Water Source Protection Funds as a Tool to Address Climate Adaptation and Resiliency in Southwestern Forests

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Abstract: *Wildfire intensity in the Southwestern United States has increased over the last decade corresponding with dense fuels and higher temperatures. For example, in New Mexico on the 2011 Las Conchas fire, intense fire and wind-driven fire behavior resulted in large areas of moderate and high severity burn (42 percent of burned area) with roughly 65,000 acres (26,300 ha) left largely without green trees or seed sources. Monsoon rains fell in several drainages that sustained high-severity burn, and these moderate rainfall events triggered massive debris flows. Debris from one canyon deposited 70 feet of ash at the confluence with the Rio Grande. The cities of Albuquerque and Santa Fe stopped using river water for municipal needs for 40 and 20 days, respectively, demonstrating the significant impact of wildfire and post-fire debris flow on municipal water users. This paper examines two case studies in New Mexico that have applied or are seeking to apply the water fund model to watersheds dominated by national forest system lands. The first case study is the Santa Fe Water Source Protection Fund established in 2009, and the second case study is the Middle Rio Grande and Forested Watersheds Fund, expected to launch in July 2014. Both case studies illustrate multiple sectors of government and community interests responding to the need to protect water sources, and joining together to generate the financial resources for rapid action to improve forest resiliency in the face of climate change.*

INTRODUCTION: ECOLOGICAL EFFECTS OF WILDFIRE IN SOUTHWESTERN FORESTS

The Southwest's fire-adapted forests are experiencing widespread changes as a result of a century of fire exclusion, climate change and various land uses, with an effect on water sources and supplies for people who live in the region. The historical fire regime in the Southwest's extensive ponderosa pine and dry-site mixed conifer forests was frequent, low-severity fire (Swetnam and Baisan 1996). Tree density increased significantly when humans removed fire from the ecosystem, resulting in ladder fuels and dense, continuous canopy fuels (Fule and others

1997; Allen and others 2002). In recent decades, rising temperatures have extended the length of the fire season. Currently, wildfire intensity has increased and caused a higher percentage of moderate- and high-severity burns, a consequence of the historic accumulation of dense canopy fuels and the current condition of fires burning during periods of higher summer temperatures (Westerling and others 2006; Williams and others 2010).

In New Mexico, the 2000 Cerro Grande Fire in the Jemez Mountains was considered large and destructive at the time, with a total size of 42,885 acres (17, 350 ha) (Balice and others 2004). New records for the largest fire in the state were set in 2011 with the 156,593 acre (63,370 ha) Las Conchas Fire (Inciweb 2011). Another record was set in 2011 in Arizona, with the 538,049 acre (217,740 ha) Wallow Fire (Inciweb 2011). The New Mexico record was broken again in 2012, with the 297,845 acre (120,533 ha) Whitewater-Baldy Fire (Inciweb 2013b).

Analysis of wildfires from 1984-2006 showed that Southwestern fires typically resulted in 11 percent high severity, 27 percent moderate severity, 39 percent low severity and 23 percent unburned area (Quayle and others 2009). However, the trend in recent, larger wildfires is toward more high severity burn. For example, the Wallow Fire's burn distribution was 17 percent high severity, 14 percent medium severity, 47 percent low severity and 22 percent unburned (Wadleigh 2011). By contrast, the equally large and fast-spreading Whitewater-Baldy Fire had 13 percent high severity burn, 13 percent moderate severity and 74 percent low severity, due in part to frequent fires in the Gila National Forest (Southwest Fire Consortium 2012).

Southwestern forests are critical sources of water for people and play a key role in the hydrologic cycle. Most precipitation comes as snowfall and is stored in forested mountains until spring. Snow melt is the primary source of surface water for agriculture and municipal and industrial use (Leopold 1997). The recent large wildfires with significant areas of moderate and high severity burn have caused extensive and severe hydrologic damage in many watersheds across the region. The magnitude of post-fire flooding can be orders greater than pre-fire flows (Veenhuis 2002) and in some locations has resulted in catastrophic debris flows (Cannon and Reneu 2000). Rising temperatures are predicted to further threaten water supplies and forests, not only due to longer fire seasons with more large fires (Westerling and others 2006), but also through drought-induced forest die-off (Breshears and others 2005) and reduced snowpack and altered stream flow (Barnett and others 2008).

SOCIAL, POLITICAL AND ECONOMIC ISSUES OF WILDFIRE AND WATER SOURCE PROTECTION IN A CHANGING CLIMATE

Community and political leaders responded to the 2000 Cerro Grande Fire with changes in national policy and local practices. A National Fire Plan was created in 2001 as a policy response to large fires such as Cerro Grande (McCarthy 2004). The National Fire Plan evolved as a result of the work of the interagency Wildland Fire Leadership Council, established in 2003, as large fires continued in western forests (U.S. Government Accountability Office 2009). The primary issue addressed in the National Fire Plan was protecting human life, homes and communities. Preventative efforts emphasized proactive treatments to cut and remove overgrown brush and trees around homes in natural areas; this work was to take place in what was termed the Wildland Urban Interface. National programs like FireWise and Community Wildfire Protection Planning were launched to increase local engagement in preparing for wildfire. The Healthy

Forests Restoration Act of 2003 was passed in part to simplify the environmental review process for thinning projects (U.S. White House 2003). The Collaborative Forest Landscape Restoration Act of 2009 created a funding mechanism for thinning and burning at a larger scale (Schultz and others 2012). After 10 years, the National Fire Plan was replaced with the Cohesive Strategy that is currently the guiding policy for fire management and forest restoration by federal and state agencies.

Studies of ponderosa pine and other forest types that historically experienced frequent, low-severity wildfires supported the thinning emphasis in national policy. Extensive research from sites throughout the west suggested that thinning to reduce tree density to historical levels, eliminate ladder fuels, and create canopy separation between trees or groups of trees, would change fire behavior to reduce damaging crown fire (Omi and others 2006; Ecological Restoration Institute 2013).

Congressional appropriations for the USDA Forest Service and Department of the Interior agencies were established for treatments in a Hazardous Fuels Reduction Program as part of the National Fire Plan (McCarthy 2004). Analysis of Congressional appropriations shows the level of funding for Hazardous Fuels Reduction increased significantly between 2001 and 2012, growing from about $100 million to over $500 million for the Forest Service and Interior Departments combined. However, even with these major increases, funding for Hazardous Fuels Reduction was insufficient to meet the full need for fuels reduction in western forests. Funding remained a fraction of the amount spent on fire suppression, which exceeded $1 billion in 7 of the 10 years from 2002 to 2012.

Early in the National Fire Plan implementation, thinning treatments in Southwestern forests averaged in the hundreds of acres per state, despite wildfires that might grow thousands of acres in a day (McCarthy 2004). Throughout the last decade the average treatments cost has been $500–$1,000 per acre in the Southwest. Funding is allocated to the forest or district level, and a 500-acre treatment at a cost of $250,000–500,000 might be all a unit can afford in a given year. The Collaborative Forest Landscape Restoration Program (CFLRP), authorized in 2009, provides up to $4 million year for selected large landscape projects, can finance treatments of thousands of acres and was enacted to boost the scale of restoration that can be accomplished (Schultz and others 2012). However, the authorized appropriation for CFLRP is capped at $40 million, which is sufficient to fund 20 large landscapes around the United States. Despite the CFLRP, scientists are increasingly recognizing that the policy and funding context is making it impossible to restore large areas of fire-prone forests at a scale that can make a difference in fire behavior. (Ecological Restoration Institute 2013; Stephens and others 2013)

WATER FUNDS AS A FOREST RESTORATION AND CLIMATE CHANGE RESILIENCY FUNDING TOOL

Funding decreases for federal fuels reduction, coupled with the national recession, federal budget cuts, and declining state revenue prompted some to look at other possible funding mechanisms for forest restoration. Water funds are among the most successful funding mechanisms under the model of payments for ecosystem services, that is, mechanisms whereby payments are made for ecological benefits or services that are not captured in traditional market prices (Goldman-Benner and others 2013). The Nature Conservancy in Latin America established its first water fund in 2000 in Quito, Ecuador. Today there are 12 established water funds in countries in Latin America, each providing a mechanism for water users to help pay for land management in headwaters that improves water quality and reliability.

Water storage and release is an important service provided by forests in the arid Southwest. A number of cities and towns in the Colorado, Utah, Arizona and New Mexico have created mechanisms that link the water forests provide to downstream users with the funding needed to restore forest health—arrangements that are payments for water services (Carpe Diem West 2011).

In Denver, Colorado, the 1997 Buffalo Creek and 2002 Hayman Fire caused damage to watersheds supply the city with water. Denver Water spent $26 million on reservoir dredging, water treatment and watershed stabilization (U.S. Department of the Interior 2013). Subsequently, Denver Water entered into a partnership with the Forest Service, Rocky Mountain Region, to share the cost of reducing fuels on forests that are important water sources. Their Forest to Faucets Partnership represents a 5-year $16.5 million commitment by both parties to invest in restoration on the Pike-San Isabel, Arapahoe and Roosevelt National Forests (Denver Water 2013).

In Flagstaff, Arizona, the 2010 Schultz fire was estimated to cost taxpayers between $130 and $147 million in fire suppression and related post-fire flooding damage. These costs and the threat of fire damage to municipal water sources prompted the City to take action with a $10 million bond to restore two areas with critical water sources (Combrink and others 2013). The bond passed in 2012 with support from 73 percent of voters (Stempniewicz and others 2013).

Both Denver and Flagstaff demonstrate that community leaders are becoming aware of the connections between the security of their water sources and the condition of fire-prone forests that supply their water. Water utilities especially face extra costs for post-fire clean up, costs that may include reservoir dredging, pipe and other infrastructure replacement, clean-up of dirty water in treatment plans, and trucking water to communities whose water supplies are disrupted. Given that forest conditions have deteriorated to the point that federal appropriations for Hazardous Fuels Reduction are insufficient to meet the need in fire-prone forests, community leaders are increasingly seeking to play a role in leveraging solutions.

In New Mexico, wildfire damage to water sources is prompting deeper community engagement. New Mexico is currently experiencing significant drought, higher temperatures and increases in wildfire intensity and severity (Williams and others 2012). With 9.4 million acres (3.8 million ha) of National Forest System lands (Western States Data 2007) in New Mexico, accounting for the majority of mid- and high-elevation forests, water managers have strong incentive to partner with forest managers on proactive solutions. The following two case studies describe the development of water funds as a tool for municipal water source protection in the fire-prone interior West. The first example is a water fund in Santa Fe, New Mexico established in 2009. The second example is a new water fund in development for the Rio Grande and Rio Chama watersheds in New Mexico to protect water sources for Albuquerque, Rio Rancho, Los Alamos, Santa Fe, Espanola, several Pueblos and numerous rural towns and villages. Both examples are based on the model of Latin America water funds, using the manual written by Nature Conservancy staff as a guide to design, creation and operation of water funds (Nature Conservancy 2012).

CASE STUDIES

Santa Fe Water Source Protection Fund

Situation

The Cerro Grande Fire of 2000 had direct effects on Los Alamos, New Mexico, which lost 280 homes (Gabbert 2010) and was without municipal water delivery for 4 months while fire-damaged pipes were repaired. One year after the fire, reservoir sedimentation was 140 times higher than the previous 57 years and remained significantly elevated for at least five-years (Lavine and others 2005)

In nearby Santa Fe, the City considered the risk of a similarly damaging wildfire, should one ignite in their 17,000 acre (6,900 ha) municipal watershed, contained entirely within the Santa Fe National Forest. Even though the City sustained no direct costs from Cerro Grande fire, the threat of wildfire to their two reservoirs, supplying 30 percent of municipal water, was of serious concern. Local scientists noted similarities between the overgrown forest conditions in Santa Fe's watershed and the area where the Cerro Grande fire burned, and considered it only a matter of time before Santa Fe experienced a large fire of its own. A few months after Cerro Grande was extinguished, community leaders in Santa Fe launched a concerted effort to proactively cut and remove the overgrown brush and trees, replicating historical forest conditions and reducing the amount of vegetation that could act as fuels in future wildfires.

An Environmental Impact Statement for treatments was approved in 2003 and over the next four years more than $7 million of Congressionally earmarked funding was appropriated to thin 7,000 acres (2,830 ha) of forests in the lower watersheds that are critical to supply Santa Fe's water (Figure 1). Controversy over the forest treatments was high at first, with local and national environmental groups expressing concern about tree cutting. Concerns diminished after dozens of public meetings, several science forums, and establishment of a multi-party monitoring process to ensure community oversight.

Making the Case

Historically, fire burned in the Santa Fe watershed every 15 years (Derr and others 2009), prompting forest and water managers to plan for maintenance of the thinned forest with controlled burning. The Nature Conservancy offered the "water fund" model as potential vehicle to pay for maintenance with controlled burning and other treatments. In 2008 the City of Santa Fe Water Division formed a partnership with the Santa Fe National Forest, Santa Fe Watershed Association and The Nature Conservancy to seek water user funding for long-term management of Santa Fe's critical water sources in the National Forest.

Data about the full economic costs of wildfire was limited in 2008, so the Nature Conservancy developed cost estimates based on the few actual costs available from other communities. Based on this, an estimate of $22 million cost to the City of Santa Fe and Forest Service was projected from a 10,000 acre (4,050 ha) wildfire in the watershed (Derr and others 2009). These cost estimates were important to make the case for investment in preventative treatments.

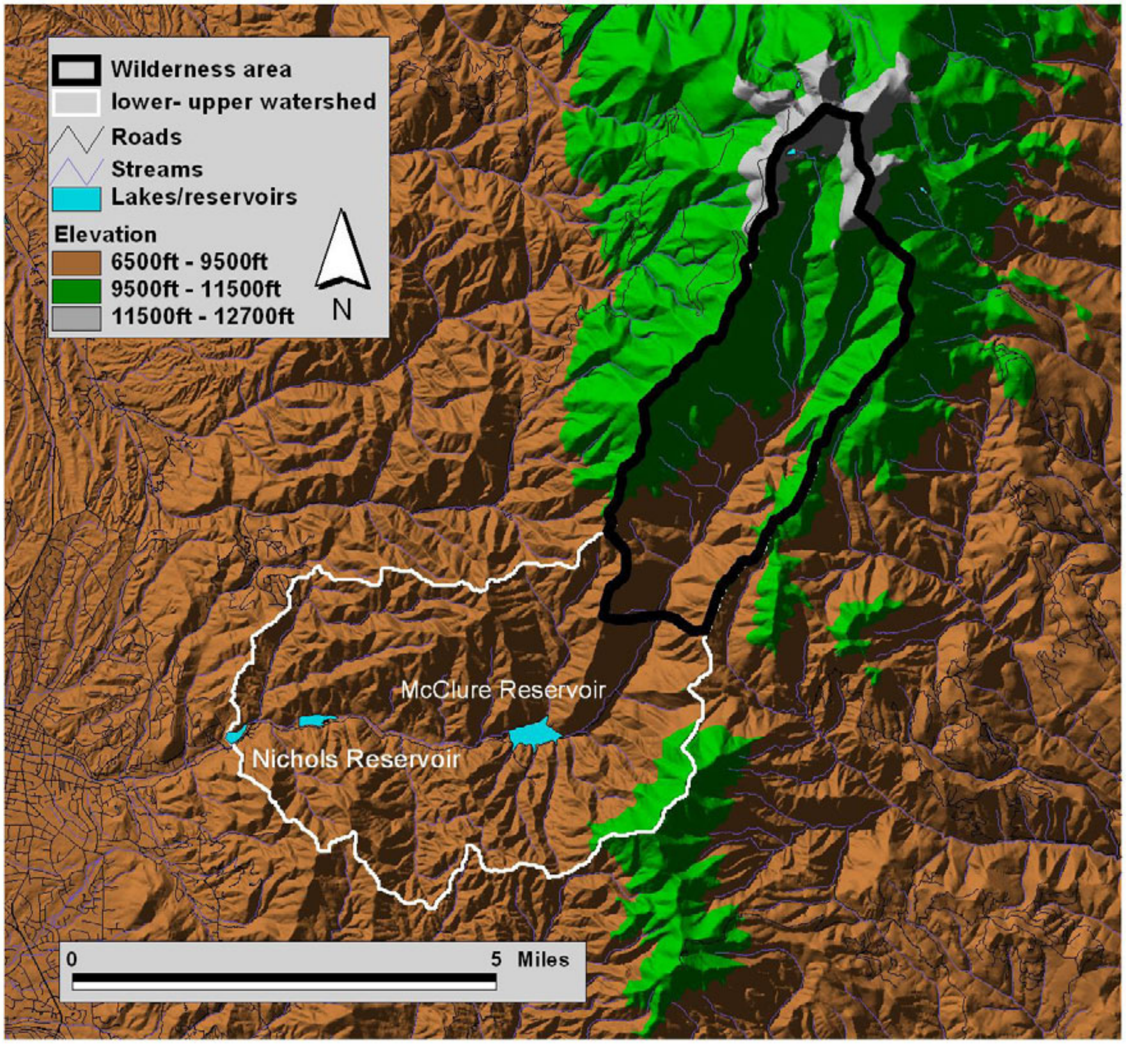

Figure 1. Shaded relief digital elevation map of the upper Santa Fe Watershed, NM. The area delineated in white was the focus of initial fuels reduction and maintenance with controlled burning. The area delineated in black is designated Wilderness. Adapted from Derr and others 2009.

Public opinion research conducted in 2011 as part of the Santa Fe program found overwhelming voter support for the establishment of a fund to protect Santa Fe's water supply from forest fires. In a poll conducted by telephone, voters were presented with a description of the threat that a major forest fire poses to the city's water supply; steps the U.S. Forest Service currently takes to manage this threat; and the need for a stable source of funding to help prevent fires on lands that surround the City's water supply (Metz and others 2011). The poll found that by a nearly four-to-one margin, voters voiced support for this concept. Voters were also asked how much they would be willing to pay for a Santa Fe Water Source Protection Fund, which would protect water sources and reservoirs from damaging wildfire. More than 80 percent of voters indicated they would be willing to pay, on average, an additional 65 cents per month on their water bill to go towards the Santa Fe Water Source Protection Fund. Voters also were asked whether they would support an average fee of one dollar, one dollar and fifty cents, and two dollars. Even at the highest potential price point—two dollars per month—nearly two-thirds of voters who were surveyed said they would be willing to pay the fee (Metz and others 2011).

<u>Into Action</u>

The Santa Fe Water Source Protection Fund was approved by the City Council in 2011 as a program of watershed investment. In the final agreement, the City approved a Watershed Management Plan for sharing up to 50 percent of costs with the Forest Service for 20 years to maintain the current conditions in restored forest areas through burning, add new fuels breaks and restoration of some additional lands. The commitment also included funding for monitoring of water quality and restoration treatment effects, and for community outreach and watershed education programs for Santa Fe youth. The approved Watershed Management Plan describes the expected management needs over 20 years and includes a financial plan that outlines the cost-sharing agreement between the City and the Forest Service (Derr and others 2009).

The financial arrangement is for the City of Santa Fe to pay just over $3 million over 20 years to the Forest Service to ensure protection of its water sources. The watershed treatment costs are split 50-50 between the City and Forest Service (Derr and others 2009). Considering the additional education, water quality and monitoring costs, the expenses are shared as follows: 62 percent City, 36 percent Forest Service, and 2 percent Santa Fe Watershed Association. The initial years of funding for the City and Santa Fe Watershed Association were provided by a $1.4 million grant from the New Mexico Water Trust Board, funded by New Mexico gross receipts tax. The Water Trust Board funding enabled the City to finish paying for another water infrastructure project before using revenue from the Water Division budget to pay their half of the water source protection (Lyons 2013).

The Santa Fe case study predates Denver, and was the first application of the water fund model to U.S. public lands forests. Testing the water fund model on a small watershed with a few partners made it possible to prove the concept in just a few years. The key lessons from Santa Fe are to keep the funding mechanism simple and to develop a good monitoring and feedback mechanism to keep water fund investors up to date.

Rio Grande Water Fund

<u>Situation</u>

Historically, Albuquerque's political leadership, business community and water utility have put significant effort into planning for a sustainable water future. The Albuquerque Bernalillo County Water Utility Authority's (Water Authority) long-range water supply plan, completed in 2007, outlined the use of water imported from the Colorado River Basin to replenish groundwater and recharge Albuquerque's aquifer as a drought reserve and to establish surface water as the City' primary supply (Albuquerque 2007). Incentives were provided for municipal and industrial conservation, and as a result per capita use of water has dropped from over 250 gallons per person per day in the 1990s to 150 gallons per person per day today (Albuquerque 2013).

About half of Albuquerque's water today comes from the Colorado River Basin via a trans-mountain diversion known as the San Juan-Chama project. Planning for the importation of this water from the Colorado River Basin to New Mexico began in the 1950s, at a time of growth for Albuquerque and in the middle of a ten-year drought cycle. The San Juan-Chama Project is a system of diversion structures and tunnels that moves water from the Navajo River in the San Juan River Basin to the Rio Grande Basin where it flows into the Chama River, a series of reservoirs, and then the Rio Grande. About 110,000 acre-feet of water are authorized for diversion, and most New Mexico cities have purchased rights to this water. Albuquerque owns the biggest share of San Juan-Chama Project water, but Santa Fe, Los Alamos, and other towns own San Juan-Chama water, as well as the Jicarilla Apache Tribe and the Middle Rio Grande Conservancy District, which uses the water for irrigated agriculture (Reclamation 2013).

The 2011 Las Conchas Fire and 2000 Cerro Grande fire both had a large impact on municipal water sources. The Las Conchas fire occurred in New Mexico's Jemez Mountains, within 30 miles of roughly half of the state's population living in Albuquerque, Rio Rancho, Los Alamos, and Santa Fe, and numerous Pueblos and small towns. The fire was notable for the extent of moderate and high severity burn, which affected 42 percent of the area (Tillery and others 2011). The severely burned areas in Las Conchas left nothing but ash and occasional standing dead trees and boulders. Monsoon rains about six weeks after the fire started created heavy debris flows in four canyons draining directly to the Rio Grande. For example, rainfall of 1.5 inches on August 21st and 22nd of 2011 caused debris flows in Bland and Cochiti Canyons. The debris flows flooded the popular Dixon Apple Orchard, deposited tons of debris into the U.S. Army Corps of Engineers' Cochiti Reservoir, and lowered dissolved oxygen content of the Rio Grande well past the point where fish and other aquatic species could survive (Dahm and others 2013). Utility operators in Albuquerque and Santa Fe decided the water was unfit for treatment and shut down their surface water use for 40 and 20 days, respectively, switching to groundwater wells at a time of peak summer usage.

Making the Case

The Nature Conservancy began exploring the idea of a water fund focused on protecting water sources from damage by wildfire and post-fire flooding in the Rio Grande valley in 2012 with funding from Lowe's Charitable and Educational Foundation (Nature Conservancy 2014). Unlike Santa Fe, Albuquerque had not yet considered the possibility of wildfire and post-fire debris flow threatening their surface water or contaminating their San Juan-Chama water. However, the Las Conchas fire provided a tangible demonstration of the problem, and city and business leaders were soon convinced that a solution must be found. The Nature Conservancy's initial presentation to the water and energy subcommittee of the Greater Albuquerque Chamber of Commerce was met with a surprisingly high level of support. Additional outreach led to endorsements of the need to find a solution for this problem from other business groups, including the New Mexico Association of Commerce and Industry, which functions like a statewide chamber of commerce, and the New Mexico Water Business Task Force, a group initially formed to advocate for the San Juan-Chama Project.

The underlying problem of dense forests and high severity wildfire adjacent to important water supplies was relatively easy to establish; the more difficult task was to build support and establish funding for a large-landscape program of forest and watershed treatments to improve resiliency to climate change and wildfire. The Nature Conservancy convened a Rio and Forest Advisory Board in April 2013 for the specific purpose of establishing a water source protection fund for the Middle Rio Grande and Forested Watersheds. The Advisory Board is made up of leaders from federal and state forest and water management agencies, business community leaders, university experts, and a diverse cross-section of interest groups from traditional agriculture and recreation to the wood products industry. As the convener and facilitator, the Nature Conservancy has organized the Advisory Board into a set of task-oriented working groups.

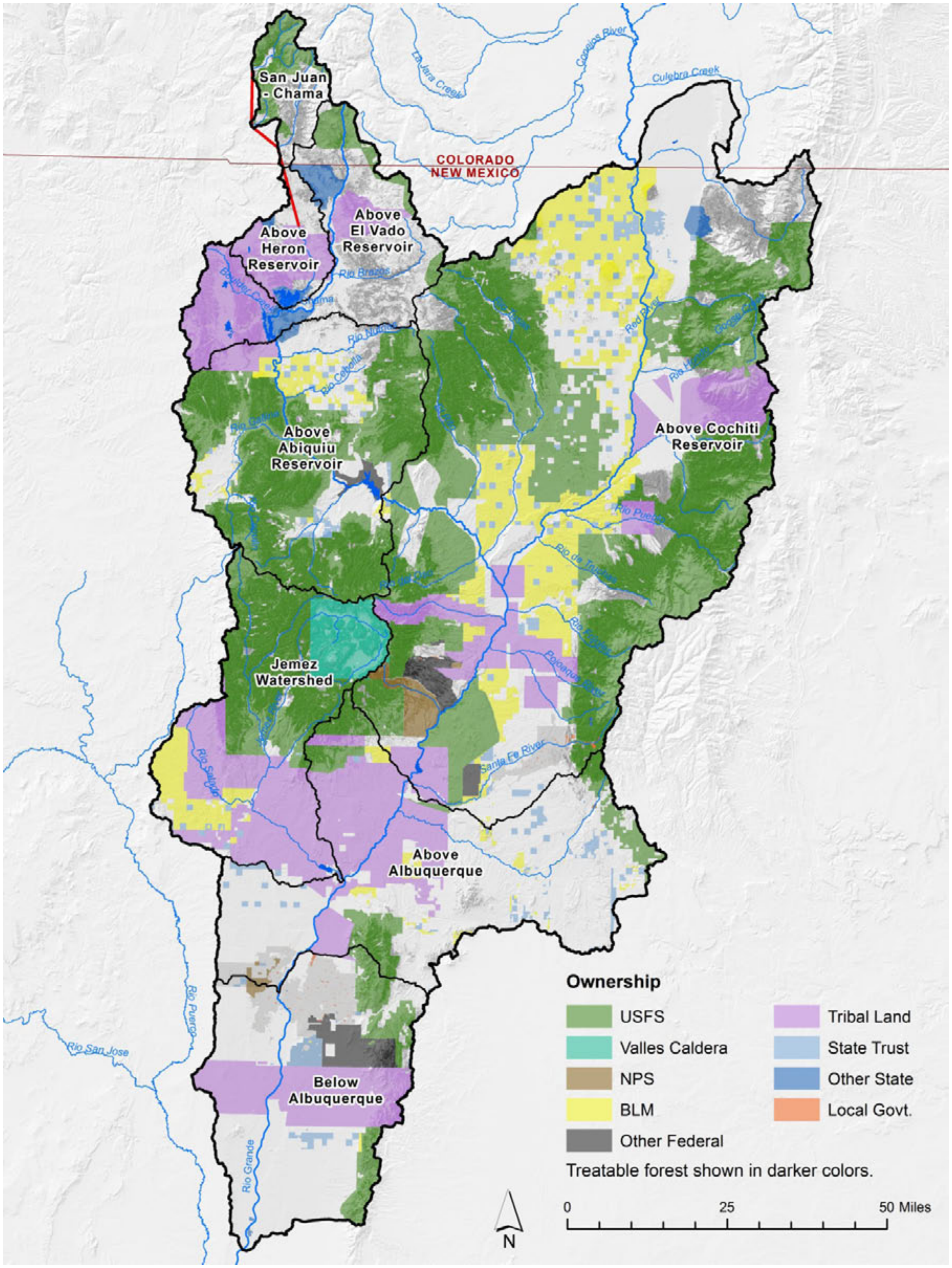

Figure 2. Proposed area for the Rio Grande water source protection fund.

The Conservancy's efforts are focused on creating a dedicated funding mechanism for large-scale investment in forest and watershed treatments from Albuquerque north to the Colorado border (Figure 2). The Rio Grande Water Fund area includes all of the forested watersheds and tributaries to the Rio Grande and Rio Chama, as well as the headwaters of the San Juan-Chama water just over the state line in Colorado.

Studies are underway to establish a clear case for a water source protection fund for the Rio Grande. The studies are necessary to guide development of the water fund. The studies are to:

- Identify the watersheds that are most vulnerable to high-severity wildfire and post-fire to set priorities for water fund expenditures (Figures 3 and 4);
- Estimate water yield that may result from the forest treatments, including water increases that may sustain forests (Grant and others 2013) or streamflow;
- Assess the full economic costs of the Las Conchas wildfire to inform a cost-benefit analysis; and
- Survey municipal water users and agricultural users to determine their understanding of the threats to water security and willingness to pay for restoration treatments of at-risk forests.

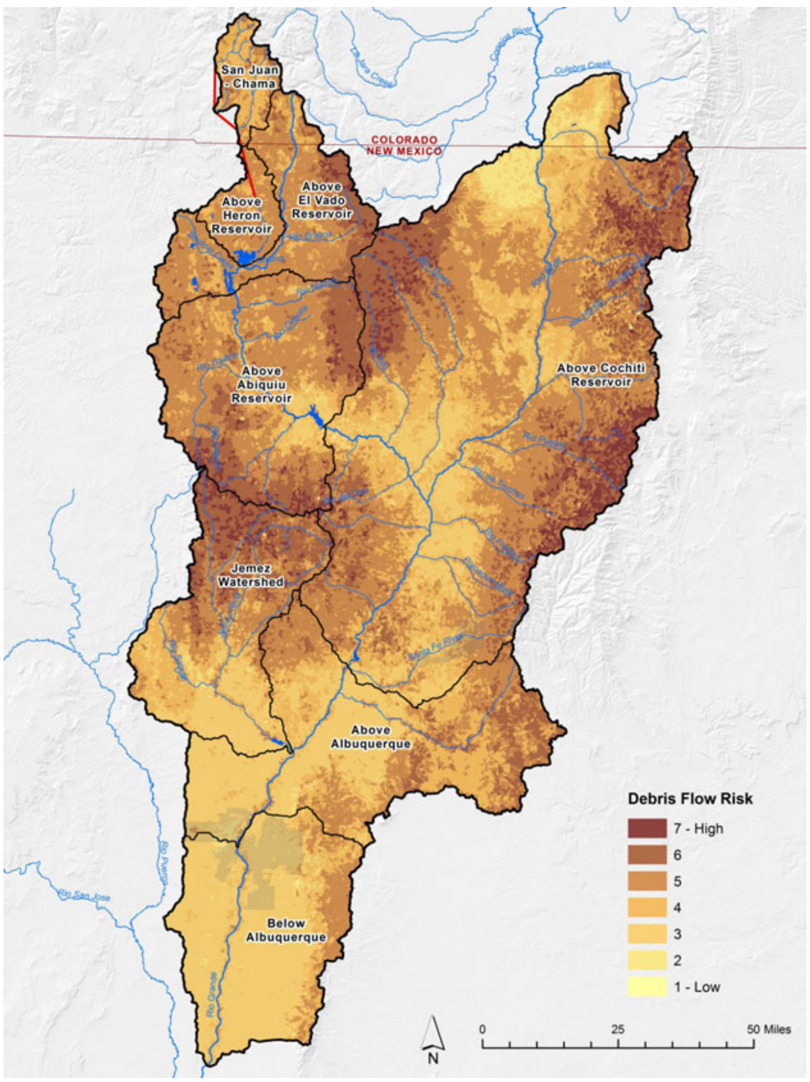

Figure 3. Probability of Wildfire and Post-fire Debris flow in the proposed Rio Grande water source protection fund area.

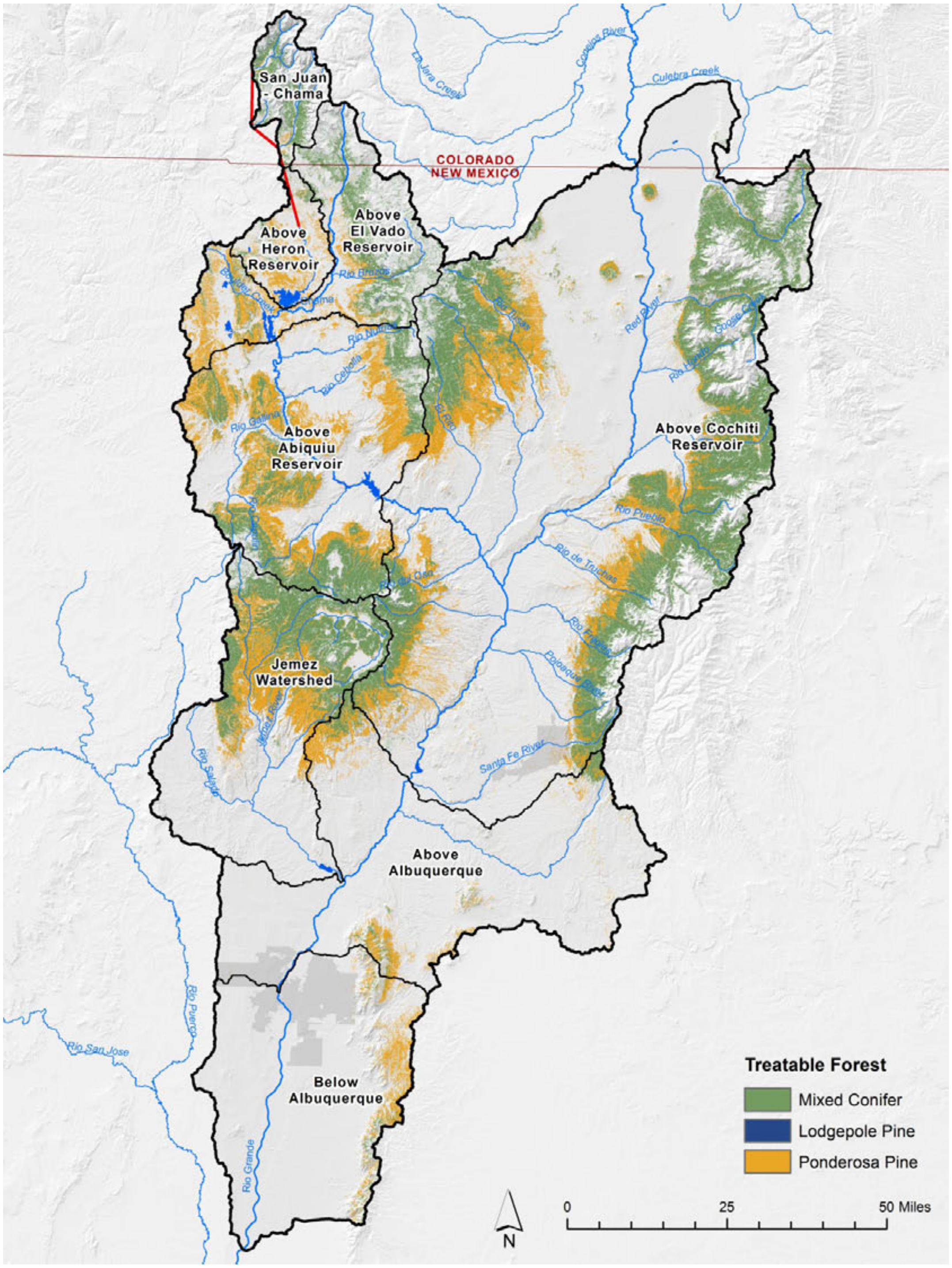

Figure 4. Areas of ponderosa pine and mixed conifer forest in the proposed Rio Grande water source protection fund area.

The outcome of these studies and engagement of the Advisory Board and working groups will be to produce a comprehensive water security plan for the Rio Grande from Albuquerque north to the Colorado border. A draft of the plan is forthcoming and will be available at www.nature.org/riogrande. The plan will include a prioritized list and map of restoration treatments for forests and riparian areas; estimated costs and capital needs to implement the plan, including NEPA assessment for federal lands, wood product utilization and investment needs in infrastructure; and a detailed plan for water fund structure, governance and revenue.

Early estimates by the Nature Conservancy are that the Rio Grande and forested watersheds in the area from Albuquerque north to the Colorado border includes 1.7 million acres (688,000 ha) of ponderosa pine and mixed conifer forests (Nature Conservancy 2014). Historically, these forests experienced frequent low-severity fire. Mechanical thinning and controlled burning recommended by scientists and land managers are effective treatments to reduce fuel loads. The Nature Conservancy's estimate assumes that 40 percent of the 1.7 million acres (688,000 ha) of eligible forests would actually be treated, with a preliminary goal to treat 700,000 acres (283,300 ha) in 10-30 years, depending on how quickly the rate of treatment can be accelerated. Current treatment levels in this area is estimated at roughly 3,000 acres (1,215 ha) annually, so a tenfold increase would be 30,000 acres (12,140 ha) per year, and it would take roughly 23 years to reach the goal. At a cost of $500 per acre, about $7-15 million revenue would be needed annually, assuming current markets for low-value wood and assuming federal appropriations at current levels are available as matching funds.

Raising $7-15 million non-federal funds each year for 30 years for forest and watershed restoration will not be easy. The water fund needs to be structured in a way to receive funding from a variety of sources, including payments by municipal water users and irrigation district members, homeowner's insurance premium taxes, and corporate and voluntary donations. These options are under study now. After the investment period needed to reduce fuels substantially, a program of controlled burning and mechanical thinning with commercial by-products will need to be sustained in the long-term. The annual costs to maintain forest and watershed resiliency after the initial treatments should be far less and is estimated at $1-3 million.

Into Action

The Rio Grande Water Fund will be launched in July 2014. Strong support of political leaders and business interests is propelling the water fund idea into the political arena, where there is some possibility of having the fund established by the New Mexico Legislature in their 2015 session. In this scenario, the water fund would probably need to be statewide, with a provision for establishing priority areas that would likely include protection of the San Juan-Chama water.

CONCLUSION

The evolution of water funds in New Mexico has progressed from a small-scale, proof of concept in Santa Fe to a large and complex Rio Grande Water Fund that includes many diverse partners and a complex landscape. The Rio Grande Water Fund is framing the issue as water security, and is gaining far more traction for forest restoration than was achieved when the issue was framed as wildfire protection. All aspects of New Mexico life are touched by water availability and reliability. The Cerro Grande and Las Conchas fires, and subsequent flooding and debris flows, provided water managers, water users and politicians with a first-hand view of the consequences of inaction. Forests in New Mexico function much like water towers do in wetter parts of the United States. State leaders are starting to understand the risk of waiting to take large scale action to restore forests. New Mexico water managers and political leaders are realizing they will bear the costs of cleaning up water that is degraded by post-fire flooding and replacing water sources that sustain long-term fire damage. The water fund model from Latin America provides a structure for customized local solutions to water security problems in places like the Southwest where climate change is causing large-scale changes to forests. Both the Santa Fe and Rio Grande Water Funds are, in essence, climate change adaptation strategies, focused on garnering long-term funding to maintain resiliency in large, forested watersheds. It remains to be seen if a project as large in scale as the proposed Rio Grande Water Fund for treatments across 1.7 million acres (688,000 ha) of forest can be achieved. The concept, however, is gaining serious traction and its success or failure may be assessed within a few years.

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