $1.2 billion in damages
- Treatments implemented on more than 1,200 acres
- Environmental clearance for treatments on an additional 8,667 acres of national forest

Takeaways: The community was well-prepared to leverage awareness of the implications of fire risk for water supply, and it treated the catastrophic Schultz Fire in 2010 as a window of opportunity to pass a bond measure to fund forest treatments.

Assessments and Collaboration

The Flagstaff Watershed Protection Project grew from a long history of community engagement in forest restoration and fire-risk reduction. The Greater Flagstaff Forests Partnership formed after an especially severe fire season in 1996 to address fire risks at the wildland-urban interface. Over the following 16 years, the partnership built fire-risk awareness in the community and strong working relationships among the key partners, including the City of Flagstaff, the U.S. Forest Service, Coconino County, researchers at Northern Arizona University, business interests, and conservation nonprofits (Mottek Lucas 2014; Summerfelt 2014; Vosick 2014).

Following the Schultz Fire, the Ecological Restoration Institute at Northern Arizona University subcontracted researchers Wayne Fox and Jeff Peterson to conduct a full-cost accounting of the fire's total cost to governments, private property owners, and society. Drawing on a broad range of data, they estimated the total impact of the fire at between $133 and $147 million (Combrink et al. 2013). This analysis was used as a foundation for a subsequent Flagstaff Watershed Protection Project cost avoidance study, which estimated $573 million to $1.2 billion of avoided damage costs (FWPP 2015).

The Flagstaff program includes dedicated staff both on the city side and on the U.S. Forest Service side. The city has reassigned staff to dedicate 50 percent of their time to the program and directed their focus to activities that will shift as the program develops (e.g., from developing monitoring plans to managing field implementation). The city also hired an additional staff member in 2015 to conduct field implementation of program plans. The U.S. Forest Service created a dedicated position for the Flagstaff Watershed Protection Project by hiring a project manager, which was credited as a successful move in the program development.

To assess program performance over time, the partnership convened stakeholders to identify existing research and monitoring efforts that could be used to monitor program impacts. They found that many of the program's monitoring objectives could be met using data from ongoing environmental monitoring activities conducted by Northern Arizona University researchers, the U.S. Forest Service, the City of Flagstaff, and conservation organizations. Flagstaff's planned monitoring process will use fire and hydrologic modeling to understand the link between treatments and risk reduction. Field crews will monitor vegetation changes before and after treatments, and this information will be used to calibrate models to quantify fire risk reduction. In order to quantify fire-risk reduction, the Flagstaff Watershed Protection Project will need to overcome limitations related to available fire models and baseline data. Detailed stand exams for the treatment area have not been conducted, and existing Forest Service baseline data are extrapolated from data collected in nearby stands. As a result, partners are planning to conduct thorough stand exams prior to the beginning of treatments.

Key Leadership and Champions

The Flagstaff Watershed Protection Project benefited from champions both at the grassroots and highest level of city government. A group of community leaders and activists—many of whom had been engaged in the Greater Flagstaff Forest Partnership—formed "Yes on 405," a political action committee, to advocate for the ballot measure that funded the project. At the same time, City Manager Kevin Burke helped bring partners together and provided crucial momentum during the early stages of the planning process. Burke also identified a municipal bond as a financing mechanism for the program and provided important support to getting the bond measure on the ballot (Summerfelt 2014; Vosick 2014).

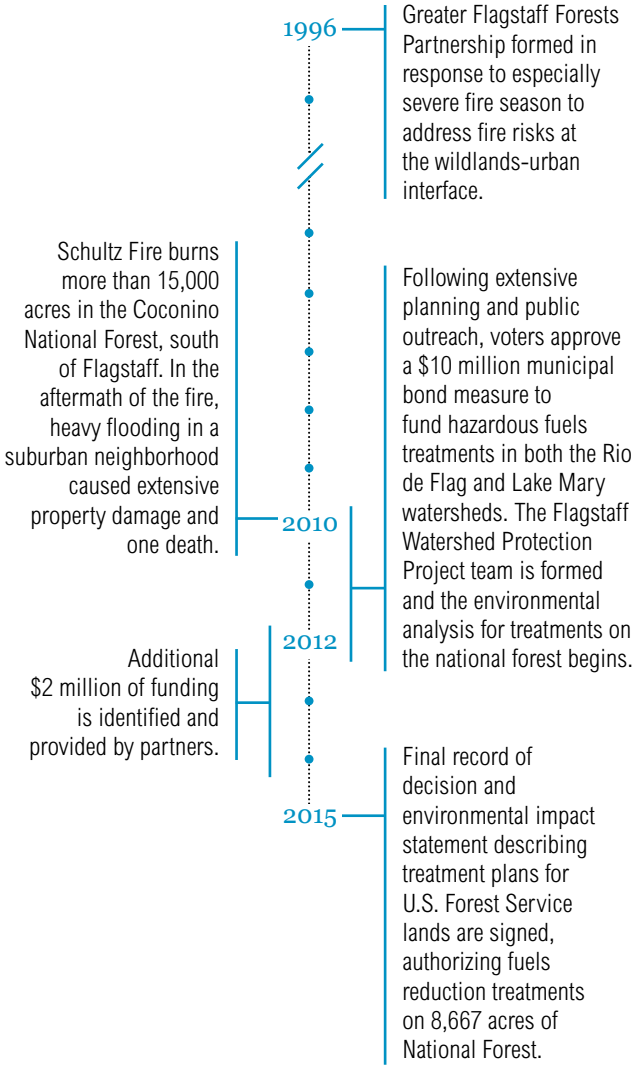
Meanwhile, staff within the Flagstaff city government, the U.S. Forest Service, and other organizations provided the sustained engagement needed to fully develop the program and plan forest treatments. These individuals included Paul Summerfelt of the Flagstaff Fire Department, the U.S. Forest Service's Erin Phelps, Diane Vosick of Northern Arizona University's Ecological Restoration Institute, and Anne Mottek Lucas of the Greater Flagstaff Forests Partnership.

Accomplishments to Date

Following the Flagstaff Watershed Protection Project's extensive planning and public outreach, local voters approved a $10 million municipal bond measure in November 2012 to fund hazardous fuels treatments in both the Rio de Flag and Lake Mary watersheds (Figure 14). Although the partnership agreements between the city and the U.S. Forest Service do not outline long-term requirements to match city funds, as of December 2014, the bond funding attracted an additional $2 million to be leveraged from the U.S. Forest Service and 10 other partners (Phelps 2014). Because fire risk mitigation in the western United States requires periodic maintenance treatments, partners in Flagstaff are now considering a permanent water-use rate increase that will sustain ongoing work in the watershed after funds from the revenue bond are exhausted.

Project partners moved rapidly to define and establish the project after the bond measure vote. In addition to engaging the public through the NEPA process, the Flagstaff Watershed Protection Project conducted an extensive public planning process to incorporate community input into treatment goals and develop monitoring strategies. The program also engaged a broader range of regional researchers and organizations to provide baseline data and assist in monitoring (Vosick 2014). Treatments were implemented on over 1,200 acres of both city- and state-owned lands (FWPP 2015), and a final record of decision and an environmental impact statement describing treatment plans for U.S. Forest Service lands were signed on October 22, 2015 (McDonald 2015).

Figure 14 | **Flagstaff Watershed Protection Project Timeline**



Case 9: Portland Water District

Background

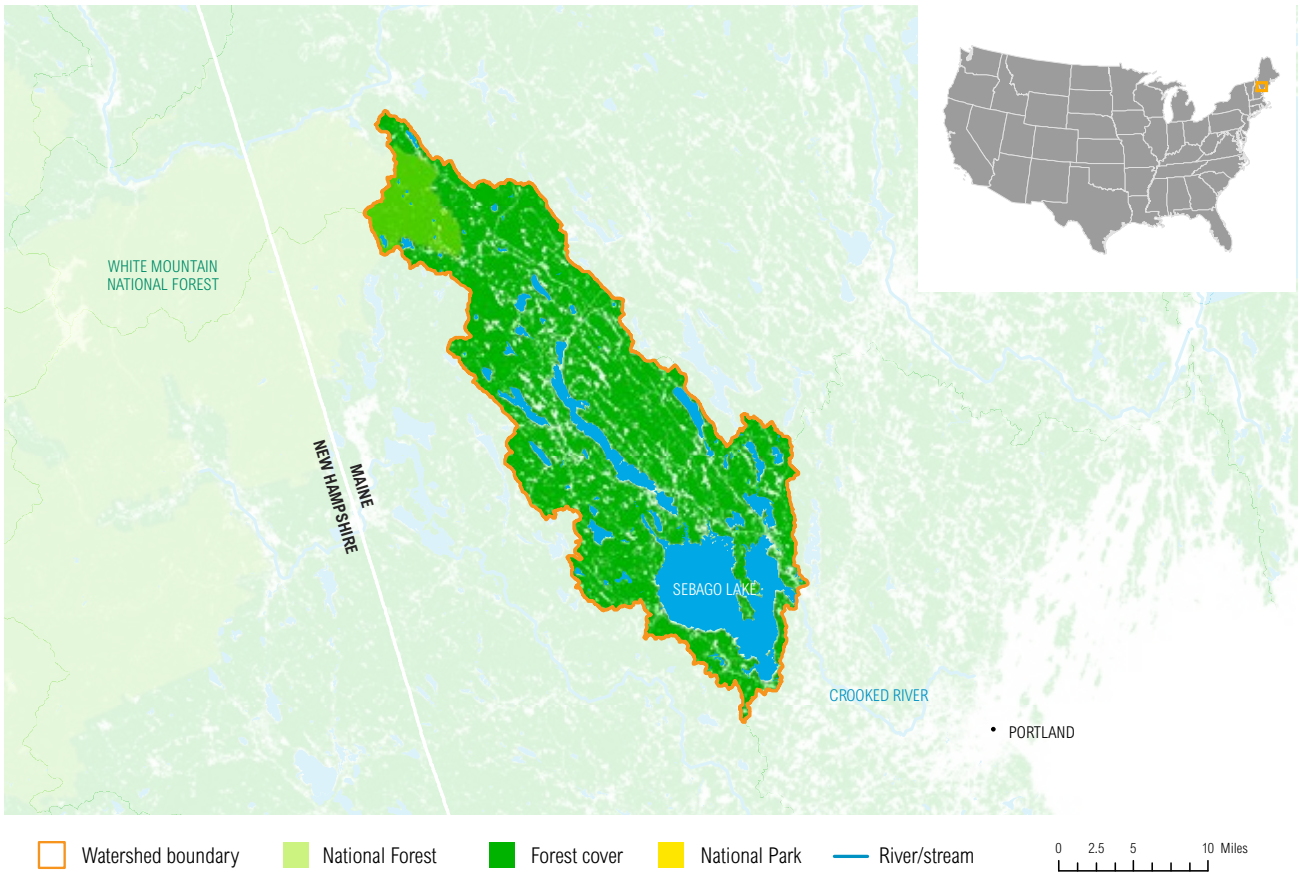
The Crooked River flows into Sebago Lake, which is the drinking water source for 52,000 household water customers in Portland, Maine, and surrounding communities (Figure 15). The lake is an ideal water supply—deep, cold, low in nutrients, and fed by mostly forested land in the Crooked River watershed. The U.S. Environmental Protection Agency has granted Portland Water District a filtration avoidance waiver under the Safe Drinking Water Act, allowing it to avoid the cost of a built filtration plant as long as the water meets strict quality standards.

Ninety-two percent of the land in the Crooked River watershed is privately owned, leaving Portland Water District little control over long-term land-use trends. Efforts to preserve forest cover to protect water quality date back to 1908 but, throughout the 20th century, the utility's efforts focused on purchasing forested land immediately around the water intakes in the lower watershed. Funds to support forest conservation on private lands in the upper reaches of the watershed account for just a sliver of the utility's source water protection expenditures.

Assessments and Collaboration

Two assessments contributed to the Portland Water District board's unanimous decision to scale up the conservation easements component of its source water protection efforts. In 2009, the U.S. Forest Service conducted a "Forests to Faucets" analysis, assessing the role of forested lands in providing drinking water throughout the United States and

Figure 15 | **Map of Portland Water District Program Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

CASE AT A GLANCE

Watersheds: Crooked River and Sebago Lake, Maine (Figure 15)

Water provider: Portland Water District

Population served: 200,000

Program established: 2013

Key concerns: Development threats, water quality deterioration, threat of losing EPA filtration waiver

Partners: Portland Water District, U.S. Forest Service, World Resources Institute, University of Massachusetts, and two local land trusts

Funds committed: $200,000/year

Accomplishments:

- Water provider decided to fund up to 25 percent of the conservation value of each proposed conservation easement within watershed, to a maximum of $500,000/year.
- Two assessments in the Sebago Lake region—one on the role of forested lands in providing drinking water and one on payment for watershed services programs—helped make the case for a proactive strategy to maintain high water quality.
- A green-gray assessment demonstrated probable cost savings of over $12 million over 20 years through natural infrastructure investments to maintain high water quality.
- The Conservation Priority Index tool was developed to rank land parcels for their conservation value.

Takeaways: Assessments, both economic and environmental, and internal advocacy were critical in influencing the Portland Water District to adopt a proactive approach to watershed protection and maintain high water quality

potential threats to these lands. The study revealed that areas of the Sebago Lake watershed were at high risk of forest conversion from development pressure (Barnes et al. 2009; Hunt 2014).

Concurrently, the U.S. Department of Agriculture awarded a Conservation Innovation Grant to the American Forest Foundation, World Resources Institute, the Manomet Center for Conservation Sciences, and the Western Foothills Land Trust to study the feasibility of a payment-for-watershed-services program in Portland (Talberth et al. 2013). The study included an avoided cost analysis, which compared the cost of a built filtration plant with that of a program of five types of forest-based natural infrastructure investments. Under the expected scenario, the natural infrastructure option represented a probable cost savings of more than $12 million over 20 years, even when excluding public benefits such as carbon sequestration and Atlantic salmon habitat.

Given the uncertainty associated with the lack of underlying biophysical modeling, the project team tested this finding by running the analysis under six sets of assumptions. Under the most optimistic scenario for natural infrastructure, the option would generate savings of $110 million over 20 years. Under the least optimistic scenario, the natural infrastructure option would represent as much as a 46 percent increase in costs relative to the gray infrastructure option (Talberth et al. 2013). Even under the least optimistic scenario, however, the aggregate economic benefits for the natural infrastructure option exceeded those of gray infrastructure once the value of the ancillary benefits, such as carbon sequestration and improved Atlantic salmon habitat, was taken into account.

The Conservation Innovation Grant recipients and researchers at the University of Massachusetts also developed a Conservation Priority Index, ranking land parcels within the watershed by order of importance in providing water-related ecosystem services (Talberth et al. 2013). The Portland Water District developed the "Site-Specific Assessment" tool based in part on concepts included in this index. This tool lets the Portland Water District target limited program funding to parcels with the greatest impact on water quality within the Sebago Lake watershed (Hunt 2014). Environmental Services Manager Paul

Hunt explained that although the "Portland Water District doesn't say no to any parcel in the watershed," the level of financing it provides varies from 5 percent to 25 percent of a parcel's conservation value based on its water quality importance, determined from the ecological criteria outlined in the Site-Specific Assessment Tool. Land trusts secure the remaining financing, conduct the transaction, and hold and monitor the easement.

The Portland Water District's service area lies downstream from Sebago Lake, almost entirely outside of the lake's watershed. As a result, its customers do not necessarily enjoy non–water quality-related benefits of conserving forests in the watershed. By limiting their contribution to 5 to 25 percent of the cost of purchasing the development rights on forested lands, the Portland Water District has developed a mechanism whereby the customers are effectively helping to pay for the water treatment these forested watershed lands provide without paying the full costs of land conservation. The land trusts view this partnership as a valuable opportunity to magnify conservation efforts (Hunt 2014).

Key Leadership and Champions

The Portland Water District's environmental manager, Paul Hunt, provided leadership to build support within the utility for further investments in source water protection. Hunt took advantage of the U.S. Forest Service's Forests to Faucets analysis and avoided costs analyses to build awareness of the threats to watershed health. He repeatedly presented the general manager and board of trustees with opportunities to support conservation purchases in the upper watershed and developed the utility's capacity to make these investments by building relationships with land trusts and drafting internal policies to guide ongoing investments (Hunt 2014).

Lee Dassler, executive director of the Western Foothills Land Trust, is the primary liaison between the Portland Water District investments and landowners in the watershed. The land trust holds conservation easements on privately owned lands (3,615 acres) and owns seven preserves in the region (1,856 acres). Dassler and the volunteer land trust board are also responsible for securing the conservation easement agreements and raising the balance of funds required to complete the transactions. Additional funding typically comes from private donations, federal grants or mitigation funds, and state programs such as the Land for Maine's Future bond.

Accomplishments to Date

Although the Portland Water District's filtration avoidance waiver provided a regulatory driver for the utility's source water protection efforts, it has adopted a proactive "no regrets" approach to protecting the watershed—investing in forest health for its positive impact on water quality, regardless of the utility's baseline filtration needs.

The Portland Water District funds conservation easement acquisitions through its general fund as part of a multifaceted watershed protection program, which also includes enforcement of legal controls on development, public education and outreach, monitoring, and actions in response to monitoring results. The utility dedicates about $1 million a year to its watershed protection program, approximately 5 percent of the utility's total annual water revenue. There is no set amount of funding

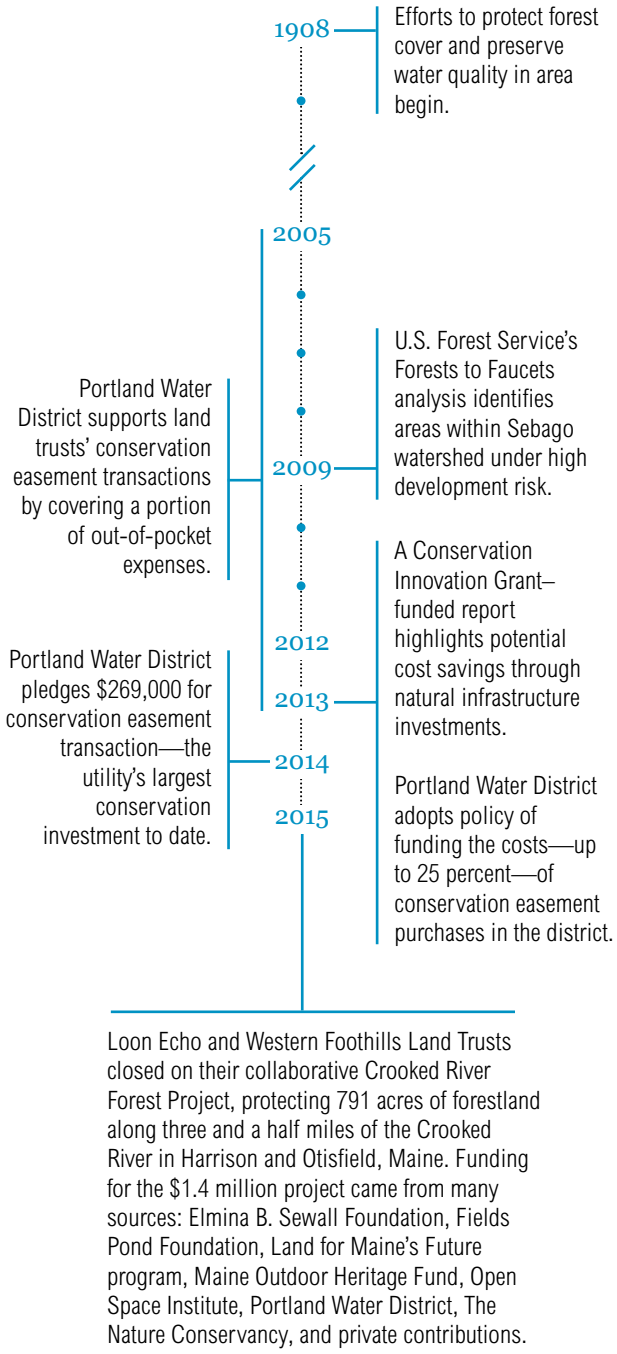
allotted for easement acquisitions; instead, each proposed transaction is subject to a vote by the utility's board. This financing mechanism evolved over the course of a decade in tandem with Portland Water District's forest conservation policies (Hunt 2014).

From 2005 to 2013, the utility regularly paid land trusts' out-of-pocket expenses for conservation easement transactions. These initial contributions often amounted to just 1 percent of the total costs that the land trusts incurred in acquiring a conservation easement, but the contributions established a foundation for greater investments (Hunt 2014).

Hunt's dedicated efforts, the awareness created by the Forests to Faucets analysis, and the results of the green-gray assessment contributed to the Portland Water District board's decision in 2013 to increase financing for conservation easements to up to 25 percent of their total value. In the spring of 2014, the board pledged a $269,000 contribution to support a single easement transaction—the utility's single-largest investment in forest conservation for source water protection to date.

In 2015, The Nature Conservancy and Open Space Institute progressed in making the Crooked River and Sebago Lake watershed a focus area for their conservation work in Maine. Their work includes creating a conservation action plan, developing public relations strategies, contributing funding and staff expertise, and further identifying financing mechanisms beyond the Portland Water District's contribution. Figure 15 depicts a timeline of these accomplishments and related events.

Figure 16 | **Portland Water District Timeline**



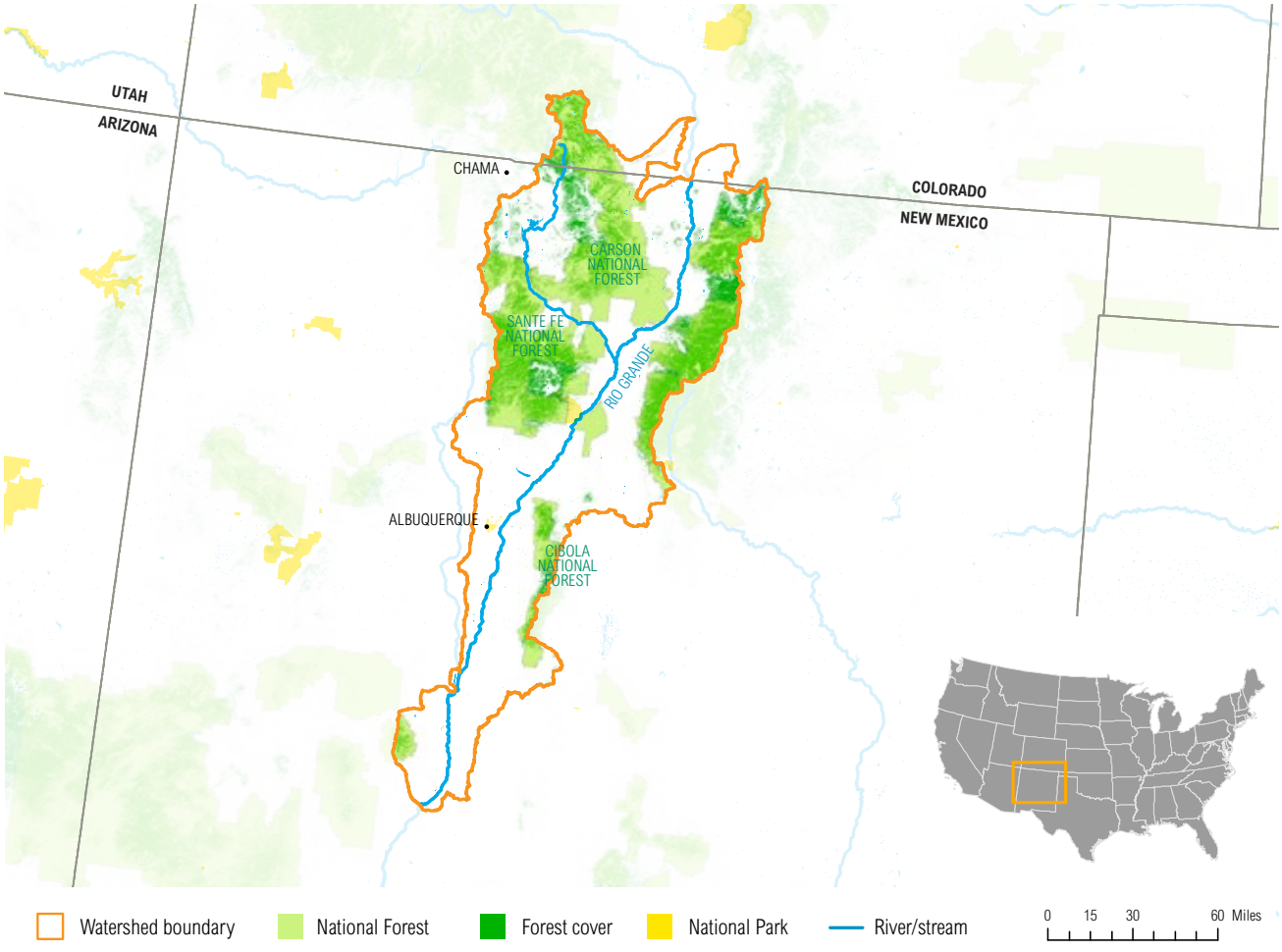
Case 10: Rio Grande Water Fund

Background

The Rio Grande watershed supplies water to about half of New Mexico's population (Figure 17). As elsewhere in the arid Southwest, frequent wildfires and post fire flooding threaten the health of the watershed. The Rio Grande Water Fund is a project of the Wildfire and Water Source Protection effort led by The Nature Conservancy and the Rio and Forest Advisory Board. It builds on the fund model created by Santa Fe to address fire risk at a much larger scale, with complex networks of water users benefiting from both publicly and privately managed forests. The fund's goal is to aggregate investments from natural infrastructure beneficiaries throughout the watershed, and to provide grants with the goal of restoring 600,000 acres of forest on both public and private lands within the next 20 years (RGWF 2014).

In 2012, Lowe's Charitable and Educational Foundation provided initial funding to The Nature Conservancy to explore a water fund model (McCarthy 2014) (Figure 18). Key objectives of the water fund are to restore watershed functions, reduce the risk of wildfires and mitigate their impacts, and secure sustainable financing to achieve these goals (RGWF 2014).

Figure 17 | **Map of Rio Grande Water Fund Program Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

CASE AT A GLANCE

Watersheds: Rio Grande, New Mexico (Figure 17)

Water provider: N/A

Population served: 1 million

Key concerns: Wildfire and flooding risks

Partnership established: 2013

Partners: The Nature Conservancy, Rio and Forest Advisory Board

Funds spent: Over $1 million and $21 million/year planned for next 20 years

Accomplishments:

- Engaged 40 organizations in the development of a comprehensive plan to restore 600,000 acres on public and private lands over the next 20 years at a cost of $21 million/year ($420 million)
- Through 2015, generated $10 million from private, federal, and local sources to support restoration efforts and invited interested parties to submit proposed projects
- 130 acres treated with forest thinning and improved fire management strategies.

Takeaways:

- Implementation of the comprehensive plan could potentially avoid damage costs of $870 million.
- The Water Fund model can be an appropriate strategy for collaboration and aggregation of funds from dispersed beneficiaries to support landscape-scale management.

Assessments and Collaboration

As a first step toward developing the Rio Grande Water Fund, organizers convened an advisory board of over 45 watershed stakeholders to guide The Nature Conservancy staff in developing its *Comprehensive Plan for Wildfire and Water Source Protection* (RGWF 2014). This document describes the vision and structure of the Rio Grande Water Fund, while also conducting ecological and economic analyses that make the case for coordinated, watershed-wide restoration. It calls for an investment of $21 million each year for the next 20 years to fully restore the watershed. It makes the case for this investment by contrasting the costs of forest restoration, an estimated $700 per acre, with the economic impacts of damaging wildfires, which can reach $2,150 per acre.

The Nature Conservancy and advisory board members are currently engaging entities that benefit from Rio Grande water quality to contribute to the Rio Grande Water Fund. These potential investors include water providers in communities such as Albuquerque and Santa Fe, irrigators, industrial water users, and the insurance industry (Lyons 2014).

Key Leadership and Champions

Key individuals within The Nature Conservancy New Mexico Chapter and The Nature Conservancy as an organizational whole were integral to the formation of the Rio Grande Water Fund. In 2013, The Nature Conservancy convened an advisory board to help shape the fund, which grew from 23 organizations and agencies to over 40 involved entities by the end of that year (RGWF 2014). The advisory board provided input on the creation of the fund by identifying areas where studies were needed and advising on the structure and governance of the fund (RGWF 2014). Laura McCarthy and Dale Lyons, both at The Nature Conservancy, played central roles in conceptualizing and organizing the Rio Grande Water Fund.

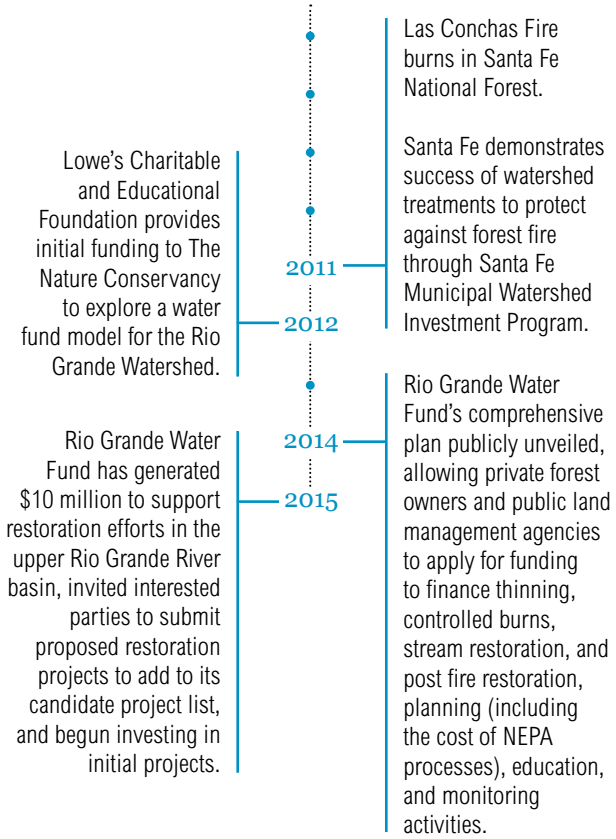
Program organizers recognize that ongoing outreach to elected officials, water utilities, and ratepayers will be needed to build awareness of large-scale (rather than localized) threats to watershed health, and to mobilize the financial commitments needed to achieve the Rio Grande Water Fund's

goals. To this end, the Rio Grande Water Fund's comprehensive plan specifies that the fund will provide grant support to water quality and watershed health outreach and education programs, and that The Nature Conservancy will develop and implement a marketing and communications plan for the fund.

Accomplishments to Date

Publicly unveiled in August 2014, the Rio Grande Water Fund's comprehensive plan provides a detailed description of the fund as a coordinating mechanism to aggregate donations from individuals, businesses, corporations, foundations, and governments, and to make them available to reduce fire risks on both public and privately owned lands (RGWF 2014). Previously, private forest owners and public land management agencies within four geographic focal areas of the Rio Grande were able to propose projects through requests for proposals to finance thinning, controlled burns, stream restoration, and post fire restoration, planning (including the cost of NEPA processes), education, and monitoring activities (RGWF 2014). Upon the most recent review of the Fund's charter signatories, it

Figure 18 | **Rio Grande Water Fund Timeline**



was decided that the fund would collaboratively develop landscape restoration strategies, and once completed, the prioritized projects would be eligible for funding from the Rio Grande Water Fund. Applications will be evaluated by an advisory board subcommittee that will rank projects based on four criteria: the condition of or threat posed to the area's natural resources, the opportunity to act, the urgency of the project, and the project's economic development potential.

As of February 2016, the Rio Grande Water Fund had generated $10 million from private, federal, and local sources to support restoration efforts in the upper Rio Grande River basin. Early in 2015, it invited interested parties to submit proposed restoration projects to be added to the "Rio Grande Water Fund Candidate Project List." Approved projects will become priorities as the Rio Grande Water Fund gains more funding (RGWF 2015).

Case 11: San Francisco Public Utilities Commission Watershed and Environmental Improvement Program

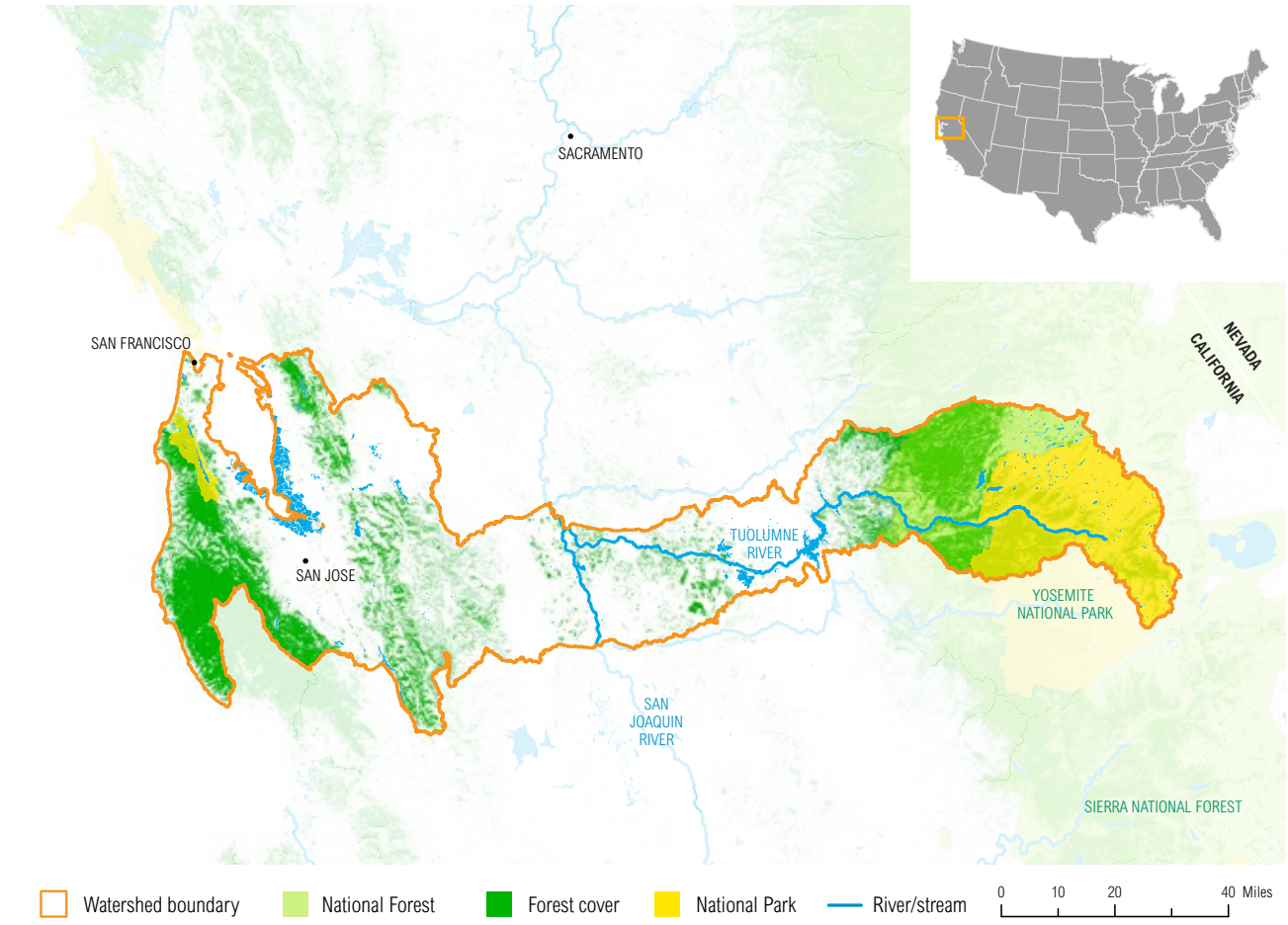
Background

In California, the San Francisco Public Utilities Commission experienced both gradual changes in its watershed, like land development and drought, and fast-moving catastrophic events, like wildfires. Its Watershed and Environmental Improvement Program funds measures to protect and restore natural resources while protecting water quality. These measures include, but are not limited to, land acquisition and conservation easements on private lands. The Watershed and Environmental Improvement Program also funds watershed protection on federal lands.

The San Francisco Public Utilities Commission (SFPUC) is the third-largest municipal utility in the state of California. Its complex water supply system extends from the Sierra Nevada region to San Francisco (SFPUC 2013). Eighty-five percent of San Francisco's water originates in the Tuolumne River watershed in Yosemite National Park. The system delivers water 167 miles across California entirely by gravity to consumers in San Francisco and neighboring Alameda, Santa Clara, and San Mateo Counties (SFPUC 2013).

In 2005, the SFPUC initiated the Watershed and Environmental Improvement Program, a 10-year $50 million program spanning the Peninsula, Alameda Creek, and Tuolumne watersheds, as well as areas in San Francisco. It strives to "proactively manage, protect and restore environmental

Figure 19 | **Map of San Francisco Public Utilities Commission Watershed and Environmental Improvement Program Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

CASE AT A GLANCE

Watersheds: Peninsula (San Mateo Creek and Pilarcitos Creek), Alameda Creek, and Tuolumne, areas of San Francisco, California (Figure 19)

Water provider: San Francisco Public Utilities Commission

Population served: 2.6 million

Program established: 2005

Key concerns: Development threats, wildfire and flooding risks, drought and declining water supply, ecological threats

Partnership: San Francisco Public Utilities Commission, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, Upper Alameda Creek Watershed Partnership organizations, Alameda County Flood Control and Water Conservation District

Funds spent: $50 million over 10 years

Accomplishments:

- Addressed concerns regarding watersheds that drain into San Francisco Public Utilities Commission reservoirs, including land and easement purchases, habitat protection, restoration, preservation, outreach and education, and public access
- Helped create the Upper Alameda Creek Watershed Partnership in order to collaborate with local organizations in connecting to private landowners for land conservation actions
- Leveraged funding from a built infrastructure bond measure to fund watershed improvements, and matched $20 million in bond funds with $30 million from the San Francisco Public Utilities Commission operating budget
- Protected approximately 3,020 acres of key properties along the Tuolumne River and in the Alameda Creek watershed

Takeaways:

- Bond measures for infrastructure improvements can contain provisions for natural infrastructure investment, helping water providers leverage their own investments.
- Creating groups like the Upper Alameda Creek Watershed Partnership can allow investors to better connect with private landowners and increase the potential to scale projects.

resources" that affect, or are affected by, the SFPUC's operations (SFPUC 2015). The origin of the Watershed and Environmental Improvement Program's funding dates to 2002, when San Francisco voters approved a bond to improve the SFPUC's water delivery, including through watershed and environmental improvements (SFPUC 2015). In 2005, the Bay Area Water Stewards (a group of conservation organizations) urged the SFPUC to set aside some of the bond funds to implement watershed and environmental improvements, adding funding to preexisting watershed and mitigation projects (SFPUC 2015). The SFPUC allocated $20 million from the bond measure funds and committed an additional $30 million from its Water Enterprise operating budget (approximately $3 million per year) to fund the Watershed and Environmental Improvement Program (SFPUC 2015).

The Watershed and Environmental Improvement Program's highest priority in the Alameda watershed is to "permanently protect watershed lands through the purchase of conservation easements and/or fee title from willing landowners of property that drains directly into SFPUC reservoirs" (SFPUC 2015). The program identifies critical watershed lands and ecosystem restoration needs within the Alameda Creek, Peninsula (San Mateo and Pilarcitos Creeks), and Tuolumne River watersheds in order to address issues on a watershed-by-watershed basis (SFPUC 2015). Because of the size and checkerboard nature of landownerships within the SFPUC Alameda watershed, the Watershed and Environmental Improvement Program employs a multipronged approach to address a diverse range of challenges, including fire risk, drought, land-use change, development, and ecological threats.

Fires pose a significant threat in the region. The third largest in California history, the 2013 Rim Fire in the Sierra Nevada affected 257,000 acres in the Stanislaus National Forest and Yosemite National Park and cost over $127 million (InciWeb 2013). While the Hetch Hetchy watershed was largely unscathed, the fire served to remind the SFPUC of the need to remain vigilant about mitigating wildfire risks.

Assessments and Collaboration

The Watershed and Environmental Improvement Program supports the Upper Tuolumne River Ecosystem Program in partnership with the National Park Service, U.S. Forest Service, and U.S. Fish and Wildlife Service. The Upper Tuolumne River Ecosystem Program includes a series of studies and planning efforts designed to improve instream flow releases from O'Shaughnessy Dam to better mimic natural snowmelt hydrology. Additionally, in the Tuolumne River watershed, the SFPUC works directly with the National Park Service to fund studies of water quality and quantity, and to support ranger positions for National Park Service staff to patrol the watershed.

To coordinate conservation efforts in the Alameda Creek watershed, approximately 60 percent of which is not protected, SFPUC is engaged with the Upper Alameda Creek Watershed Partnership—a group of NGOs and public agencies interested in land conservation, including The Nature Conservancy, the Guadalupe Coyote Resource Conservation District, the California Rangeland Trust, the Santa Clara County Open Space Agency, the Trust for Public Land, the Alameda County Resource Conservation District, and the USDA Natural Resource Conservation District. Over a series of stakeholder engagement sessions, the entities outlined their collective mission goals, the focus of each individual organization, and the approval processes for each agency. Additionally, the stakeholders are creating a map of property owners in the region to identify priority areas in the watershed. With the priority areas identified, the SFPUC, along with the Upper Alameda Creek Watershed Partnership, is working with private landowners to establish conservation easements and land acquisitions for conservation purposes.

The SFPUC owns almost 100 percent of the Peninsula watershed lands. The Watershed and Environmental Improvement Program focuses on protecting the natural resources and providing restricted public access to the watershed. The SFPUC has collaborated with the U.S. Forest Service to understand the spread of sudden oak death and possible treatment. The Watershed and Environmental Improvement Program has also funded recreation opportunities in the watershed, which the SFPUC considers a key component of its outreach and education programming.

Carla Schultheis, watershed and environmental improvement program coordinator at the SFPUC, noted the influence that this engagement has had in fostering a culture of collaboration among stakeholders. Through group discussions, each entity became familiar with the stakeholders in the field and more receptive to a collaborative approach.

Key Leadership and Champions

The Watershed and Environmental Improvement Program evolved from the work of multiple advocacy groups. To garner sufficient support for the bond measure, the SFPUC required support from the Bay Area Water Stewards, who pushed for the utility to engage in proactive environmental work. Only after persistent efforts and lengthy discussions between the Bay Area Water Stewards and the SFPUC did the Watershed and Environmental Improvement Program develop into the program it is today.

Accomplishments to Date

The Watershed and Environmental Improvement Program is in its ninth year of an initial 10-year investment period (Figure 20). The SFPUC estimates that the program will have spent $27.9 million by the end of FY 2014/2015, ($10 million of bond funds, and $17.9 million of operations budget), which leaves another $22.1 million for the coming years (SFPUC 2015).

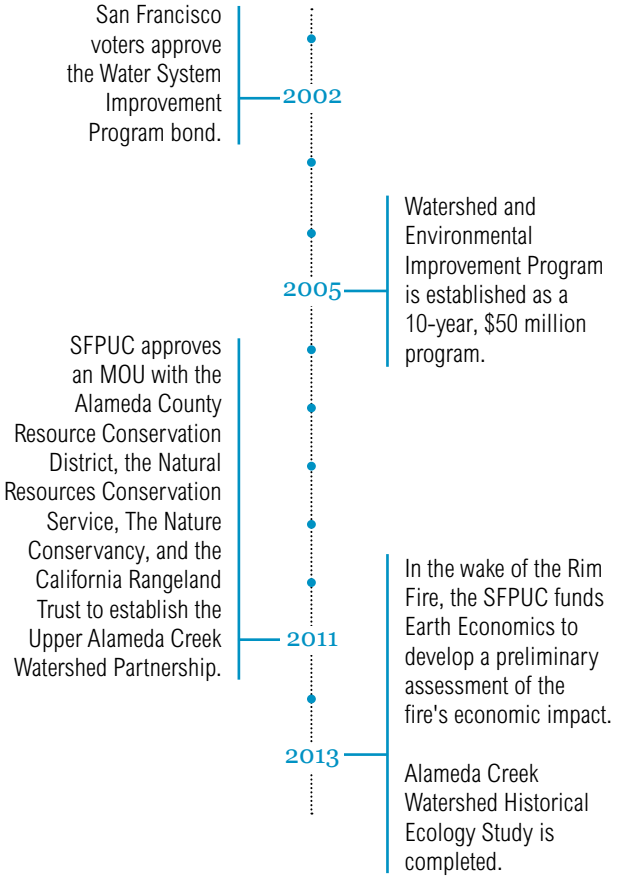
Recent accomplishments include the completion of the Alameda Creek Watershed Historical Ecology Study. The study contributed to an understanding of the historical extent and function of terrestrial, fluvial, riparian, and wetland resources in the Alameda watershed. The study will inform future restoration activities throughout the SFPUC watershed lands.

The SFPUC credits its work with the Upper Alameda Creek Watershed Partnership organizations as critical to its productive collaboration with private landowners. The SFPUC depends on these local organizations with established credibility and trust to conduct landowner outreach, education, monitoring, and easement enforcement.

To date, the Watershed and Environmental Improvement Program has funded a broad range of initiatives, including supporting National Park Service studies that inform park management plans, efforts to protect rare plants in the Peninsula watershed, the development of the Alameda Creek Watershed Center, and implementation of fish restoration projects, among other activities.

Looking forward, the SFPUC will focus on educational and recreational opportunities in the Alameda and Peninsula watersheds. The Alameda Creek Watershed Center will be completed in 2019, and several new trails in the vicinity of the center are in the early planning phases. In the Peninsula watershed, two important connections to local and regional trail systems will be completed in the next few years along with a plan for interpretive signage along the trails. It is expected that one large conservation easement in the Alameda watershed will be finalized. The SFPUC has already allocated funds for continuing the program, albeit at a lower level than in the program's first 10 years.

Figure 20 | **Watershed and Environmental Improvement Program Timeline**



Case 12: Santa Fe Municipal Watershed Investment Program

Background

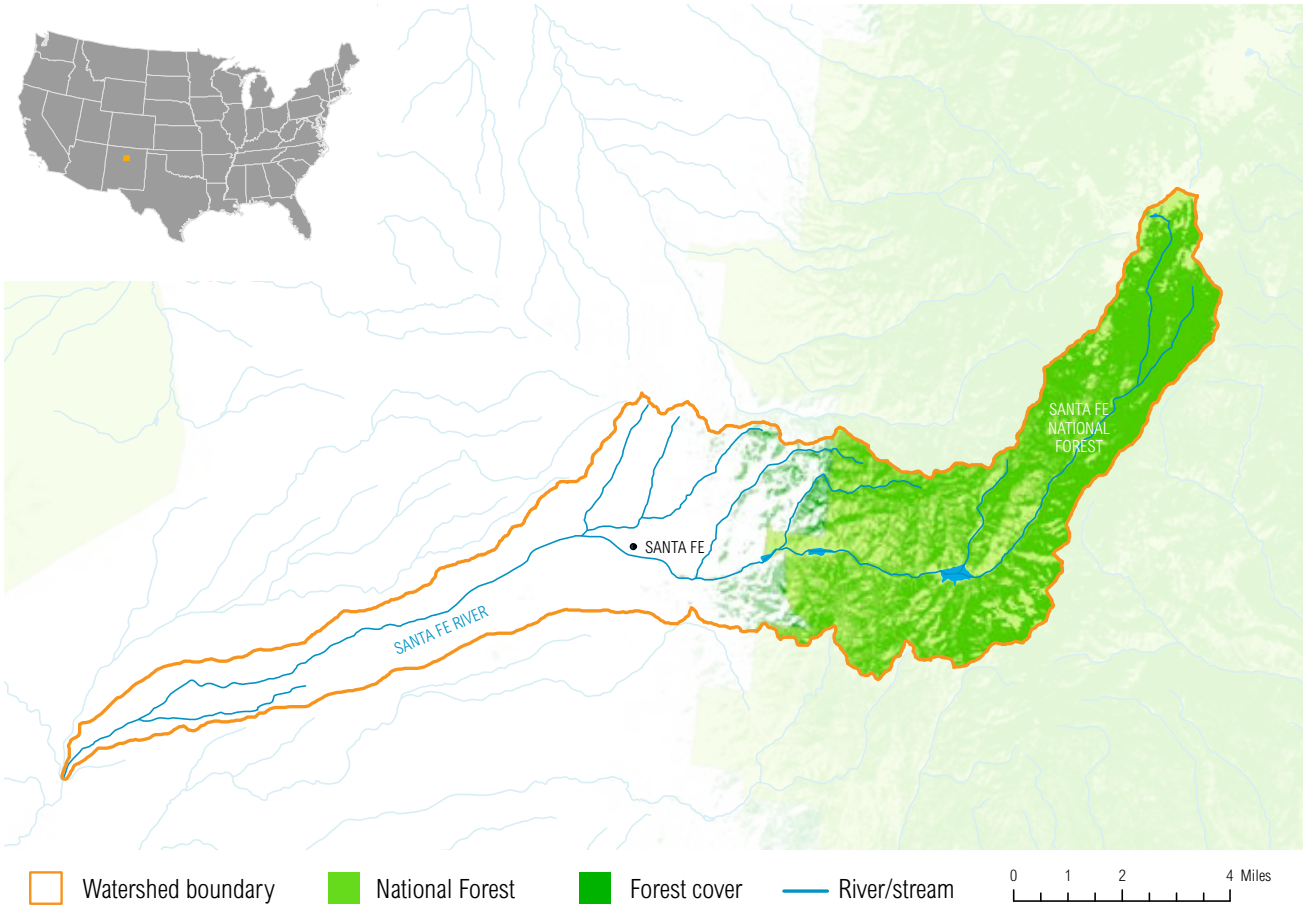
Santa Fe's Municipal Watershed Investment Program, which seeks to protect municipal water supply in the face of significant wildfire risk, was the first partnership of its kind in the arid West.

The 17,200-acre Santa Fe municipal watershed lies completely within the public lands of the Santa Fe National Forest. The Santa Fe River originates within the Santa Fe National Forest on the slopes of the 12,000-foot Sangre de Cristo range and flows through Santa Fe's downtown to its confluence with the Rio Grande. The Upper Santa Fe municipal watershed is a highly visible part of the city's landscape and serves as one of the principal water sources for 30,000 households and businesses in the Santa Fe area (Everett et al. 2013).

By the late 1990s, it became clear that the Santa Fe municipal watershed was highly susceptible to wildfire (Grant 2009; Margolis et al. 2011). Recent severe fires, especially the 2000 Cerro Grande Fire, the 2011 Las Conchas Fire, and the 2012 Whitewater-Baldy Fire, underscored this risk (McCarthy 2014). The Cerro Grande Fire in particular caught Santa Fe's attention, destroying 280 homes in nearby Los Alamos and halting municipal water delivery for 4 months (McCarthy 2014).

In the aftermath of the Cerro Grande Fire, city leaders in Santa Fe began considering the potential fire impacts on the municipal watershed and the two reservoirs that supply 30 percent of the city's water

Figure 21 | **Map of Santa Fe Municipal Watershed Investment Program Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

CASE AT A GLANCE

Watersheds: Santa Fe River (sub basin of the Rio Grande watershed), New Mexico (Figure 21)

Water provider: City of Santa Fe Water Division (municipally owned utility)

Population served: 78,000

Key concerns: Forest fire (2000 Cerro Grande Fire), drought, climate change

Program established: Partnership formalized in 2009

Partners: City of Santa Fe Water Division, Santa Fe National Forest, local conservation organizations (e.g., Santa Fe Watershed Association and The Nature Conservancy)

Funds spent: $8.3 million for work in lower elevation portion of the municipal watershed ($7 million from a congressional earmark; $1.3 million from NM Water Trust Board); water rate increase implemented in 2009 to fund multiple water utility priorities, including the work in upper watershed ($220,000/year)

Accomplishments:

- Forest restoration treatments completed in lower non-wilderness portion of watershed (5,500 acres) through Municipal Watershed Project
- Development of the 20-year Municipal Watershed Plan, which lays out strategy for maintaining reduced wildfire risk in treated areas and further treatments in the wilderness portion of the municipal watershed that poses wildfire risk to municipal supply
- As part of ongoing monitoring effort, constructed new water quality and quantity infrastructure

Takeaways:

- Municipal ownership of the water utility facilitated a proactive strategy by the city to take responsibility for watershed management.
- Assessments demonstrating fire risk in a highly visible area were leveraged to build public support.
- Community organizations played an important role in addressing public concerns regarding controlled burns and in lobbying for funds, allowing the city to focus its efforts on funding and contracting project work.

(McCarthy 2014). Over the following 15 years, the City of Santa Fe Water Division and the U.S. Forest Service unrolled two projects to restore and maintain forest health. From 2002 to 2009, the Municipal Watershed Project reduced fuel loads within the non wilderness portion of the watershed. The subsequent Municipal Watershed Investment Program began when the Municipal Watershed Plan (first developed in 2009 and updated in 2013) set out a strategy for restoring the remainder of the watershed and maintaining forest health through 2029. These two projects represented a significant and innovative step in Santa Fe's municipal water protection efforts through watershed investment strategies.

Assessments and Collaboration

Local networks of environmental educators, land managers, city employees, and conservation organizations played key roles in mobilizing resources and support for the Municipal Watershed Project and the subsequent Municipal Watershed Plan.

Santa Fe's public conversation about watershed health began when the city purchased its water system from a private utility in 1995, giving Santa Fe a direct stake in protecting its water supply. In 1997, the city and the Santa Fe National Forest began a collaborative assessment of the watershed. The resulting report found that much of the watershed, particularly the mid elevation ponderosa and mixed conifer forests around the city's reservoirs, faced a high risk of fire (Grant 2009).

Following the release of the assessment, the U.S. Forest Service initiated a public scoping process to identify potential fuel reduction treatments in the watershed. The frequent meetings required by NEPA's scoping process provided an opportunity to strengthen relationships and build a shared recognition of the need for forest restoration among a range of key watershed stakeholders, laying the foundation for an ongoing partnership between the City of Santa Fe Water Division, the Santa Fe National Forest, and local conservation organizations—most notably the Santa Fe Watershed Association (Hurlocker 2014).

Sustained public engagement was a key focus of this program, including educational field trips into the watershed. Public opinion research conducted in 2011 assessed ratepayer willingness to pay for

water source protection through forest restoration in the municipal watershed. Over 80 percent of survey respondents indicated their willingness to pay, on average, an additional 65 cents per monthly bill toward the fund, and nearly two-thirds of these participants said they would pay up to $2 a month on their bill (Metz et al. 2011; McCarthy 2014).

Both the U.S. Forest Service and the City of Santa Fe refer to their collaboratively developed Watershed Management Plan as the primary document outlining overall treatment goals and guiding each partner's role in the program (Everett et al. 2013). The 20-year plan was first developed in 2009 and revised in 2013. The document includes the following elements:

- An introduction to the payment for ecosystem services program
- A vegetation management plan outlining preliminary fuel reduction treatments in the wilderness portion of the watershed and maintenance treatments for the entire watershed
- A water management plan for restoration and stream flow management around and between reservoirs
- A public outreach plan to deepen community engagement with watershed health

Staff from the Water Department and the U.S. Forest Service meet annually to develop a work plan and cost-share agreement outlining and scheduling specific treatments. Allan Hook (2014), water resources analyst with the utility, describes this annual goal-setting as an important part of maintaining momentum in a long-term project.

The Santa Fe annual work plan has enabled adaptive management, as it is easier to modify and update this plan than to rely upon a formal federal partnership agreement. As a result, partners have been able to define specific treatments in response to changing environmental factors and agency capacities over time. For example, a drought in 2011 limited the U.S. Forest Service's ability to conduct prescribed burns that year. As a flexible, 5-year collection agreement had been established, however, the Forest Service was able to allocate that year's unspent funds toward work in future years, preventing a reduction in treatments that otherwise would have occurred.

Key Leadership and Champions

The sustained advocacy of conservation nonprofits allowed the U.S. Forest Service to take on the potentially controversial project of forest treatments for fire prevention. During the NEPA process, proposed treatments in the Santa Fe municipal watershed faced opposition from some local conservation and environmental groups due to concerns about impacts on habitat, opposition to interventions in designated wilderness, and a lack of trust in the U.S. Forest Service. Interviewees noted that, unlike the U.S. Forest Service, the Santa Fe Watershed Association held credibility through a history of environmental advocacy, which allowed it to make a more convincing case for forest treatments to the broader community (Hurlocker 2014).

Advocacy groups took on lobbying work, which allowed the U.S. Forest Service to focus its resources on planning and implementing forest treatments (Hurlocker 2014; Lyons 2014). Paige Grant of the Watershed Association and Laura McCarthy of The Nature Conservancy lobbied city leaders, New Mexico's congressional delegation, and higher levels of the U.S. Forest Service for funding. Thanks in part to this support, the project received $7 million in congressional earmarks and $1 million from the New Mexico Water Trust Board.

Dedicated city and U.S. Forest Service staff also provided the sustained support needed to move both projects from idea to implementation. Santa Fe's Water Resources Projects Coordinator collaborated with U.S. Forest Service District Rangers John Miera and Sandy Hurlocker to build and maintain relationships between the institutions. Beyond their advocacy, the Santa Fe Watershed Association and The Nature Conservancy also provided crucial support in planning and analysis (Lyons 2014).

Accomplishments to Date

Between 2002 and 2009, partners mobilized the appropriation of $7 million in congressionally earmarked funding to thin 5,500 acres of forests in the lower portion of the municipal watershed that were of critical importance to Santa Fe's water supply (McCarthy 2014) (Figure 22). The revised 2013 Watershed Management Plan outlines a comprehensive program for restoring the upper portion of the watershed. The collection agreement with the

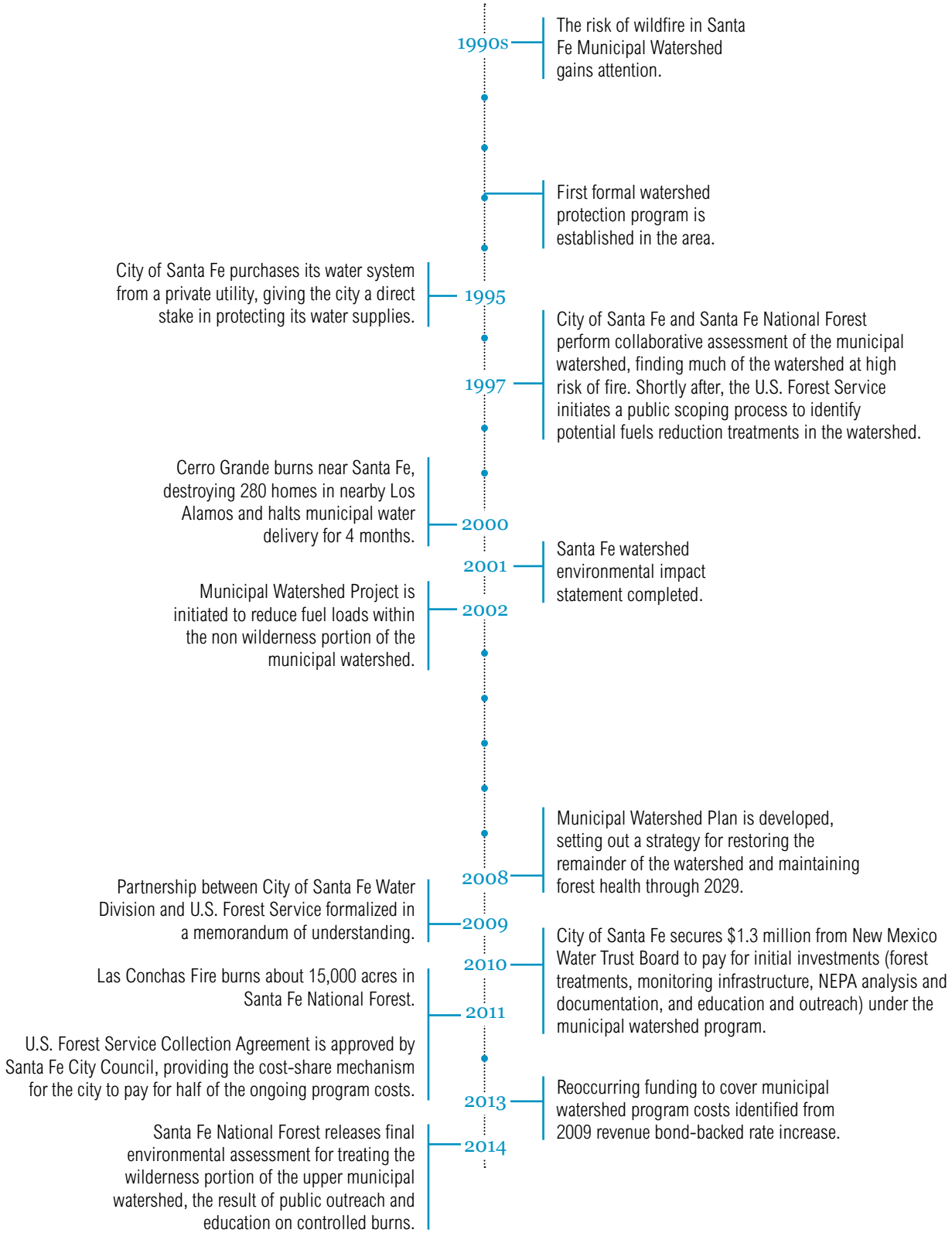
Santa Fe National Forest was approved by the city council in 2011 to serve as the city's main mechanism for paying its share of forest restoration. Since 2009, approximately 6,000 acres have been treated in the municipal watershed, including some initial thinning and slash piling, pile burning, and broadcast burning. In addition, the City Water Division has constructed new stream gauges and installed precipitation gauges in order to monitor watershed response to project activities.

Developed by a range of project partners and approved by Santa Fe's City Council, the 2009 Watershed Management Plan outlines steps to restore mixed-conifer areas in wilderness that pose a significant wildfire risk, and continue to maintain forest health throughout the municipal watershed through 2029. The plan set a goal of moving away from piecemeal funding by identifying a reoccurring source of program funding based on payment for ecosystem services (Lyons 2014). This goal was realized in 2013 when funding from a revenue bond and accompanying rate increase originally issued to construct a new water diversion facility was permanently redirected to cover ongoing program costs. This strategy emerged in response to the city council's hesitation to approve a separate water rate increase for the Watershed Investment Program, because it directed money to the program without a net increase in customers' water bills.

This water rate increase occurred in 2009, after the original $7 million of funding from congressional earmarks and the New Mexico Water Trust had been spent on watershed treatments. Additional revenue from the rate increase provides approximately $220,000 per year, beginning in fiscal year 2013–2014. Watershed treatment costs are split 50-50 between the city and the U.S. Forest Service, for a total investment of $3 million each over 20 years. This agreement includes funding for water quality and restoration treatment monitoring, youth education, and community outreach (Derr et al. 2009).

Initially, the U.S. Forest Service was hesitant to treat the wilderness portions of the upper watershed, but this is changing. Because the area is designated wilderness, it would have been difficult to secure authorization for the use of mechanized treatment techniques; at the same time, concern from some residents about smoke made controlled burns a challenging alternative. Support from watershed partners proved key to addressing these concerns. Ultimately, community organizations worked to educate the public about smoke and controlled burns and facilitated analysis of alternatives in the NEPA process. Santa Fe National Forest released a final environmental assessment for this project in June 2014, describing a treatment strategy that uses controlled burns to restore mosaic patterns in the forest structure, reducing the potential for a sustained high-intensity fire (Hurlocker 2014).

Figure 22 | **Santa Fe Municipal Watershed Timeline**



Case 13: Upper Neuse Clean Water Initiative

Background

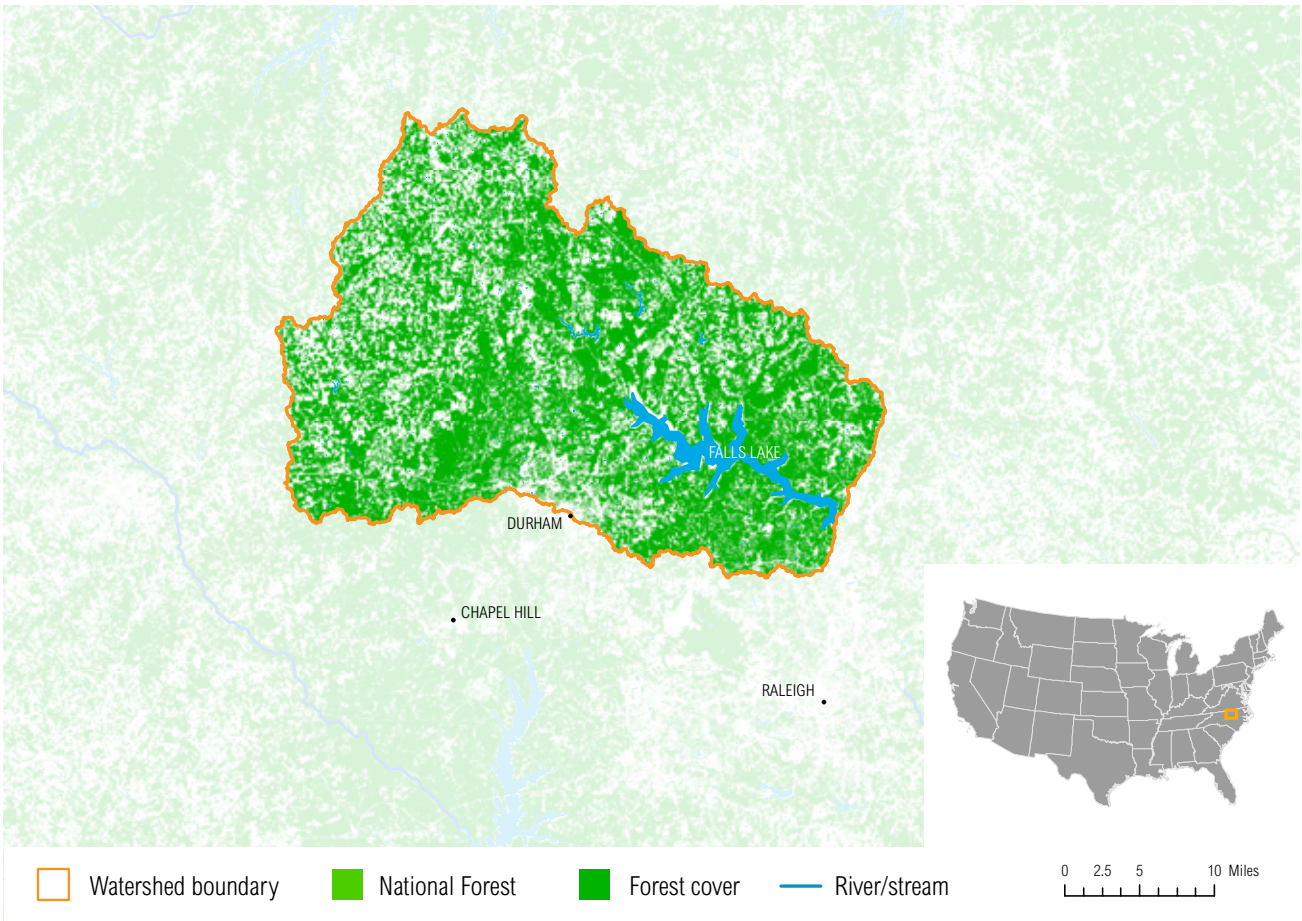
The Upper Neuse River basin in North Carolina's north-central Piedmont region drains over 770 square miles. It provides drinking water to eight municipalities, serving as the principal water source for about 500,000 residents of the Raleigh metro area (Triangle Land Conservancy and Tar River Land Conservancy 2010). Over 50 percent of the basin is forested, and much of this land is privately owned and unprotected.

The Upper Neuse Basin's population is projected to increase by 50 percent by 2050, leading to increases in both drinking water demand and development pressures on the unprotected forests (CTNC n.d.).

Falls Lake, a prominent water body within the Upper Neuse Basin, has faced water quality threats from non–point source nutrient pollution and algal blooms since the 1980s and was added to the Clean Water Act 303(d) list of impaired waters in 2008. Continued deterioration of water quality could force Raleigh to upgrade its water treatment plant, at a potential cost of up to $200 million (Reichers 2011).

The Upper Neuse Clean Water Initiative (UNCWI) responds to these concerns. Coordinated by the Conservation Trust for North Carolina, the initiative brings together the City of Raleigh and six local land trusts. The initiative targets critical areas through land acquisition, conservation easements, and sustainable forestry, providing landowners with an additional revenue stream while mitigating development threats and avoiding additional nutrient pollution.

Figure 23 | **Map of Upper Neuse Clean Water Initiative Area**



Source: Hansen et al, USDA Forest Service, US Geological Service, Esri, NASA, WWF, USGS EROS, Global Runoff Data Centre, GeoNames, Commonwealth of Australia Bureau of Meteorology, USGS, EPA, National Atlas. TomTom, US Department of commerce, US Census Bureau

CASE AT A GLANCE

Watershed(s): Upper Neuse Basin, North Carolina (Figure 23)

Water provider: Raleigh Public Utilities

Population served: 500,000

Program established: 2005

Key concerns: Increases in water demand, population growth, development threats, and water quality deterioration

Partners: Conservation Trust for North Carolina, City of Raleigh, and six local land trusts

Funds spent: A total of $5.8 million in City of Raleigh funding had been spent as of 2015. Approximately $7.3 million in revenue has been generated, composed of $3.7 million from nutrient impact fees for new water and sewer hookups between 2005 and 2011, and approximately $1.3 million/year since 2011 from watershed fees charged to users. These investments have been matched 8:1 by a range of grants and in-kind donations. In 2015, the City of Raleigh approved a water use fee increase to make an additional $750,000 per year available for program implementation.

Accomplishments:

- Protected 88 properties with 84 miles of stream banks across 7,698 acres
- Adopted watershed protection surcharge of $0.15 per 1,000 gallons of water, a financing mechanism that provides more than $2 million a year for water quality protection; this surcharge leveraged matching funds at an impressive ratio of 1 (surcharge revenue): 8 (other sources)

Takeaways:

- Concerns over water quality and costly regulatory compliance were the primary driver of the initiative.
- Advocacy by Raleigh's mayor, sustained funding, and relationships with land trust partners were pivotal to the realization and continuation of the initiative.

Assessments and Collaboration

The UNCWI convened a technical advisory group, which developed a two-part prioritization model to identify areas for conservation. First, a watershed assessment scored the impact of individual catchments on Falls Lake water quality according to a combination of ecological indicators, including forest cover. Second, an implementation model identified priority parcels within each catchment based on size, management practices, and development pressures (Triangle Land Conservancy and Tar River Land Conservancy 2010).

The UNCWI takes advantage of each partner organization's expertise and fundraising capabilities. The land trusts have 10 to 30 years of local experience through which they have developed relationships with landowners and knowledge of matching grant programs that fund land and easement purchases. However, the land trusts often lacked a reliable source of funds to cover operations and on which to base these matches. The city's watershed protection surcharge provides guaranteed funding, without matching requirements, which the land trusts can use to leverage other sources of funding (Burke 2014).

The Conservation Trust for North Carolina's preexisting relationships with the land trusts and experience with facilitating multi party grants allow it to act as an intermediary between the city and the land trusts, streamlining communications and reducing coordination costs on both ends. Each land trust works in a distinct geographical area of the watershed, avoiding potential redundancy or duplication of efforts.

The UNCWI includes dedicated partnership staff at both the utility and the Conservation Trust for North Carolina. The Conservation Trust staff person performs all administrative functions needed for the program, including coordinating with partners and local land trusts, processing invoices, communicating with and educating the public, and searching for funding opportunities. Raleigh Public Utilities dedicated a staff person to coordinate UNCWI efforts to investigate metrics for program success, and to direct resources toward building the capacity of land trust partners. Interviewees cited this position as necessary for shepherding projects through the city's review and approval process.

Key Leadership and Champions

The UNCWI benefited from the dedicated efforts of Raleigh's elected officials. The process that led to its formation began when a local conservation group met with Raleigh's mayor, Charles Meeker, to propose upstream land conservation as a way to address water quality degradation in Falls Lake. Meeker embraced the idea and discussed it in his "state of the city" speech. Lisa Creasman, the conservation projects director at the Conservation Trust for North Carolina at that time, credits Mayor Meeker's "intuitive, value-based leadership" as "crucial" to the program's establishment. According to Creasman, Meeker was an ideal champion and convener, able to "get the right people in the room" and build publicly visible support for the program among council members.

Raleigh's city council, on which the mayor sits, also serves as the water utility's governing body. At Meeker's prompting, the council voted in 2005 to approve a $500,000 grant to fund UNCWI. UNCWI partners report that Meeker and the council's clear support proved especially important to overcoming initial skepticism on the part of utility personnel, who questioned the cost-effectiveness of natural infrastructure investments compared to built solutions.

Accomplishments to Date

Between 2006 and 2015, the UNCWI supported its six land trust partners in protecting 88 properties with 84 miles of stream banks across 7,698 acres of the 492,800-acre watershed (UNCWI 2015) (Figure 24). The Upper Neuse Clean Water Initiative has historically monitored several proxy indicators (dollars spent, acres of forest conserved, and miles of stream bank protected) to evaluate program impacts, but it is moving toward modeling water quality performance. Program partners have now developed biophysical models that estimate how much nutrient runoff is avoided by keeping a parcel of forest intact.

The program was initially funded through one-time "nutrient impact fees" collected from new hook ups to the water and sewer system. However, in 2011, the city council established a permanent financing mechanism through a watershed protection surcharge of 10 cents per 1,000 gallons, which was increased to 15 cents per 1,000 gallons in 2015. The new rate is forecast to provide more than $2 million each year for water quality improvements. This surcharge is clearly delineated on water bills as a "watershed protection fee" and averages about 60 cents per month per household. Leigh Ann Hammerbacher, the city's water conservation specialist, reports that the utility has received "remarkably little" pushback from customers about the surcharge.

Program advocates cite two factors that contributed to the city council's support of a watershed protection surcharge, which went into effect in 2012. First, an interactive online tool developed by the University of North Carolina Environmental Finance Center communicated the affordability of source water protection by letting decision-makers explore the impacts of incremental rate increases both on revenue generation and on customers' water bills.

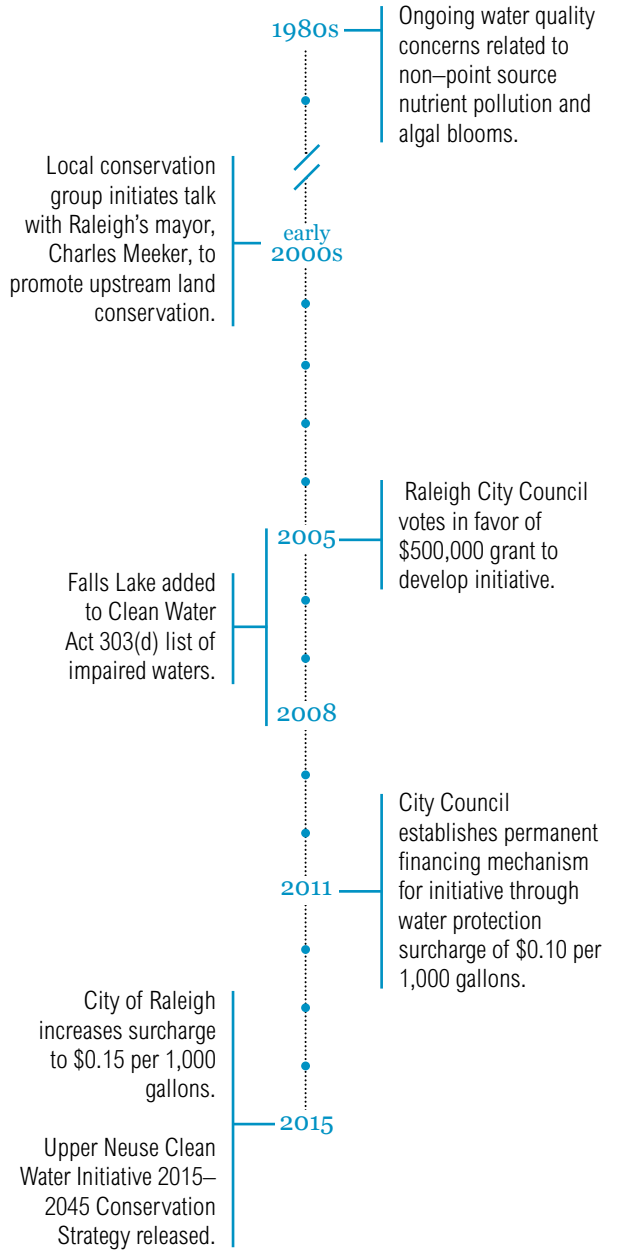
Second, the UNCWI's work over the previous 6 years demonstrated a strong record of successfully leveraging a wide range of funding sources to complete land and conservation easement purchases. The Conservation Trust for North Carolina and the six land trust partners have leveraged the city's funding with grants and in-kind donations totaling $72 million (UNCWI 2015). To date, each dollar of

funding from Raleigh water users has been matched with an average of $8 from other sources, including the Clean Water Management Trust Fund, the North Carolina Attorney General's Environmental Enhancement Grants, the U.S. Endowment for Forestry and Communities, a USDA Conservation Innovation Grant, contributions from Durham and other regional municipalities, and in-kind land donations from landowners. The UNCWI's proven track record in leveraging funds inspired confidence in the financial viability of the proposal and influenced the council's decision to support the surcharge (Burke 2014; Creasman 2014).

UNCWI partners continue to refine the program. Directly quantifying the water quality and economic impacts of conservation actions has posed an ongoing challenge. The UNCWI and Raleigh Public Utilities have convened a technical advisory committee to better model the water quality impacts of conservation easement purchases and to better estimate the investment needed to avoid increased water treatment costs. The UNCWI is expanding its work to preserve forest cover in the utility's most recent source watershed, Swift Creek. The UNCWI partners acquired one conservation easement in this new drinking water watershed and are considering rebranding the UNCWI as the "Watershed Protection Program" to reflect this broader focus (Hammerbacher 2014).

In 2015, the UNCWI published a conservation strategy for the next 30 years (2015–2045) that provides a framework for protecting drinking water supplies through land protection, including specific goals and metrics for measuring success. In designing and updating the land conservation strategy, the UNCWI also developed an enhanced GIS-based watershed protection model that uses the latest and best available science and geographic data to refine and refocus land protection priorities. After 10 years of operation, the UNCWI covers all of the City of Raleigh's active water supply watersheds. Project types have included land acquisition, easements, forestry best management practices, and landscape restoration.

Figure 24 | **Upper Neuse Clean Water Initiative Timeline**



APPENDIX A. EXPERT ADVISORY COMMITTEE

- America Water Works Association
- Association of Metropolitan Water Agencies
- Association of State Drinking Water Administrators
- Beaver Water District
- Carpe Diem West
- Clackamas River Water Providers
- Colorado State University Center for Collaborative Conservation
- DC Water
- Earth Economics
- Forest Trends
- The Nature Conservancy
- Pinchot Institute for Conservation
- Salt Lake City Public Utilities
- SIG-NAL
- Trust for Public Land
- USDA Natural Resources and the Environment
- USDA Natural Resources Conservation Service
- USDA Office of Environmental Markets
- U.S. Endowment for Forestry and Communities
- U.S. Environmental Protection Agency
- U.S. Forest Service
- U.S. Water Alliance
- Willamette Partnership
- World Resources Institute
- Yale University School of Forestry and Environmental Studies

APPENDIX B. PROGRAM STAFF AND REPRESENTATIVES CONSULTED IN THIS STUDY

STATE(S) / PROGRAM	CONTACT	POSITION AND ORGANIZATION	INTERVIEW	SURVEY
Arizona Flagstaff Watershed Protection Project	Ann Mottek Lucas	Board of Directors – Greater Flagstaff Forest Partnership; Mottek Consulting, LLC	●	
	Diane Vosick	Director of Policy and Partnerships – Northern Arizona University Ecological Restoration Institute	●	
	Erin Phelps	Project Manager – U.S. Forest Service	●	
	Jeff Peterson	Research Associate – Arizona Rural Policy Institute	●	
	Mark Brehl	Wildfire Specialist – Flagstaff Fire Department	●	
	Paul Summerfelt	Fuel Management Officer – Flagstaff Fire Department	●	●
	Wayne Fox	Director – Arizona Rural Policy Institute	●	
Arkansas Central Arkansas Water	John Tynan	Customer Relations and Public Affairs Department (formerly Watershed Protection Manager)—Central Arkansas Water	●	●
	McRee Anderson	Director, Fire Restoration Program—The Nature Conservancy	●	
	Raven Lawson	Watershed Protection Manager—Central Arkansas Water	●	●
California San Francisco Public Utilities Commission Watershed and Environmental Improvement Program	Carla Schultheis	Watershed and Environmental Improvement Program Coordinator—San Francisco Public Utilities Commission	●	●
	Leslie Koenig	Biologist—Alameda County Resource Conservation District	●	
	Mike Connor	Senior Project Director, Real Estate, California—The Nature Conservancy (formerly California Director of Land Protection—The Nature Conservancy)	●	
	Nancy Schaefer	Bay Area Program Manager—California Rangeland Trust	●	
Colorado	Michael McHugh	Environmental Permitting Coordinator—Aurora Water	●	●
	Boyd Lebeda	District Forester—CO State Forest Service, managing Ft. Collins District	●	
	Bud Duryea	Private landowner	●	
	Craig Magwire	District Ranger—U.S. Forest Service: Sulphur Ranger District	●	
	Jackie Gould	Area Manager—Bureau of Reclamation, Eastern Colorado Area Office	●	
	Jerry Gibbens	Project Manager and Water Resources Engineer—Northern Water	●	●
	Mark Martin	Acting Ecosystem Group Leader – U.S. Forest Service Arapaho and Roosevelt National Forests and Pawnee National Grassland	●	
	Ron Cousineau	District Forester—Granby District, Colorado State Forest Service	●	
	Ron Turley	Rocky Mountain Special Programs Manager—Western Area Power Administration	●	
	Eric Howell	Forest Programs Manager—Colorado Springs Utilities	●	

STATE(S) / PROGRAM	CONTACT	POSITION AND ORGANIZATION	INTERVIEW	SURVEY
Colorado	Kim Gortz	Source Water Protection Manager—Colorado Springs Utilities	●	
	Cary Green	Timber Management Assistant—U.S. Forest Service, White River National Forest		●
	Don Kennedy	Environmental Scientist—Denver Water	●	
	Jan Burke	Forest Health Coordinator—U.S. Forest Service, White River National Forest	●	
	Scott Fitzwilliams	Forest Supervisor—U.S. Forest Service, White River National Forest	●	
	Brad Piehl	Senior Staff—JW Associates	●	
	Carol Ekarius	Executive Director—Coalition for the Upper South Platte	●	●
	Claire Harper	Water Partnership Coordinator/Program Manager—U.S. Forest Service, Rocky Mountain Region	●	
	Evan Burks	Partnership Coordinator—U.S. Forest Service	●	●
	Harris Sherman	Senior Council—Arnold & Porter LLC (formerly Under Secretary—Natural Resources and the Environment, USDA)	●	
	Lisa Corbin	Project Contact—U.S. Forest Service, Pike–San Isabel National Forest	●	
	Marcus Selig	Director, Southern Rockies Region—National Forest Foundation	●	
	Rick Cables	Vice President of Natural Resources and Conservation—Vail Resorts (Formerly Regional Forester for the Rocky Mountain Region of the U.S. Forest Service)	●	
	Rick Maestas	Grants and Agreements Specialist—U.S. Forest Service, Pike and San Isabel National Forest	●	
	Ron Archuleta	Deputy Forest Supervisor—U.S. Forest Service, Arapaho and Roosevelt National Forests and Pawnee National Grassland	●	
	Sara Mayben	Renewable Resources Staff Officer—U.S. Forest Service, Pike–San Isabel National Forest	●	
	Susan Alden Weingardt	Partnership Liaison—U.S. Forest Service, Rocky Mountain Region	●	
	Alan Ward	Water Resources Manager—Pueblo Board of Water Works	●	
	Steven Sanchez	Soil and Water Program Manager—U.S. Forest Service, Pike and San Isabel National Forest		●
Maine Portland Water District	John Gunn	Executive Director—Spatial Informatics Group–Natural Assets Laboratory (formerly Senior Program Leader—Manomet Center for Conservation Sciences)	●	
	Mike Abbot	Source Water Protection Coordinator—Maine Drinking Water Program	●	
	Paul Hunt	Environmental Manager—Portland Water District	●	●
	Todd Gartner	Senior Associate—World Resources Institute	●	

STATE(S) / PROGRAM	CONTACT	POSITION AND ORGANIZATION	INTERVIEW	SURVEY
Delaware, New Jersey, New York, Pennsylvania Delaware River Common Waters Fund	Stephanie Pendergrass Dalke	Project Director—Pinchot Institute for Conservation	●	●
New Mexico Rio Grande Water Fund	Hallie Mahowald	Program Associate—Western Landowners Alliance (formerly Program Associate—Chama Peak Land Alliance)	●	
	Monique Digiorgio	Executive Director—Chama Peak Land Alliance	●	●
New Mexico Rio Grande Water Fund and Santa Fe Municipal Watershed Investment Program	Dale Lyons	Director of Freshwater Programs—The Nature Conservancy (formerly Water Resources Projects Coordinator—City of Santa Fe)	●	●
	Laura McCarthy	Senior Policy Advisor for Fire and Forest Restoration, New Mexico—The Nature Conservancy		●
New Mexico Santa Fe Municipal Watershed Investment Program	Alan Hook	Water Resources Coordinator Assistant—Santa Fe Public Utilities Water Division	●	
	Sandy Hurlocker	District Ranger—U.S. Forest Service, Española Ranger District	●	
North Carolina Upper Neuse Clean Water Initiative	Caitlin Burke	Special Projects and Grants Coordinator—Conservation Trust for North Carolina	●	●
	Leigh Ann Hammerbacher	Water Conservation Specialist—Raleigh Public Utilities	●	
	Lisa Creasman	Associate State Director—The Nature Conservancy (formerly Conservation Projects Director—Conservation Trust for North Carolina)	●	
National Experts	Anne Zimmermann	Retired (formerly Director of Watersheds, Fish, Wildlife, Air, and Rare Plants—U.S. Forest Service)	●	●
	Chi Ho Sham	Chief Scientist—The Cadmus Group	●	●
	Chris Hartley	Environmental Markets Analyst—USDA Office of Environmental Markets	●	
	Deirdre Mason	Project Manager—Association of State Drinking Water Administrators	●	●
	G. Tracy Mehan	Source Water Protection Coordinator—U.S. Endowment for Forestry and Communities (formerly Principal—The Cadmus Group)	●	
	Kimery Wiltshire	CEO and Director—Carpe Diem West	●	
	Peter Stangel	Senior Vice President—U.S. Endowment for Forestry and Communities	●	●
	Rowan Schmidt	Project Leader—Earth Economics	●	

APPENDIX C. WRI 2015 ONLINE SURVEY OF WATERSHED INVESTMENT PROGRAMS

To capture additional information on the 13 source water protection programs, and to validate our identification of cross-cutting lessons among programs (which had been distilled from the original interview data), we sent an online survey to all interviewees. The survey was released on August 6, 2015, and remained open until September 11, 2015. It was sent to 63 contacts, all of whom were involved with the initial interviews for the 13 source water protection programs covered in the report. These contacts included employees of utilities, NGOs, city governments, consulting firms, the U.S. Forest Service, and private landowners. Some of these contacts forwarded the survey link to program staff who had not been included in the original interviews but whose perspectives were relevant to the study's focus.

The survey received 20 responses, representing a 31 percent response rate. Each of the 13 source water protection programs covered in the report is represented by at least one respondent to this survey. The survey categories and questions were the following:

I. Overview Information

Provide your name, title, organization, and select the studied program(s) with which you are affiliated.

II. Vision of Success

Did the partners in this program discuss a shared vision of success before initiating the program? Yes/No

If yes, what did this vision include? How did this vision guide your work, especially in helping partners to coordinate their work?

Did this vision of success include any quantifiable benchmarks? If so, please elaborate on the benchmarks used and the progress achieved on those benchmarks to date. (Examples: acres of hazardous fuels treatment, tons of sediment reduced, quantifiable improvements in water quality)

III. Understanding Challenges

Which challenges were present in your program?

A. Lack of a clear catalyst to initiate interest in a source water protection program (dramatic event or water quality threshold)
B. Creating common vision of success
C. Aggregating sufficient funding
D. Lack of trust between landowners and utility
E. Prioritizing program goals
F. Quantifying the economic/financial benefits of conservation actions
G. Managing negative public perceptions of forest wildfire treatments
H. Developing a memorandum of understanding (MOU) with partners
I. Establishing monitoring programs
J. Attributing quantifiable improvements in water quality to the program actions
K. Maintaining public support over longer time periods
L. Sustaining/expanding financial support for continuance of program
M. Adapting goals as project shifts from short-term to long-term implementation
N. Coordinating program work across public and private lands
O. Delays in implementation
P. Using limited budgets to fund source water protection at an adequate scale
Q. Other (specify)

Of these, which were your top three most significant challenges?

IV. Program Staffing

Within your own organization and across all partner organizations, how many staff members have their full time or responsibilities specifically dedicated to this program?

If possible, please list the names and affiliations of these staff members.

V. Recent Progress

Have there been any key updates, progress, or outcomes in your program since Fall 2014 that you would like to ensure are included in our study?

Are you planning for the next stages of your program?

If yes, what kind of planning are you conducting?

A. Identifying new partners to include in the program
B. Identifying new funding sources
C. Identifying new lands on which to expand conservation work
D. Creating spin-off conservation projects/programs
E. Establishing monitoring programs/protocols

Please elaborate on any of your planning efforts.

VI. Factors in Program Establishment and Growth

Were these factors important in BUILDING MOMENTUM for your program?

A. Identifying drivers and windows of opportunity
B. Recruiting champions and advocates
C. Creating a clear and joint vision of success among program partners
D. Establishing and investing in effective partnerships
E. Supporting investments with a sound business and economic case
F. Engaging in public outreach and communication

Were these factors important in DESIGNING your program?

G. Conducting landscape assessments to identify priority investment areas
H. Utilizing sustainable financing mechanisms

Were these factors important in IMPLEMENTING your program?

I. Defining responsibilities and implementation capacity of partners
J. Understanding how program needs vary depending on landownership (e.g., federal versus private land management options)

Were these factors important in MAINTAINING your program?

K. Monitoring and reporting outcomes based on common definition of success
L. Leveraging sufficient funding to achieve landscape-scale impacts
M. Looking ahead and planning for the future

Elaborate on those particularly important for each program phase

GLOSSARY

Avoided costs	Cost that a supplier (such as a utility) escapes by obtaining a service from another source instead of supplying the service itself (e.g., cost of building a filtration plant versus investing in watersheds to reduce erosion).
Built infrastructure (or gray infrastructure)	For the purposes of this report, built infrastructure refers to human-engineered infrastructure to manage water resources (Gartner et al. 2013). Examples of built infrastructure include dams, treatment plants and associated filtration technology, roads, retention ponds, and storm water management plants.
Clean Water Act	The primary federal law in the United States governing water pollution, which includes regulating discharges of pollutants into U.S. waters and regulating quality standards for surface waters.
Conservation district	Government entities that provide technical assistance and tools to manage and protect natural resources in the United States. Conservation districts work with landowners and operators who are willing to help them manage and protect resources on all public and private lands in the country.
Conservation easement	A voluntary legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values.
Coordinators	The primary administrators of many programs; they manage funding, broker deals, distribute investments, facilitate decision-making, bridge communications, and coordinate the efforts of multiple partners.
Filtration avoidance determination	A waiver of the requirement that all surface drinking water must be filtered to remove microbial contaminants. The U.S. Environmental Protection Agency grants filtration avoidance determinations to water suppliers demonstrating that they have an effective watershed control program and that their water meets strict quality standards.
Land trust	A private, nonprofit organization that works to conserve land by undertaking or assisting in land or conservation easement acquisition, and through its stewardship of such land.
Natural capital accounting	The process used to make the business case for natural infrastructure by calculating the value of natural resources and services in a given ecosystem or region. Accounting for such goods may be undertaken in physical or monetary terms.
Natural infrastructure	The "strategic use of networks of natural lands, working landscapes, and other open spaces to conserve ecosystem values and functions and provide associated benefits to human populations" (Benedict and McMahon 2006). Forests, wetlands, riparian buffers, and other natural elements in the landscape can make up natural infrastructure when strategically used and managed to provide services for communities. There are diverse ways of establishing natural infrastructure, from land acquisition and conservation easements to low-impact development and conservation practices on agricultural and forest lands. Accordingly, several terms are used to refer to the practice, including "watershed protection," "stewardship," and "conservation." Natural infrastructure is also sometimes referred to as "green infrastructure."
Natural infrastructure investors	Entities that provide funding to conserve or restore upstream forests in order to maintain or enhance the forests' watershed services. These investors typically include municipal and federal governments or public utilities, as well as grant-making organizations. Water customers and the general public can also be considered investors, particularly if the water supplier charges a fee for watershed investment. Increasingly, water-dependent companies such as food and beverage manufacturers are also investing in watersheds.
Natural infrastructure providers	Private landowners or public land managers that use investors' funds to implement local forest restoration and conservation. This includes the federal government—in fact, the U.S. Forest Service is a partner in 10 of the programs in this study.
Source water protection	The protection of water quality, quantity, timing of flows, and associated benefits at the water's source—before it reaches the intake of a drinking water system (Gartner et al. 2013). Water management practices targeting protection of the quality, quantity, or timing of water supply upstream of a water intake point, through watershed protection, restoration, or sustainable management. Many watershed investment programs in this study focus on source water protection to protect urban drinking water supply.
Total Daily Maximum Load	A regulatory term in the U.S. Clean Water Act, describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.
Watershed Investment Program	A program that funds watershed restoration or protection to deliver benefits to society like aquifer recharge or erosion control (Bennett and Carroll 2014). These programs connect downstream water users (such as water providers and municipal governments) to upstream landowners (such as private forest owners and the U.S. Forest Service) to collaboratively develop and fund watershed stewardship activities that safeguard water supply. Conservation organizations, community groups, and government agencies also commonly contribute to programs. This report focuses only on programs that address forest management for drinking water protection.

ABBREVIATIONS

C-BT	Colorado–Big Thompson
CIG	Conservation Innovation Grant
FRFTP	Front Range Fuels Treatment Partnership
FWPP	Flagstaff Watershed Protection Project
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NGO	Nongovernmental organization
NRCS	Natural Resources Conservation Service
RGWF	Rio Grande Water Fund
SFPUC	San Francisco Public Utilities Commission
TNC	The Nature Conservancy
UNCWI	Upper Neuse Clean Water Initiative
USDA	U.S. Department of Agriculture
WRI	World Resources Institute

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

Our Challenge
Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision
We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT
We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT
We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT
We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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