



RIO GRANDE WATER FUND
COMPREHENSIVE PLAN FOR WILDFIRE
AND WATER SOURCE PROTECTION
▶ JULY 2014 ◀



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The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We achieve this mission through the dedicated efforts of our diverse staff, including more than 600 scientists, located in all 50 U.S. states and more than 35 countries; with the help of many partners, from individuals and governments to local nonprofits and corporations; and by using a non-confrontational, collaborative approach.



Terry M. Sullivan, State Director

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Staff of the Nature Conservancy who worked on this plan include: Steve Bassett, Anne Bradley, Dave Gori, Jackie Hall, Dale Lyons, Robert Martin, Laura McCarthy, and Lara Wood Miller. Brent Racher of the New Mexico Forest Industry Association wrote the section on jobs and economic development. Nichole Melanson was the editor.

COVER PHOTOS: TOP: Headwater forests in the Valles Caldera feed the Jemez River, a tributary of the Rio Grande. © Alan Eckert Photography
BOTTOM: Healthy forests provide clean drinking water, places for outdoor recreation, fish habitat, forest and wood industry jobs, and water for farms and communities. © istockphoto; © Ron Loehman; © Quita Ortiz, NM Acequia Association; © Mark Skalny
PHOTO THIS PAGE: Boaters are just one group who benefit from a healthy river system. © istockphoto

EXECUTIVE SUMMARY



▶ Water is life and livelihood. Nowhere is that more true than in New Mexico. However, the reality is that each year the size and severity of wildfires in our state increases, along with subsequent post-fire flooding that degrades rivers, streams and other critical water sources. In addition, state and federal agencies spend hundreds of millions of dollars a year reacting to these fires, not including the lost revenue to business. Without action, New Mexico's future water security is at great risk.

The Rio Grande Water Fund is a solution that can bring clean water to New Mexicans for generations to come. This innovative project will invest in the restoration of forested lands upstream so we can secure clean water for communities in these watersheds and downstream. Our goal is to generate sustainable funding over the next 20 years to proactively increase the pace and scale of forest restoration, including the most high-risk areas in the Rio Grande watershed. We are working together so nature can keep working for us.

A PLAN FOR THE FUTURE

The *Rio Grande Water Fund: Comprehensive Plan for Wildfire and Water Source Protection* is the culmination of a collaborative partnership among more than 40 organizations and agencies and more than two years of research and planning guided by a diverse advisory board. The Comprehensive Plan uses the best available data to describe the current wildfire threat to water sources and forested watersheds, setting forth a path for New Mexico's future water security. The focus is on water as the primary resource that people value, and that originates in forested headwaters at high risk of damaging wildfire.

Las Conchas Fire: Case in Point

In 2011, the Las Conchas Fire burned 156,000 forested acres in the Jemez Mountains of northern New Mexico. Post-fire thunderstorms then led to massive ash and debris flows in surrounding canyons. The Rio Grande turned black with sediment and the cities of Albuquerque and Santa Fe halted water withdrawals because water managers determined the ash-laden water was not worth treating in their new \$450 million and \$215 million river-water facilities. Meanwhile, the flooding deposited tons of debris in Cochiti Lake, closing the area to recreation and dumping excessive sediment in the reservoir. The damaging effects of the Las Conchas Fire on the Rio Grande will persist for years to come.



In Their Words



“An economic development strategy and a comprehensive plan that responds to the uniqueness of a place and realistically assesses the water resources necessary to retain and attract new business enterprises is a goal of the Rio Grande Water Fund. Growth, conservation and well managed natural resources can all work together if the end game is to build a resilient economy and a quality place for current and future generations to live, work and raise a family.”

Dale Dekker, Principal
Dekker/Perich/Sabatini and
Greater Albuquerque Chamber
of Commerce, Water and
Energy Subcommittee Chair

PHOTO: Dale Dekker, member of the Rio Grande Water Fund Advisory Board. © Dekker/Perich/Sabatini

4 Rio Grande Water Fund

Frequent fire is normal in New Mexico’s ponderosa pine and dry mixed conifer forests, but changes in tree density and summer temperatures over the last century are causing wildfires to burn hotter. Watersheds that experience extensive mid- and high-severity fire have greatly diminished water storage functions—soil doesn’t absorb and hold water, and runoff during rainstorms can cause flooding and debris flows. In addition, the large amounts of sediment that move into rivers and reservoirs during these floods and flows may disrupt water delivery and storage. Other important values—such as homes, property and community infrastructure, wildlife and fish, acequias and rural economies, tourism and outdoor recreation—are also at risk when forested watersheds are severely damaged by wildfire.

Proactive steps on a large scale are needed to protect the Middle Rio Grande, Rio Chama and their forested tributaries and headwaters, an area with roughly 1.7 million acres of fire-prone ponderosa pine and mixed conifer forest (see Figure 1). Models of debris flow risk after high-severity fire indicate that key water sources are at risk. Scientists recommend that 1%

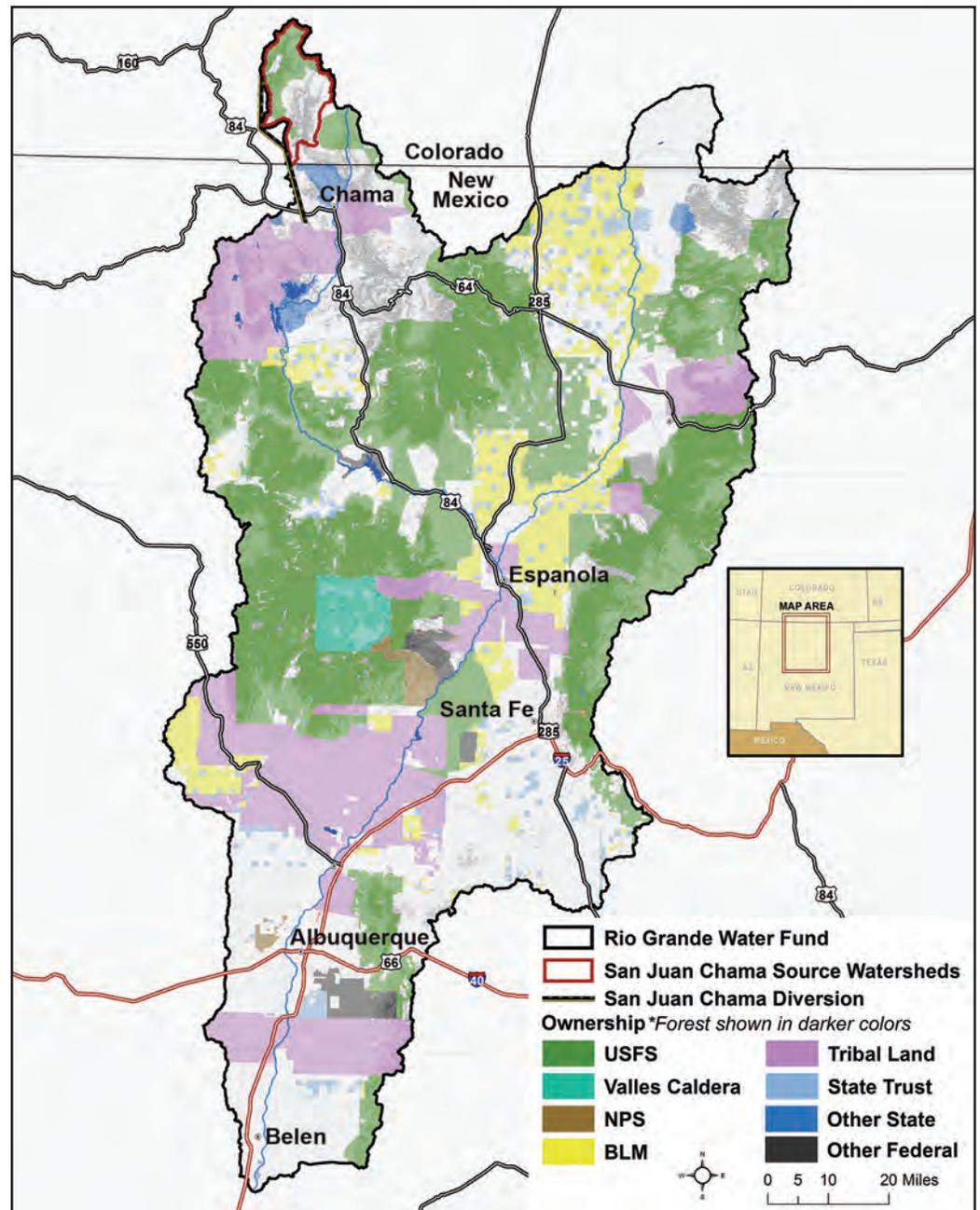


Figure 1. The Rio Grande Water Fund area includes forests, agricultural lands and communities from Belen north to the Colorado border.

to 2% of fire-adapted forest landscapes be treated each year to change fire behavior, which at the high end of this range corresponds to approximately 30,000 acres per year in this landscape. The Rio Grande Water Fund will sustain these treatments over the next 20 years for a total of 600,000 acres restored—a ten-fold increase in the current rate of forest and watershed restoration.

The Rio Grande Water Fund is the tool to collect and facilitate investments in this accelerated restoration work. A water fund allows government agencies, water users, community stakeholders and others to invest in the protection of the forests that supply our water. Similar funds have been established in Latin America and several cities in the western U.S., including a successful pilot effort in Santa Fe, New Mexico.

SETTING PRIORITIES

This Comprehensive Plan sets forth the case and process for establishing a Rio Grande Water Fund. Most important, this Comprehensive Plan sets priorities to support the objectives of the water fund. These priorities are expressed as **focal areas** and **project criteria**, developed to ensure that the water funds and other leveraged public funds are allocated to the areas where the risk to water supplies is greatest and where forest thinning, controlled burning, stream restoration and flood mitigation projects have the highest potential for immediate and successful implementation.

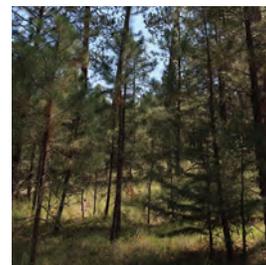
INVESTING WISELY

The benefits of forest and watershed restoration are clear. Thinning one acre of dense forest in the Rio Grande Water Fund area costs \$700 on average, whereas the economic impact of one acre affected by damaging wildfire can be up to \$2,150 per acre. The 2011 Las Conchas fire cost is estimated at \$246 million and expenses are still accruing. In contrast, to accelerate the pace of wildfire and water source protection, \$21 million a year—or close to \$420 million over the next 20 years—will be needed. For comparison, about \$6 million is currently invested annually in restoration on federal lands in the water fund area. Based on these estimates, it is more cost-effective to invest in prevention than to pay for expenses associated with reacting to damaging wildfires. Over time, the cost of prevention will decline as a larger forest industry is established. A transition period will be needed, and the Rio Grande Water Fund can fill the need as described in this Comprehensive Plan.

Water is essential for promoting economic well-being and provides a high return on investment. Water is a necessity for residents, industry, agriculture and many service activities, and to promote and sustain economic activity in the largest cities and marketplaces in the state. Water supports recreational activities and sustains the beautiful places that make New Mexico a “Land of Enchantment.” And water fund investments in forest treatments have the added benefits of creating jobs in rural communities, providing wood materials for locally sourced products, and protecting habitat for numerous forest and water dependent species.

A CALL TO ACTION

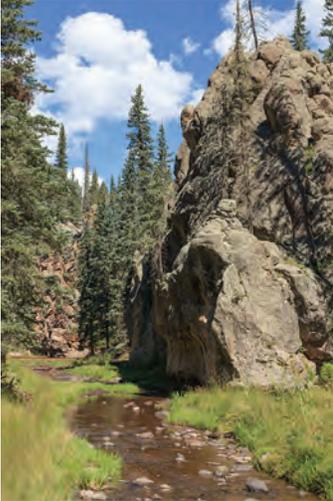
New Mexico must act now to protect our watersheds and water supply. With every year that goes by without a large-scale solution, more forested acres are severely burned, more critical water sources are jeopardized, more communities are threatened and other natural values are placed at risk. A coordinated, leveraged, multi-partner effort is needed to scale up restoration. This *Rio Grande Water Fund Comprehensive Plan for Wildfire and Water Source Protection* provides a blueprint for action. This plan includes an introduction and analysis of water security threats, a vision for the future, summaries of study results that will guide water fund investments and a clear path forward to securing New Mexico’s water for the future.



To thin one acre of dense forest in the Rio Grande Water Fund area costs \$700, on average, whereas the economic impact of one acre affected by damaging wildfire can be up to \$2,150 per acre.

PHOTOS: Dense forest in the Rio Grande Water Fund area; grass rejuvenates in a thinned forest; acres of high-severity burn are without a seed source to foster a new forest. TOP TO BOTTOM: © Alan Eckert Photography; © Alan Eckert Photography; © Craig Allen

In Their Words



“In the region of country where land is more abundant than water, the value inheres in the water, not the land.”

John Wesley Powell

PHOTO: Headwater streams fed by snowmelt are critical to New Mexico's water supply. © Alan Eckert Photography

INTRODUCTION

▶ New Mexicans' notion of what constitutes a “large” wildfire has grown substantially over the past decade. Since 2000, the size of the largest fire recorded in New Mexico has more than quintupled (see Figure 2).ⁱ

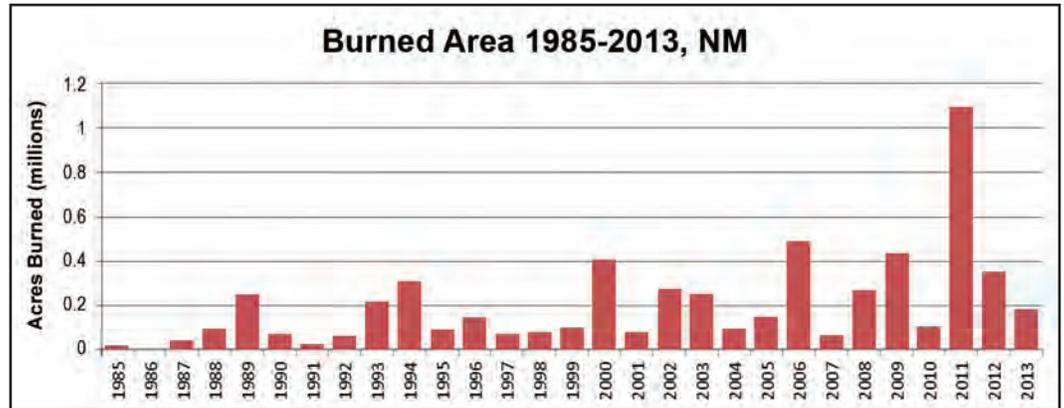


Figure 2. The record of wildfires since 1985 shows an increase in the acres burned annually over the last decade.

Wildfire severity is increasing too, and in the case of the Las Conchas and Whitewater-Baldy fires, they are spreading at unprecedented rates. For example, the Las Conchas fire grew by 43,000 acres in 12 hours on the first day, causing some of the most severe watershed damage in the entire burn perimeter. Just six weeks later, average-size thunderstorms over the burn areas caused massive debris flows and flushed ash, rocks, trees and more into streams and the Rio Grande. These combined factors of wildfire and flooding are the catalyst for the Rio Grande Water Fund.

The *Rio Grande Water Fund: Comprehensive Plan for Wildfire and Water Source Protection* is the culmination of more than two years of research and planning conducted by a collaborative partnership of more than 40 organizations and agencies. The Comprehensive Plan uses the best available dataⁱⁱ to describe the current threat of wildfire to water sources and other values of forested watersheds, and sets forth a path for the future (see Figure 3).

VISION, GOALS AND OBJECTIVES

The Rio Grande Water Fund is established 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. The **objectives** of the water fund are to:

- Restore watershed functions by improving the health of streams and riparian areas,
- Mitigate the downstream effects of flooding and debris flows after wildfires,
- Reduce forest fuels in areas identified as high risk for wildfire and debris flow,
- Support forest products industries' use of wood by-products from forest fuel reduction,
- Maintain the reduced wildfire hazard in treated areas, and
- Secure sustainable financing from water users, government, investors and donors, and facilitate payments to upstream land managers.

New Mexico | Rio Grande Water Fund

Restoring essential forested lands upstream will ensure a continuous supply of clean water downstream

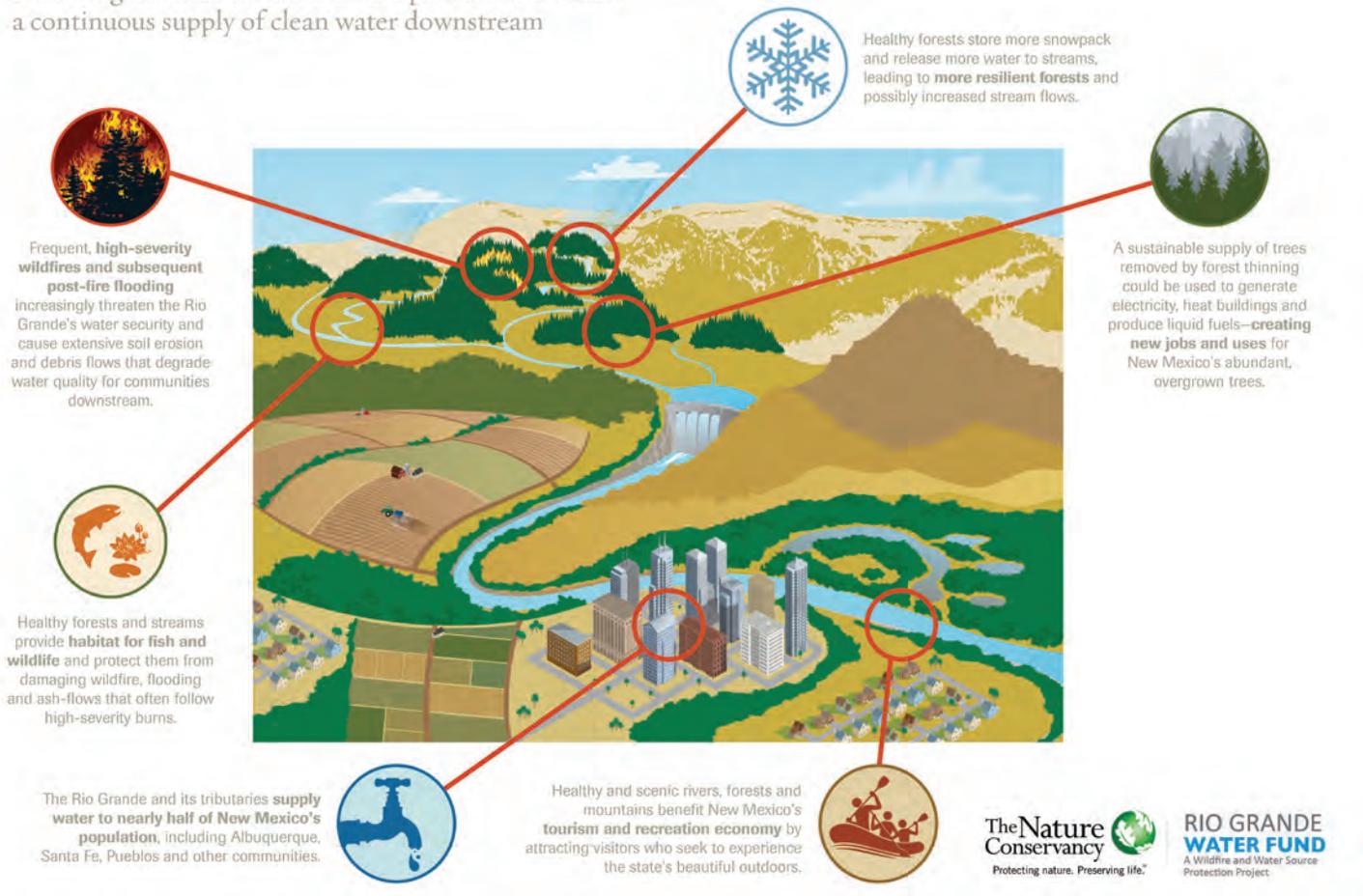


Figure 3. Forests, wildfire, water and people are interconnected as shown in this graphic.



PHOTO: The advisory board represents diverse interests, with many meeting for the first time at the comprehensive planning process. © Chama Peak Land Alliance

ADVISORY BOARD

The Nature Conservancy convened an advisory board in April 2013 to guide the formation of the Rio Grande Water Fund. Initially, 23 organizations and agencies participated and over the course of a year the board grew to more than 45 New Mexico entities. Each advisory board member represents a unique constituency or stakeholder who cares about water security and wants to help implement large-scale forest and watershed restoration (Appendix A). The advisory board has two important roles:

- Involve local, state, federal, and tribal government and water managers, the business sector, foresters, conservation organizations and other stakeholders in the creation of a water fund that connects the Rio Grande, Rio Chama and tributaries to surrounding forested watersheds.
- Provide direction for the creation of a water fund including guidance about studies needed, creation of a comprehensive water security plan that will complement and inform other plans,ⁱⁱⁱ and determination of the water fund structure, governance and fund raising.

WILDFIRE THREAT TO FOREST HEALTH AND WATER SECURITY

In Their Words



“The Las Conchas Fire was shocking to those of us who have been studying fire behavior and effects in New Mexico for decades. The severity and scale of the impacts surpassed anything we’d seen before.”

Craig Allen,
Research Ecologist,
U.S. Geological Survey

▶ Watersheds have five essential functions: to collect water that falls as rain or snow; to store water and snow in various amounts and for different lengths of time; to release water as runoff; to filter and clean stored water and runoff; and to provide habitat for plants and animals. The overgrown condition of New Mexico’s watersheds, coupled with extended drought, is a key factor that impairs watershed function and leaves our forests susceptible to wildfire and insect infestation.^{iv}

The Rio Grande watershed, including the Rio Chama and other tributaries, supplies water to Albuquerque, Santa Fe, Pueblos and many rural communities—half of New Mexico’s population—and is essential for a thriving economy and the health of New Mexico’s agriculture and industry (see Figure 1). Yet, water quality and security in the Middle Rio Grande and the Rio Chama is increasingly threatened by frequent high-severity wildfires and subsequent post-fire flooding that cause extensive soil erosion and debris flows.

The 2011 Las Conchas fire best illustrates the problem: nearly 45% of fire area burned at high severity. Subsequent rain over the burned areas created large ash and debris flows in Peralta, Bland, Cochiti and Santa Clara Canyons. The Rio Grande turned black with sediment and the cities of Albuquerque and Santa Fe halted water withdrawals because water managers determined the ash-laden water was not worth treating in their new \$450 million and \$215 million dollar river-water facilities.^v Meanwhile, the flooding deposited tons of debris in Cochiti Lake, closing the area to recreation and dumping excessive sediment in the reservoir.



PHOTOS: LEFT TO RIGHT: Craig Allen in the Las Conchas fire burn area. © Rory Gauthier, National Park Service; Debris floats on Cochiti Lake after moderate thunderstorms in areas that burned at high-severity in Las Conchas fire. © US Army Corps of Engineers

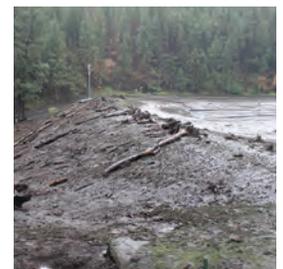
The effects of the Las Conchas fire on the Rio Grande will continue for years. For example, three years after the burn, sediment flowed out of burned portions of Peralta Canyon into the Rio Grande after several days of rain. The 50,000 cubic yards of sediment acted like a dam across the river, posing a flooding risk to a nearby irrigation canal and temporarily preventing the release of stored water from Cochiti Reservoir.

Extensive studies of New Mexico fire behavior and fire ecology by leading southwestern scientists provide important background for understanding how wildfire threatens water security. These key concepts are as follows:^{vi}

- **Fire Severity:** Frequent but low-severity fire is normal in New Mexico's extensive ponderosa pine and dry-site mixed conifer forests.^{vii}
- **Tree Density:** Suppression of natural fires over the past 100 years has resulted in an increase of tree density in New Mexico forests. The dense trees act as a "ladder" for fire to move from grass and shrubs at ground level into the tops of trees. The continuous nature of the dense forest makes it easy for fire to spread through the tree crowns, also known as a "crown fire."^{viii}
- **Summer Temperatures:** Rising temperatures since the 1960's have extended the length of the fire season and increased the extent of mid- and high-severity burns during periods of higher summer temperatures.^{ix}
- **Water Storage:** New Mexico's forests are nature's water storage tanks and play a key role in the hydrologic cycle. Most of the surface water in the Rio Grande originates as snowfall^x and, in restored forests, is stored under the tree canopy until spring. Snow melt is the primary source of surface water for agriculture, municipal and industrial use.^{xi}
- **Post-Fire Flooding:** Fires that burn at moderate and high severity cause extensive and severe watershed damage. The magnitude of flooding after a fire is much greater than flows from unburned lands, and in some locations has resulted in catastrophic debris flows.^{xii}
- **Drought:** Scientists predict rising temperatures will further threaten water supplies and forests through drought induced forest die-off, reduced snowpack and altered stream flow.^{xiii}

The cost of a damaging fire far exceeds the cost to put it out. A recent study by economists at the University of New Mexico estimated the full costs of the Las Conchas wildfire between \$156 million and \$336 million (with a mid-point cost of \$246 million), or up to \$2,150 per acre.^{vix} The study, which is based only on existing studies and uses the benefit transfer method, does not capture all costs, and some costs are still accruing.

Full wildfire costs are paid by society: taxpayers fund fire suppression costs while indirect costs are covered by a variety of sectors.^{xv} For example, downstream water users, counties and municipalities bear the cost of flooding and debris when their water delivery is interrupted or water infrastructure is damaged. Insurance rates increase for all property owners in areas with high occurrences of large fires or post-fire flooding. Health insurance costs rise and more people are afflicted by smoke-related respiratory illnesses. Tax revenue is lost from the reduction in tourism; business revenue decreases; and property losses accumulate over the longer term. Finally, landowners and agricultural communities accrue rehabilitation costs to restore property, field and infrastructure damaged by fire.



Forested watersheds that are severely damaged by fire have greatly diminished water storage functions—the soil doesn't absorb and hold water, and runoff during rainstorms can cause flooding and debris flows.

PHOTOS: Post-fire flooding after Las Conchas fire caused severe damage to property, water sources and control structures. © U.S. Army Corps of Engineers

In Their Words



“Benefits accrue to upstream communities as well. Forest restoration acknowledges the deep connection of land-based people to water in New Mexico and will provide work that helps retain youth in our communities.”

Leonard Martinez,
President, Land Grant Consejo

PHOTOS: Improved forest and watershed health will benefit local and downstream residents and is necessary to provide water security for future generations.

LEFT TO RIGHT: © Mark Schuetz;
© istockphoto

PROTECTING PEOPLE AND WATERSHEDS

This Comprehensive Plan focuses on water as the primary resource that people value,^{xvi} and that originates in forested headwaters at risk of damaging wildfire. Forested watersheds that are severely damaged by fire have greatly diminished water storage functions—the soil doesn’t absorb and hold water, and runoff during rainstorms can cause flooding and debris flows. Furthermore, the large amounts of sediment that move into rivers and reservoirs during these floods and flows may disrupt water delivery and storage. For example, the reservoirs and conveyance systems that deliver the San Juan-Chama Project water to New Mexico for municipal and agricultural use are vulnerable to post-fire debris flows. Currently, the San Juan-Chama Project supplies water to approximately 350,000 households in New Mexico. And within the water fund area, nearly 470 rural water systems are in place serving communities, schools and businesses.^{xvii}



Many other important resource and social values, in addition to water and watershed health, are at risk when forests are severely damaged by wildfire. For example, during and after wildfire:

- **Business Impacts:** People who depend on forests may lose their source of firewood, fencing and other products. The business environment in New Mexico may be adversely affected by the perception that water supplies are unreliable.
- **Health and Well-Being:** Pervasive smoke from wildfires pollutes the air and presents a significant health risk to people with respiratory illness. People are evacuated from their homes and businesses are closed.
- **Natural Infrastructure:** Soil capacity to absorb rainfall and hold water is diminished. The ability of burned areas to retain snowpack decreases.
- **Physical Damage:** Homes, property and community infrastructure, such as water pipes, power lines, earthen dams, and irrigation and acequia structures, may be destroyed.
- **Rural Communities:** The headwater regions are first to experience the negative effects of wildfire and flooding on their homes and farms.
- **Tourism:** Severe burns in or near ski areas, popular fishing streams and hiking trails create a long-term reduction in the number of visitors. Media coverage of dramatic flames and temporary closure of outdoor recreation areas lead to short-term declines in tourism.
- **Wildlife:** Animals are displaced from burned areas and may find their habitat destroyed. Popular elk hunting areas may no longer have suitable habitat. Fish cannot survive if too much ash clogs streams.

VISION FOR THE FUTURE

Large-scale, proactive steps are necessary to protect the Rio Grande, Rio Chama and their forested tributaries and headwaters – an area with roughly 1.7 million acres of fire-adapted ponderosa pine and mixed conifer forests. Scientists recommend that to change damaging wildfire behavior, 1% to 2% of fire-adapted forest landscapes should be treated each year.^{xviii} For an area of this size, this treatment would result in the annual restoration of 17,000 to 34,000 acres. The Nature Conservancy estimates the current annual rate of thinning treatment between 3,000 and 5,000 acres.^{xix} The Rio Grande Water Fund aims to ramp up and sustain treatments over 20 years, with 30,000 acres per year for a total of 600,000 acres restored in the Rio Grande, Rio Chama and tributary watersheds (see Figure 4).

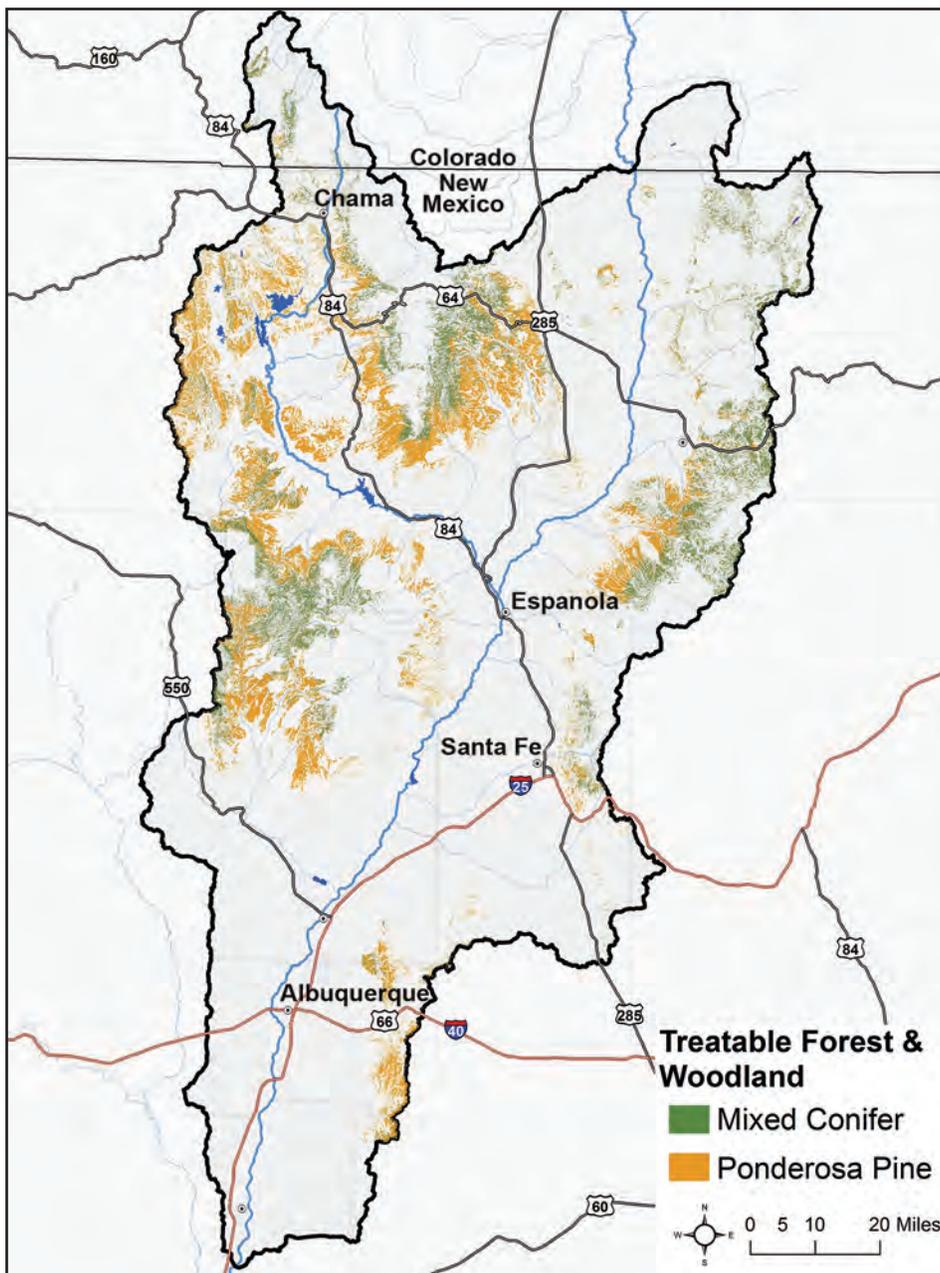


Figure 4. Approximately 1.7 million acres of ponderosa pine and mixed conifer forests occur in the Rio Grande Water Fund area. The Rio Grande Water Fund aims to ramp up and sustain forest treatments at a rate of 30,000 acres per year for a total of 600,000 acres over 20 years.

In Their Words

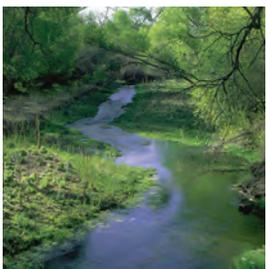


“We need a ten-fold increase in the pace and scale of forest and watershed restoration if we are going to make a difference.”

Kim Kostelnik,
Natural Resource Consultant
and Rio Grande Water Fund
Advisory Board member

PHOTO: Wildfires after the 2013 Thompson Ridge fire in the Jemez Mountains. © Alan Eckert Photography

The Rio Grande Water Fund is the mechanism to catalyze a necessary ten-fold increase in the pace and scale of forest and watershed restoration. A water fund allows government agencies, water users, community stakeholders and others to invest in protection of the forests that supply their water. Similar funds have been established in Latin America, where The Nature Conservancy and partners have 32 water funds in various stages of development that provide a steady source of funding for the conservation of more than 7 million acres of watersheds and secure drinking water for nearly 50 million people.^{xx} In western U.S. cities, such as Denver, Salt Lake City and Flagstaff,^{xxi} water funds or similar mechanisms are helping water users to invest in healthy watersheds. And a successful pilot effort on a 17,000-acre municipal watershed in Santa Fe (the Watershed Improvement Program), has proven the tool can work in New Mexico.^{xxii}



The figure on page 13 illustrates the relationships between forest condition and function. For example, tree density is one major factor determining wildfire burn severity, which in turn influences post-fire effects. These post-fire effects include the percentage of trees that die in the fire; whether seeds that are stored in the soil survive the fire; the extent of soil erosion and flooding after the fire; and how much snowpack is retained in the overgrown forest versus the burned area. Under the same moisture and weather conditions, the model assumes that a forest with more trees per acre will burn more severely than a forest with fewer trees.

The conceptual model illustrates two distinct outcomes based on whether or not action is taken to reduce the risk of wildfire. Under the “no action” scenario, a wildfire burns with high-severity, resulting in loss of soil and plants, and causing downstream impacts to water quality and quantity. Under the “action” scenario, agencies scale-up forest and watershed restoration treatments, a wildfire burns with low-severity, there is little loss of soil and plants, and downstream water quality and quantity are protected.

This Comprehensive Plan also sets priorities to support the objectives of the Rio Grande Water Fund. These priorities are expressed as **focal areas** and **project criteria**, developed to ensure that water fund investments and other leveraged public funds are allocated to the areas where the risk to water supplies is greatest and to projects that have the highest potential for successful implementation.

A water fund allows government agencies, water users, community stakeholders and others to invest in the protection of the forests that supply their water.



PHOTOS: TOP TO BOTTOM: Water for people © *Ian Shive*; Water for communities © *Alan Eckert Photography*; Water for nature © *Harold Malde*; Meadow and forest in the San Juan Chama headwaters © *Chama Peak Land Alliance*

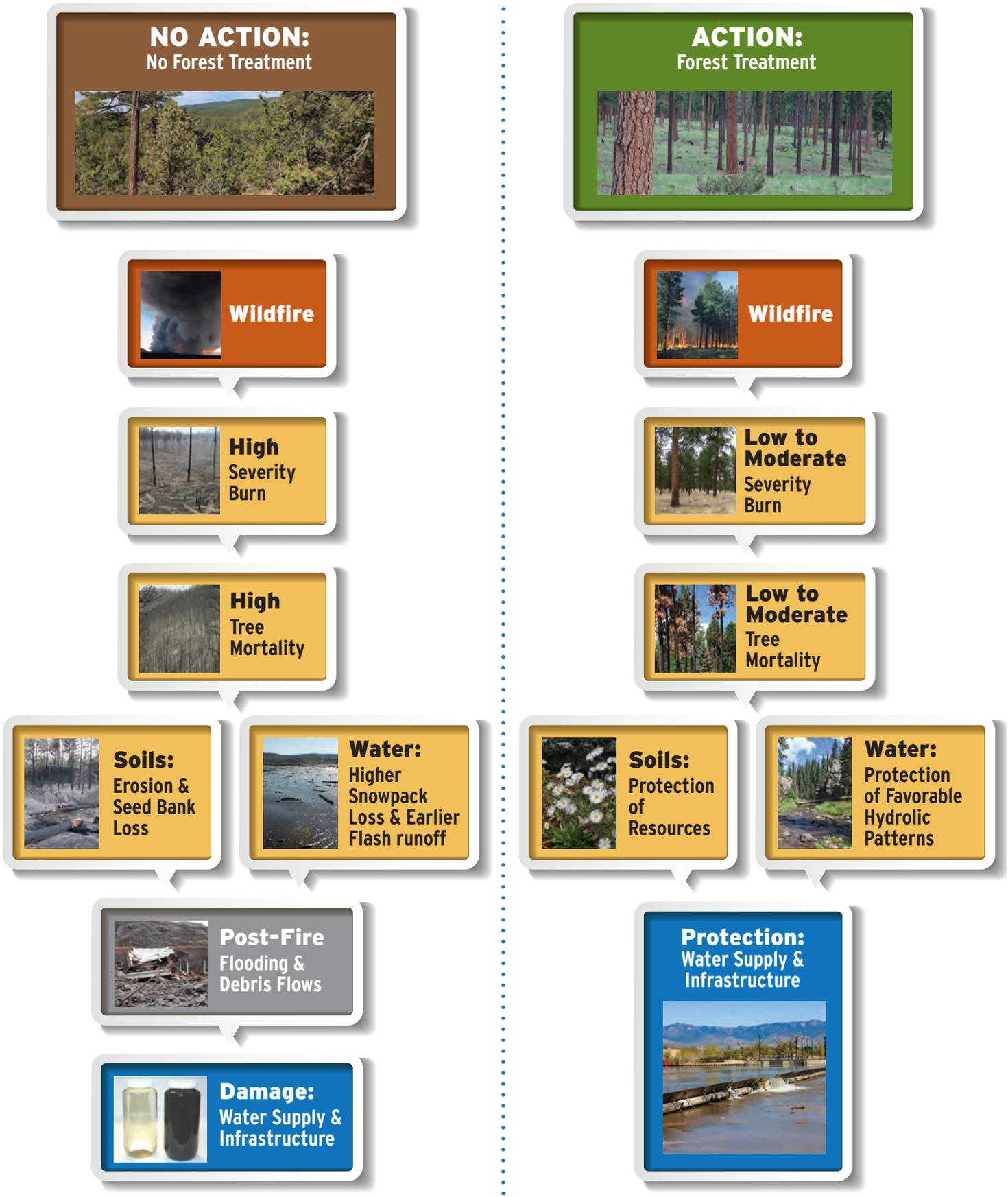


Figure 5. In the “no action” scenario, a wildfire burns with high-severity, resulting in loss of soil and plants, and negative downstream impacts to water quality and quantity. In the “action” scenario, forest restoration is scaled up so that wildfires will burn with low-severity, with little loss of soil and plants, and protection of downstream water quality and quantity.



This Comprehensive Plan sets priorities to support the objectives of the Rio Grande Water Fund. These priorities are expressed as focal areas and project criteria that will ensure water fund investments and leveraged public funds are allocated to areas with high-risk of wildfire and damage to important water sources.

• **Focal areas** are broad regions where restoration treatments and economic development should be focused. Data about forest conditions, water supplies and users, potential for wood use, and social and economic importance to the state were the bases for identifying focal areas. The four focal areas identified in this plan are (see Figure 6 and Appendix G):

1. Sandia and Manzano Mountains
2. Jemez Mountains
3. San Juan/Chama River Watersheds
4. West-slope of the Sangre de Cristo Mountains

• **Project criteria** provide a clear and transparent mechanism for selecting where water fund dollars should be allocated within the focal areas. The Comprehensive Plan uses these project criteria to evaluate and rank proposed forest and watershed restoration projects.

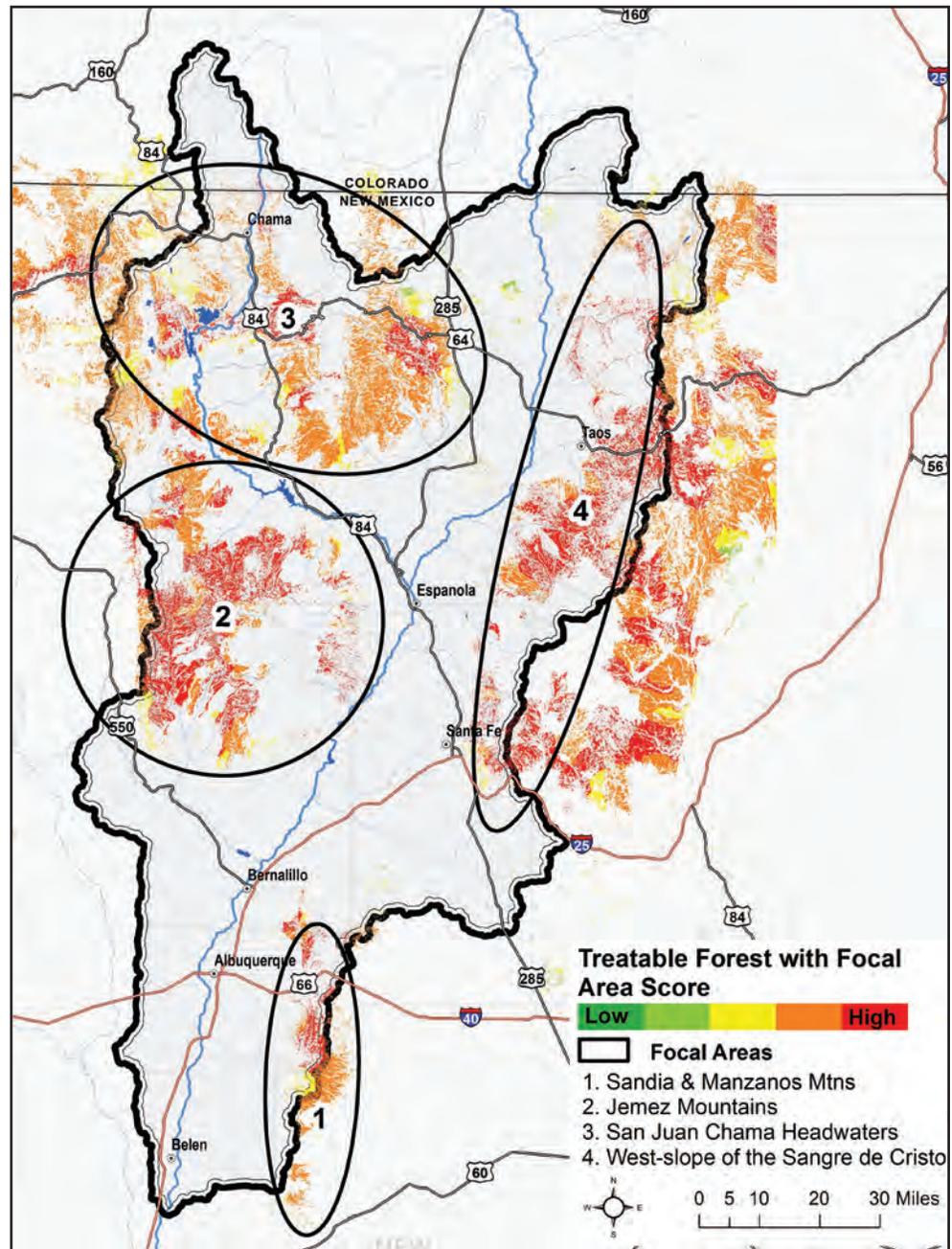


Figure 6. Four focal areas for Rio Grande Water Fund investment.

PHOTOS: River otters and river runners benefit from water in the Rio Grande. TOP TO BOTTOM: © New Mexico Game and Fish Department; © Erika Nortemann/TNC

SOURCES OF WILDFIRE RISK AND POTENTIAL FOR DEBRIS FLOW

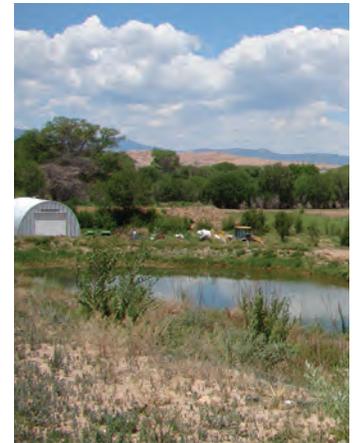


Wildfires and hazards posed from post-fire debris flows are becoming an increasingly significant threat in the Intermountain West. Debris flows are a type of landslide that is typically fast-moving and generally occurs during periods of intense rainfall on soils that are already wet and saturated. Debris flows are slurries dense enough to carry boulders, trees and other large debris. Many factors influence the likelihood and intensity of debris flows including slope, soil type and burn severity. Identifying watersheds where high-severity wildfires and post-fire debris flows are more likely to occur is a key step to reducing risks.

The Nature Conservancy convened a technical team of experts^{xxiii} to develop a modeling approach to identify forested watersheds in New Mexico at highest risk of wildfire and water source damage from debris flow (see Appendix B).^{xxiv} The team first conducted a detailed risk assessment for the East Mountains, which includes the Sandia and Manzano Mountains. The results are in publication (available August 2014) and include documentation of the methodology for estimating the variation in burn probability across the land area, fire severity and debris flow hazard. The model combines these variables to map the threat of debris flow in unburned watersheds. A second study, available in April 2015, is underway for the Jemez Mountains and the western slope of the Sangre de Cristo Mountains. The Rio Grande Water Fund Advisory Board will use the results from these studies to further refine priority projects within each focal area.

In addition, The Nature Conservancy completed a rapid assessment of wildfire and debris flow probability in the Rio Grande Water Fund area. This rapid assessment used model output developed in 2012 for the New Mexico Department of Game and Fish and data for the same key predictors of debris flow used by the technical team, such as percent slope, burn severity, soil type and percent rainfall expected (see Figure 7). The rapid assessment was used to identify the four focal areas for the Rio Grande Water Fund. The assessment is intended for landscape comparison and not to identify projects within each focal area.

In Their Words



“Burn scars contributed a tremendous amount of sediment and silt to our acequias. Loss of acequia function is a blow to our communities, culture and way of life.”

Gilbert Sandoval,
Board Member, New Mexico
Acequias Association

PHOTOS: LEFT TO RIGHT: Damaged vehicles and property after the debris flows that followed Las Conchas fire. © U.S. Army Corps of Engineers; Farming and acequias are integral to the way of life in New Mexico. © Quita Ortiz, NM Acequia Association



Debris flows are a type of landslide that is typically fast-moving and generally occurs during periods of intense rainfall on soils that are already wet and saturated. Debris flows are slurries dense enough to carry boulders, trees and other large debris.

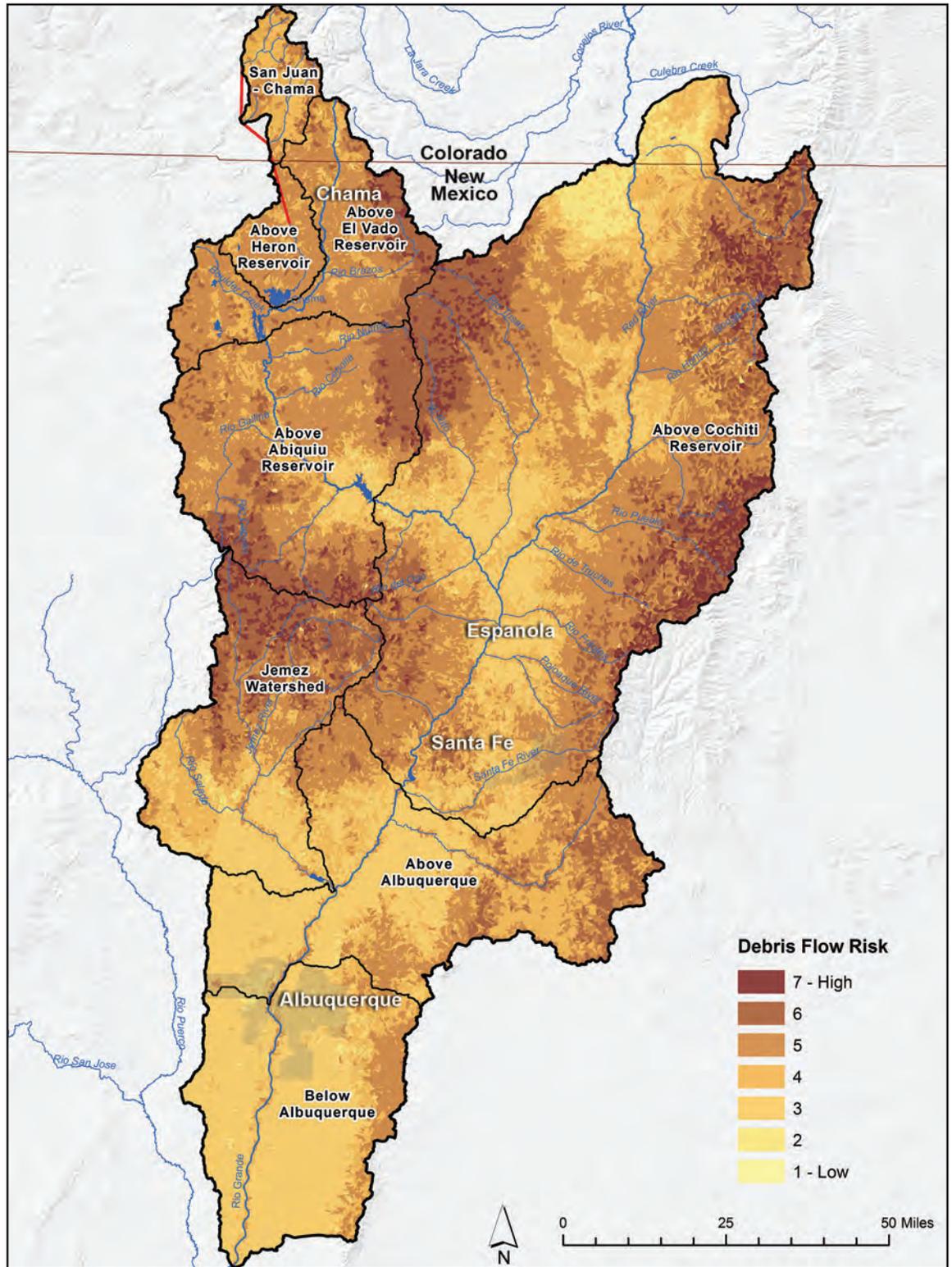


Figure 7. Results of a rapid assessment of burn probability coupled with probability of debris flow after a wildfire.

PHOTO: TOP TO BOTTOM: Road culverts become clogged as debris is washed out of burned areas. © Craig Allen; Boulder moved by debris flow in Cochiti Canyon after Las Conchas fire. © U.S. Army Corps of Engineers

IMPROVING WATERSHED FUNCTION WITH THINNING TREATMENTS

▶ The Nature Conservancy is evaluating how much accelerating the pace of forest thinning might increase snowpack storage and the regulation of runoff, as well as forest resiliency to drought. A multi-year study with several research partners is also underway to provide higher levels of certainty about watershed response to accelerated restoration treatments.^{xxv}

The Nature Conservancy's initial evaluation seeks to identify and summarize the results of previous studies related to the impacts of wildfires and thinning treatments on high-altitude forested watersheds with special emphasis on snowpack and runoff. The evaluation also provides a coarse review of existing hydrologic models that can help set priorities for where to restore forests and suggests alternatives for future model development. Finally, an initial estimate of the range of potential changes in watershed function will be provided, but thus far is only completed for ponderosa pine forests.

The initial result of the study is a preliminary estimate, using available models and data, of the range of potential changes in the release of water if the 275,000 acres of treatable ponderosa pine forest in the water fund area are thinned.^{xxvi} The calculation assumes 30,000 acres of ponderosa pine are treated annually for a little over nine years. The annual increase in runoff from treated ponderosa pine forest is estimated as 2,745 acre-feet, the annual amount used by 11,000 households^{xxvii} and a level that could restore some portion of historical flows to existing water rights holders (see Figure 8).

Future analyses will consider dry mixed conifer and aspen-mixed conifer forest types. These higher-elevation forests are expected to have a higher increase in runoff, in part because they receive more snow and are denser than the lower-elevation ponderosa forests. However, further research is needed to quantify this increase. Assuming that the water release from the higher-elevation mixed conifer and aspen-mixed conifer forests is at least that of ponderosa pine forests, and given that ponderosa pine forests are less than 50% of the treatable forest in the water fund area, it is likely that future analysis will show significantly more increase in runoff over this initial estimate.

A full description of the methods is included in Appendix C. More detailed analyses will be available by the end of 2014. Other studies are underway that consider precipitation estimates given the historical cycles of wet and dry periods and climate change; research at a variety of sites with differing soils and underlying geology; and field measurements of the runoff and in-stream flow at treated and control sites. These studies will help determine if the stream flow component of watershed function is likely as a secondary benefit of the Rio Grande Water Fund.



In Their Words



“Thinning will restore the space between trees and allow snow to reach the ground instead of falling on branches where it evaporates after being exposed to wind and sun. The thinned forest also provides partial shade for the accumulated snowpack, extending snow melt into the spring.”

Bob Parmenter,
Chief Scientist, Valles
Caldera National Preserve

PHOTOS: LEFT TO RIGHT: Water that originates in snowy tributaries of the San Juan River is delivered via the Rio Grande and treated for municipal use at this plant in Albuquerque. © Alan Eckert Photography; Bob Parmenter on Redondo Peak in the Valles Caldera National Preserve. © Photo courtesy of Bob Parmenter



The annual increase in runoff from treated ponderosa pine forest is roughly equal to the annual amount used by 11,000 households.

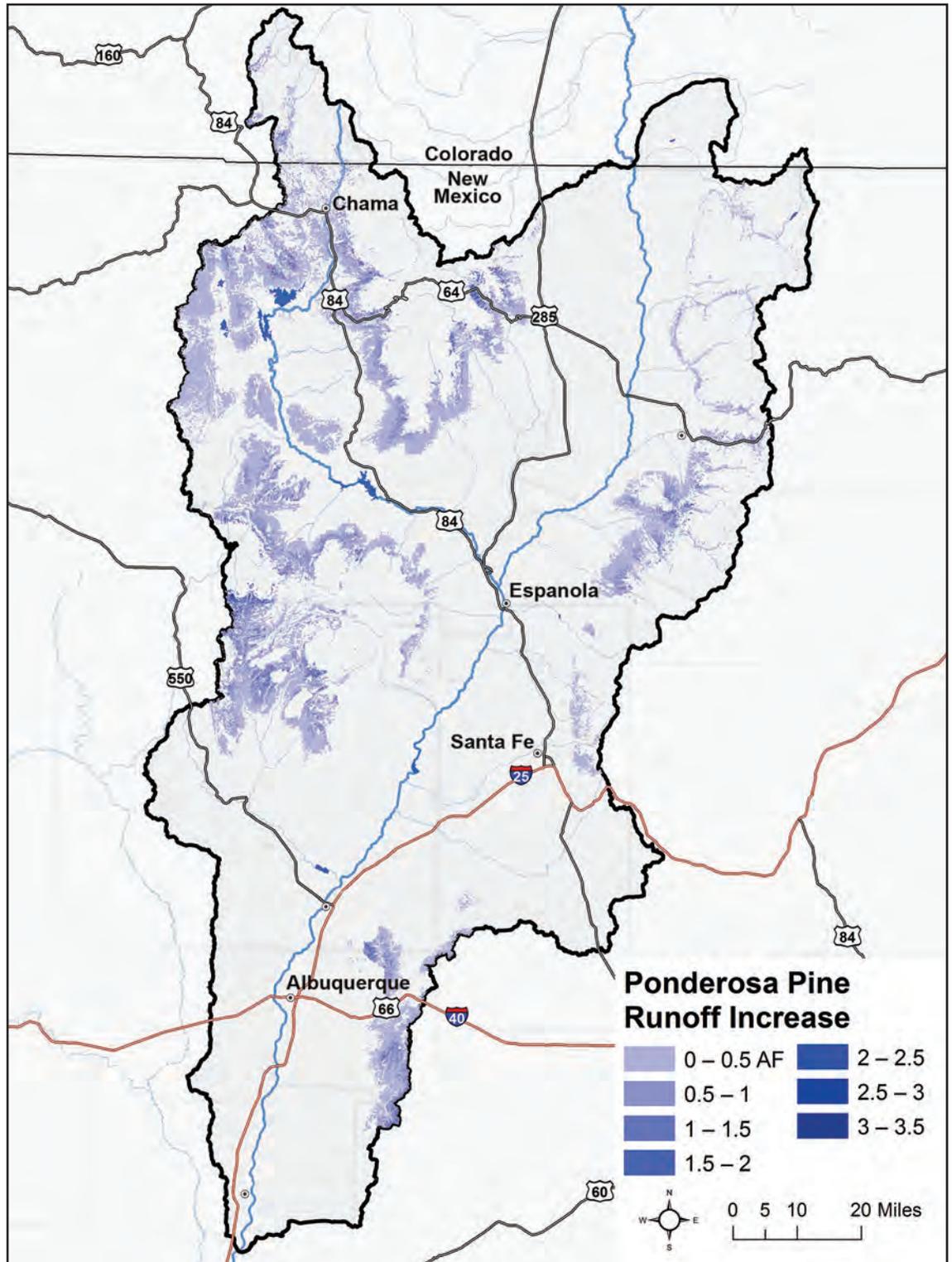


Figure 8. Results of a rapid assessment of watershed response to widespread thinning of ponderosa pine forests. The second assessment will include dry mixed conifer forests at higher elevations that receive more precipitation.

PHOTO: TOP TO BOTTOM: Snow that falls on a dense forest lands on branches where it is exposed to wind and sun. © istockphoto; Thinned forests capture and store snow better than dense forests with intersecting tree tops. © Valles Caldera National Preserve

RESTORATION PLAN

Accelerated landscape-scale restoration that reduces the risk of crown fires in tributary forested watersheds will help protect and enhance surface water sources. Restoration will take place primarily in ponderosa pine and mixed conifer forests; however restoration of piñon-juniper woodlands may be included. The New Mexico Forest Restoration Principles and a recent Forest Service general technical report, *Restoring Composition and Structure in Southwestern Frequent-Fire Forests*, serve as important references for retaining or restoring forest diversity.^{xxviii} Funding will be available for thinning, controlled burns, stream restoration, post-fire watershed restoration,^{xxix} planning, education and outreach, and activities that contribute to the monitoring program described in Section 11. Definitions of the specific activities that may be incorporated into eligible projects are included in Appendix D.

LAND OWNERSHIP

A mix of land ownership in ponderosa pine and mixed conifer forests is found within the Rio Grande Water Fund area (see Figures 1 and 9). The majority of these lands, 1.1 million acres, are in the National Forest system. The next largest categories of ownership are private lands, with 243,470 acres, and tribal lands, with 157,312 acres. The National Park Service, Valles Caldera National Preserve, Bureau of Land Management and State Parks and Wildlife Conservation Areas also comprise significant land ownerships. For all of these agencies, especially federal, the planning and implementation requirements for forest restoration treatments have a direct bearing on project readiness. See Appendix E for details on restoration activities each agency has planned.

Ownership	Acres
USDA Forest Service	1,103,926
Bureau of Land Management	15,611
National Park Service	31,894
Other Federal (BOR, DOD, DOE)	10,316
Tribal Lands	157,312
Valles Caldera National Preserve	37,655
Private Lands	243,470
State Trust Lands	3,835
State Parks and Wildlife conservation Areas	13,537
Local Government (City, County) Lands	619
Total	1,618,175

Figure 9. Ownership of Mixed Conifer and Ponderosa Pine Forested Lands in Water Fund Area

FEDERAL PLANNING REQUIREMENTS

Agencies and landowners that receive funds from the Rio Grande Water Fund will need to comply with regulations and practices relevant to their individual jurisdiction, and may also use the water fund to cost-share planning and compliance expenses. Projects on federal lands, or those funded with federal dollars, must comply with federal statutes designed to protect the environment. Most notable is the National Environmental Policy Act, or NEPA.

In Their Words



“Restoration of forested watersheds will take the expertise of many different agency and private sector natural resource professionals, including water, fire and forest managers, as well as engagement of diverse community, business and environmental and private land interests.”

Monique DiGiorgio,
Chama Peak Land Alliance

PHOTO: Monique DiGiorgio and her young daughter. © Photo courtesy of Monique DiGiorgio.



Despite overall declining budgets for several federal natural resources agencies, the U.S. government has created several new initiatives to accelerate forest restoration treatments and encourage larger, collaborative projects.

The purpose of NEPA is to inform the public and to ensure that agencies make good decisions based on sound analysis. Environmental impact statements and environmental assessments are examples of the documentation required to comply with NEPA. The NEPA process includes coordination with other state and federal regulatory agencies, including the Fish and Wildlife Service for Endangered Species Act compliance, the Environmental Protection Agency for Clean Water Act compliance, and the state Cultural Properties Review Committee, which sets standards for cultural resource protections.

A NEPA document analyzes different alternatives, including a no-action alternative. The document outlines alternatives to respond to a set of issues or concerns raised by the public or the agency. Alternatives analyze the impacts and benefits of different intensities, scope and timing of forest restoration work. For example, one alternative may emphasize wildlife protection during restoration and propose fewer acres treated. Another may propose removal of more volume of wood to enhance economic opportunities. A “decision-maker” is responsible for reviewing all the alternatives, as well as the public response, and selects one alternative or some combination of the alternatives to implement.

Federal agencies have both mandated regulations and their own individual internal policies to provide guidance for meeting the intent of NEPA. For the USDA Forest Service, data collection, analysis, public comment, document revision and resolution of any public concerns typically takes one to three years before implementation, with more complex or controversial projects—such as larger landscapes—taking longer. Analyzing a larger landscape in one comprehensive document has the potential to save time and money, and can more effectively communicate the scope of restoration activities needed to reduce wildfire risks and increase water security. The Forest Service is increasing its up-front collaborative efforts to resolve conflict before the more formal NEPA process begins, with the expectation that disagreements can be resolved and less effort will be spent on project objections and litigation during and after the NEPA process.

RECENT FEDERAL INITIATIVES TO ACCELERATE LARGE LANDSCAPE RESTORATION

Despite a climate of overall declining budgets for several federal natural resources agencies, the government has created several new initiatives to accelerate forest restoration treatments and encourage larger, collaborative projects. The focus on large-scale restoration and collaborative engagement align well with the objectives and structure of the Rio Grande Water Fund.

Collaborative Forest Landscape Restoration Program

In 2009, the U.S. Congress established the Collaborative Forest Landscape Restoration Program, or CFLRP, to create more opportunities for large scale (50,000 acres or greater), collaborative, science-based ecosystem restoration through a competitive funding process. The CFLRP objectives are similar to the goals of the Rio Grande Water Fund, with a focus on leveraging local resources with national and private resources; reducing the risk of uncharacteristic wildfire; demonstrating the degree to which various restoration techniques achieve ecological and watershed health objectives; and encouraging the use of restoration by-products to offset treatment costs, benefit local rural economies and improve forest health. The 210,000-acre Southwest Jemez Mountains Landscape is in a water fund focal area and was one of the first landscapes awarded funds through CFLRP. The program makes available up to \$4 million additional each year for treatments and monitoring within this landscape through 2019. Water fund investments would leverage the federal CFLRP funds.

PHOTOS: TOP TO BOTTOM: Firefighters with Santa Fe's Nichols reservoir in the background © Alan Eckert Photography; Snowy mountains near Chama are an important water source for New Mexico. © Chama Peak Land Alliance

Integrated Resource Restoration

In 2012, the U.S. Congress approved three Forest Service Regions as pilots for an Integrated Resource Restoration (IRR) program, including the Southwestern Region (or Region 3). IRR provides flexibility to combine budget allocations that were previously separate congressional budget line items. The IRR pilot regions can fund more diverse restoration activities and share costs across resources, thus using available funds more efficiently. Baseline funding levels did not change, but the theory was that budget flexibility would help accelerate the pace of restoration.

Stewardship Contracting

The 2013 Farm Bill included permanent approval for stewardship contracting authority. Stewardship contracting helps achieve land management goals while also meeting local and rural community needs for economic sustainability. Contracts focus on desired end results, or ecological outcomes of projects, rather than the amount of wood removed. Contracts can be in place up to 10 years, and may bundle a number of activities to benefit an entire landscape, e.g., thinning to reduce fire risk, fuel wood collection and stream restoration. A stewardship contract allows participants to trade goods for services. For example, removed wood can be used to offset the costs of a treatment. Receipts retained from one project can be applied to costs of another. Collaboration with local communities, tribes, non-governmental organizations and other interested groups is expected to continue throughout the project. Contract proposals are evaluated on best value rather than lowest cost to allow more flexibility in contractor selection. As part of the upfront planning, the agency and the community can jointly determine the landscape for a stewardship contract.

NON-FEDERAL LANDS PLANNING

New Mexico does not have a state equivalent to NEPA. State lands require surveys for cultural resources and rare or threatened species.

New Mexico state water planning directives call for river, riparian and watershed restoration that protects water supply and improves water quality.^{xxx} The New Mexico Office of the State Engineer 2003 *State Water Plan* will soon be updated and is re-establishing the 16 Regional Water Planning steering committees to update the regional plans. The Regional Water Planning guidelines list watershed management policies as a possible strategy to help balance supply and demand. The regions will be able to use the Rio Grande Water Fund's wildfire and debris flow risk information in their planning efforts to protect water supplies and improve watershed function.

PRIVATE LANDS

Private lands provide an opportunity to restore forested watersheds without the procedural requirements of public lands. The landowners engaged in the Chama Peak Land Alliance have launched the San Juan-Chama Watershed Partnership and are working on forest health projects at cost, or often at a financial loss, to benefit forest health and wildlife.^{xxxi} Many of these landowners utilize the same forester and are thus able to combine efforts across this focal area. Less complex planning for private lands allows for faster implementation of restoration activities. If private landowners receive federal funds from the New Mexico Forestry Division, federal planning requirements may apply.

State of New Mexico Watershed Restoration Initiative

In March 2014, Governor Susana Martinez signed the Work New Mexico Act, which includes \$6.2 million allocated by the state legislature to fund watershed restoration improvements across the state. The capital outlay dollars will fund “shovel ready” projects that will benefit high-priority watersheds.



Adaptive management and forest restoration will benefit endangered species like the Jemez Mountain salamander, whose habitat could be damaged by high-severity wildfire.

PHOTO: Specially trained dogs scent and locate the endangered Jemez Mountains salamander so its habitat can be protected during forest restoration. TOP TO BOTTOM: © Paige Lewis; © Karine Aigner; © David Solis

Funding will focus on landscape-scale improvements on forested lands in public ownership. Governor Martinez also created the \$2.3 million River Stewardship Program for projects that improve surface water quality and river habitat, including streams damaged by wildfire.



CHALLENGES COMMON TO ALL LANDSCAPE-SCALE PROJECTS

Adaptive Management

An adaptive management process allows participants to learn as they go by monitoring and evaluating project outcomes to improve future efforts. Adaptive management is necessary for a large, multi-decade program like the Rio Grande Water Fund, where continuous learning is needed to discern the intended and unintended effects of treatments, and take corrective action.^{xxxii} Challenges to adaptive management include limited budgets for monitoring, institutional barriers to information-sharing between agencies and management units, and the length of time it may take to fully assess project results.

Roads

For projects that propose wood removal, access by road is a necessity. Road building and road maintenance can be costly (see Appendix F) and must be factored into any thinning projects. New roads are controversial and will not be paid for by the Rio Grande Water Fund. Road rehabilitation is sometimes proposed where the legacy of existing roads continues to cause soil erosion, add sediment to streams, and spread noxious weeds. However, roads also provide access to forests by people who enjoy outdoor recreation, including motorized recreation and local community and traditional uses.

Smoke Management

Controlled burns and managed wildfire are important restoration tools to create more resilient forests and watersheds. Most water fund projects will include controlled burns after thinning to further reduce hazardous fuels or to maintain restored sites over time. Some projects may also use fire as a primary restoration tool. Any fire will generate smoke, with particulate matter that poses a health hazard for a substantial segment of the public. New Mexico and Albuquerque/Bernalillo County Air Quality Bureaus are charged with developing standards to implement Clean Air Act requirements. Fire managers work with state air quality regulators to find burn times that will optimize the rapid dispersal of smoke. Good information and early, proactive communication between fire managers, air quality regulators and the general public is critical to retain support.

Cost of Compliance

In order to complete the planning and analyses necessary to comply with federal law, comprehensive and/or multi-year surveys may be required to properly mitigate threats to rare species and cultural sites. Federal and state agencies must conduct the required surveys for each proposed project, which can lead to some of the highest costs in the planning process.

Workforce Capacity

Recent years have shown significant reductions in federal and state budgets for natural resource management, and agencies have encountered difficulties refilling vacant positions. A diminished workforce means longer planning timelines and the initiation of planning for fewer projects in any single year.

PHOTOS: Management of all New Mexico National Forests must address complex issues of smoke from complex issues such as smoke from controlled burns and road access for restoration treatments.

TOP TO BOTTOM: © Alan Eckert Photography; © USDA Forest Service; © USDA Forest Service

AVAILABLE TREATMENT AREAS

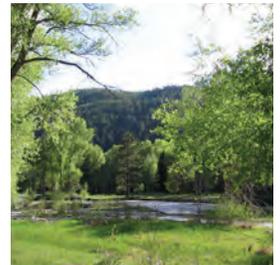
Following is a brief description of available treatment areas in the Rio Grande Water Fund's four focal areas. These projects have already demonstrated success with collaborative projects that cross multiple jurisdictions and address restoration of large landscapes. Work is already underway in these landscapes and can be accelerated with funding from the Rio Grande Water Fund and leveraged sources.

Chama and San Juan River watersheds: The Chama Peak Land Alliance and San Juan-Chama Watershed Partnership are facilitating forest restoration work in this public and private landscape.^{xxxiii} Coordinated efforts include the Jicarilla Apache and the Tres Piedras District of the Carson National Forest, which has started a 160,000-acre analysis of the Rio Tusas area. The Chama Peak Land Alliance has already completed a wood supply and biomass use feasibility study for their region, which could be the basis for a wood processing center that would benefit all north-central New Mexico. This focal area provides the opportunity to protect conveyance and storage for waters from the San Juan and Chama Rivers that supply urban areas, as well as engage private forest landowners, and traditional farming and rural communities, in restoring thousands of acres of forest.

Jemez Mountains: In the Jemez River watershed, the Pueblo of Jemez, the Santa Fe National Forest and the Valles Caldera Trust are restoring a 210,000-acre landscape through the CFLRP program. These partners are also planning additional NEPA in a clockwise direction to encompass all of the Jemez Mountains. Restoration work will improve watershed conditions on a major Rio Grande tributary, the Jemez River, as well as culturally important landscapes for at least five northern New Mexico pueblos. This focal area has more federally listed species than the other three focal areas and an adaptive management approach that restores and maintains forest diversity will be needed. The Jemez River and its tributaries provide important water for acequias and rural agriculture.

Sandia and Manzano Mountains: The Cibola National Forest, in a partnership with the Pueblo of Isleta and Chilili Land Grant, has NEPA completed or in progress for 10,420 acres of the northern Manzano Mountains. National Forest staffs are also planning and carrying out projects to encircle the Sandia Mountain Wilderness with treatments to protect Placitas and the East Mountain communities, water sources and acequias, and to abate the threat of debris flows into the Northeast and Southeast Heights neighborhoods of Albuquerque. The East Mountains provide a unique opportunity to engage Albuquerque flood and land management planners in forest restoration projects adjacent to their communities.

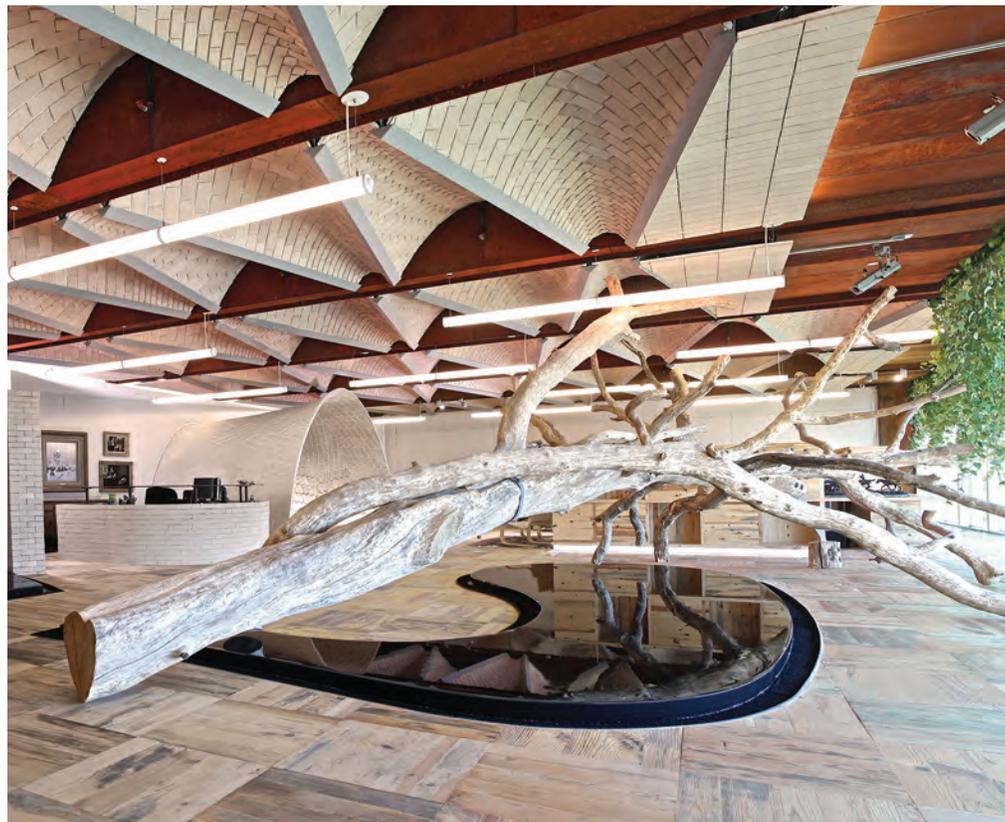
West-Slope Sangre de Cristo Mountains: The Carson and Santa Fe National Forests are predominant landownerships along the west-slope of the Sangre de Cristo Mountains, with private lands and towns, such as Taos, Taos Ski Valley and Red River, intermixed. Active Community Wildfire Protection Plan teams have spearheaded small projects along federal-private boundaries. Mid-size project planning, such as the Camino Real District's 70,000-acre analysis of the Rio Trampas, is a collaboration of partners such as Bureau of Land Management, Picuris Pueblo and State Land Office. The west slope focal area includes several ski areas, which are major economic drivers for northern New Mexico, as well as many small communities dependent on traditional agriculture and the acequia system.



The Chama Peak Land Alliance has already completed a wood supply and biomass use feasibility study for their region, which could be the basis for a wood processing center that would benefit all north-central New Mexico.

PHOTO: TOP TO BOTTOM: Fire can spread rapidly through tree tops that are touching. © Alan Eckert Photography; Meadows and aspen groves are common features of northern. © Chama Peak Land Alliance

ECONOMIC DEVELOPMENT AND JOB CREATION USING WOOD FROM FOREST TREATMENTS



▶ The accelerated restoration work outlined in this plan will create jobs that are critically needed in New Mexico communities and expand markets for the forest products that will result from the restoration work.

The wood that results from mechanical restoration treatments can either create an enormous disposal problem or be used as a raw material for economic development. Leaving most of the brush and debris in the forest is not a safe option—it simply moves the fuel for wildfires from the tree tops to the ground. Instead, viable uses for at least some of the woody biomass need to be developed.

A conservative generalization of the wood to be removed from restoration treatments is about 20 bone-dry tons (BDT) or 40 green tons per acre treated. About 30% of the wood removed is commercial timber that can be made into lumber or construction products, and the remaining 70% is small, woody biomass that has no traditional, commercial value.^{xxxiv} The accelerated pace of restoration could generate 600,000 BDT per year (1.2 million green tons), enough to heat more than 500,000 homes. Following is a description of the current and anticipated uses from scaled up restoration.

Community and traditional uses, such as personal-use firewood and small-scale firewood sales, are important in most rural areas of New Mexico. The level of use is consistent and could be increased by allowing greater community access to the raw material. However, this increase will use only a small portion of the woody material that will be generated with accelerated restoration.

PHOTO: Wood flooring products made by Old Wood, Inc. in New Mexico come from trees removed by restoration treatments. © David Old

Commercial timber use, as documented by Hayes in 2007,^{xxxv} shows a declining trend in New Mexico. In 2013, researchers collected new data that indicates a continuing decrease in timber use throughout the state. Although some commercial timber operators are cautiously growing, some substantial operations have shut down in the last several years. In addition, access to commercial timber supply has not improved significantly in recent years.

Woody biomass currently has few uses except as mulch, compost, chips, pellets, wood shavings and small biomass heating operations. Existing operations use only a fraction of the woody biomass currently being created from forest treatments.

Opportunities for new and expanded use operations exist in all of the focal areas, especially if the uses for personal wood, commercial timber and woody biomass are integrated. To achieve the Rio Grande Water Fund restoration and watershed health goals, industry must develop new infrastructure that integrates the use of woody biomass with the expansion of commercial timber products. In addition, reliable markets will be needed for the increased volumes of all three categories of wood.

All commercial timber produced in the region ends up with a buyer, so the expansion of infrastructure for these products is likely as the supply of raw material increases. For woody biomass use, expansion into large markets, such as energy, is necessary, but brings with it challenges such as how to transport the energy to markets. Heating and cooling, electrical generation and biofuels creation provide the greatest opportunity for significant biomass use, but are not yet proven at a commercial scale. Of these, electrical generation is well established in other parts of the U.S. and could use enough of the biomass to accomplish the forested watershed restoration goals.

Transportation and other infrastructure can also make or break the prospect of expanded wood use. Wood-use facilities will need to be strategically located near transportation infrastructure for access to markets. Electrical transmission infrastructure and capacity, electrical market demand, and coordination amongst electrical cooperatives and/or utilities will also be necessary for woody biomass use for electrical generation to succeed.

Construction and permits will be necessary for any new wood use facilities. All facilities will need to be compliant with New Mexico environmental protection laws, and permitting should consider the overarching goals of wildfire and water source protection.

JOB EXPANSION AND WORKFORCE DEVELOPMENT

Conservative estimates of direct job expansion and creation from increasing the pace and scale of wildfire and water source protection is 600 jobs in the area of the Rio Grande Water Fund and more than 1,100 jobs statewide. Of these jobs, it is estimated approximately:

- 10% jobs in planning, administration and monitoring
- 25% jobs in positions conducting treatments “in the woods” and wood extraction
- 40% jobs in utilization, such as primary or secondary manufacturing and sales
- 25% jobs in transportation, including raw materials and finished products

Workforce development is a concurrent activity that must take place to ensure the integration of operations is successful in rural and urban communities.



PHOTOS: Scaling up restoration treatments in New Mexico will require substantial infrastructure for wood removal and processing.
TOP TO BOTTOM: © Brent Racher; © Sue Sitko/TNC; © Layne Kennedy

ENTREPRENEURIAL TRAINING

The key to a thriving industry is the creation of wood product hubs: businesses that, between them, use every part of the tree. In addition to jobs making products from wood, opportunities will be created for related services, such as trucking and harvesting equipment repair. Entrepreneurial training for expansion and creation of small businesses will be the backbone of success to achieve wildfire and water source protection. Partnerships with New Mexico Economic Development Department, local and regional economic development councils and departments, and various institutions that deliver entrepreneurial training, will be critical to success.

ECONOMIC DEVELOPMENT ACTIONS

In addition to the items above, economic development should take the following actions to reach the Rio Grande Water Fund goals:

- Ensure the treatment and wood by-product supply is of consistent quantity and longevity to coincide with private capital investment and provide returns on investments.
- Develop treatment and utilization hubs, where appropriate, to include offering strategic locations that encourage hub development.
- Coordinate commercial-scale utilization projects, which overlap multiple priority areas or smaller hubs. Commercial scale is the size at which the Rio Grande Water Fund provides a commercially viable payback to “investors” through the wood products resulting from the treatment and restoration work plan.
- Promote wood use and business development/planning alongside community outreach and education efforts.
- Promote development of market opportunities and removal of market barriers for wood products including promotion of State and Federal laws and policies, and related tax credits, which provide incentives to use the large amounts of woody biomass that will be generated.



PHOTO: Restoration provides substantial opportunity for product development from small diameter trees.
© Ian Shive

FUNDING PLAN

A coordinated, leveraged, multi-partner effort is needed to scale-up restoration ten-fold. The existing actions of the many agencies and organizations in the Rio Grande Water Fund provide a perfect foundation for coordinated action in a public-private partnership. Separately, the work of the key agencies and organizations has been unable to achieve the economy of scale needed to restore large areas to protect water sources. This Comprehensive Plan proposes an integrated solution that leverages existing programs and investments to achieve a larger outcome.

The Rio Grande Water Fund will collect private investments from individuals, businesses, corporations and foundations. The funding will be available for thinning, controlled burns, stream restoration, post-fire watershed restoration, planning, education and outreach, and activities that contribute to the monitoring program (see Appendix D). The Nature Conservancy will administer private donations to the Rio Grande Water Fund, drawing upon the track record and lessons learned from 12 existing water funds in Latin America.^{xxxvii} An executive committee of diverse stakeholders and investors will determine which projects in the focal areas receive funding.

FOUNDING INVESTORS

- Lowe's Charitable and Educational Foundation
- USDA Forest Service
- University of New Mexico, Experimental Program for Stimulating Competitive Research (EPSCoR)

LEAD INVESTORS

- Albuquerque Bernalillo County Water Utility Authority
- Anonymous
- Bernalillo County
- Buckman Direct Diversion Project
- Bureau of Reclamation through the Southern Rockies Landscape Conservation Cooperative
- New Mexico Interstate Stream Commission
- PNM Resources
- Santa Fe Community Foundation
- U.S. Geological Survey
- Valles Caldera National Preserve

SECURE INVESTORS

- Edgewood Soil and Water Conservation District
- New Mexico Watershed and Dam Owners Coalition

CONTRIBUTORS

- Anonymous
- Avalon Trust
- Wells Fargo

Additional thanks to:

- Bank of Albuquerque

Scaling Up In The Manzano Mountains

The Isleta Project received \$2 million in February 2014 under a nationwide, multi-year partnership between the U.S. Forest Service and the Natural Resources Conservation Service to improve the health and resiliency of forest ecosystems where public and private lands meet. Funds to Isleta Pueblo, Chilili Land Grant and the Cibola National Forest will restore more than 10,000 contiguous acres of overgrown forest. The funding application was supported by the Rio Grande Water Fund and the winning of this award demonstrates the high potential for leveraging federal, state, local, tribal and private funding in New Mexico.



PHOTO: © Bob Parmenter

Figure 10. List of Current Contributors to Rio Grande Water Fund

Written agreements, such as Memorandum of Understanding (MOU), may be needed to organize the public-private partnership and to specify the necessary commitments and fiscal agency to coordinate and leverage funding resources (Figure 11). Key elements include:

- Coordination with the Forest Service, Natural Resource Conservation Service, Bureau of Land Management and other federal land management agencies so that appropriations for hazardous fuels reduction (roughly \$6 million of FY13 dollars spent in the Rio Grande Water Fund area) are targeted at the high-priority focal areas.
- Water fund for wildfire and water source protection with revenue from voluntary contributions by water users, businesses, investors and donors. These private funds will be critical to match and leverage government expenditures on forest and watershed restoration in the focal areas (see Appendix D for list of eligible activities).
- Long-term state funding plan for forest and watershed restoration to restore the focal areas (as well as other high-priority treatment areas in New Mexico) as defined by the New Mexico Legislature in Senate Memorial 95 and House Memorial 80.
- Voluntary contributions of revenue from local governments—cities, counties, tribes, municipal water utilities, irrigation districts, soil and water conservation districts, land grants and acequia associations—to either the Rio Grande Water Fund or the long-term state funding vehicle described above.
- Investment in enterprise development, workforce capacity building and business incentives to use wood and biomass, and to re-establish a significant wood industry and restoration economy in the Rio Grande Water Fund area.

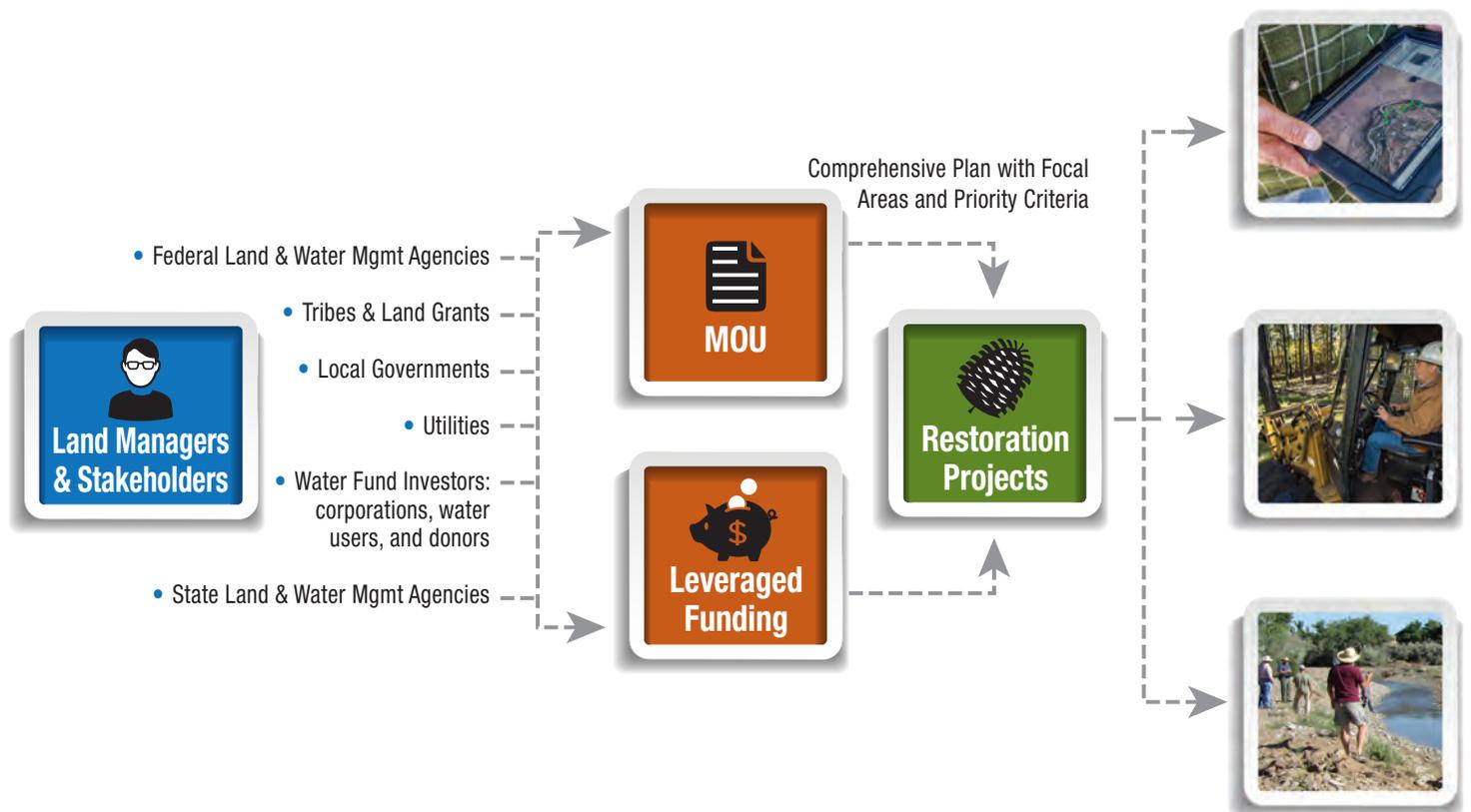


Figure 11. Organization of a public-private partnership will be needed to leverage funding to restoration projects.

FOCAL AREAS AND PRIORITY CRITERIA

The Rio Grande Water Fund will invest in the areas where the risk to water supplies is greatest and in projects that will have the strongest potential for immediate and successful implementation. The Rio Grande Water Fund Advisory Board assembled a comprehensive planning team to conduct a statewide analysis to identify focal areas for water fund support. The analysis determined five data models that captured sources of risk and values at risk. The models are described below, with the model assigned the greatest weight listed first:

1. **Wildfire Risk:** Including potential for crown fire activity, potential flame length, communities at risk from post fire debris flow and with homes in forested areas, and probability of an ignition.^{xxxviii}
2. **Water Quality and Supply Model:** Including probability and volume of a debris flow, groundwater recharge areas, and watersheds with debris flow risk that contain the only source of drinking water for a community or flow directly to the Rio Grande and Rio Chama.
3. **Economic Opportunity:** Timber and biomass availability.
4. **Forest Health:** Watersheds at risk of tree mortality from native or non-native insects or diseases.
5. **Fish and Wildlife:** Crucial habitat for wildlife as identified by New Mexico Department of Game and Fish and Western Governors' Association Crucial Habitat Assessment Tool.

Currently, the models include data for New Mexico only. The headwaters of the San Juan-Chama Project water in Colorado are not included. The planning team will update the models periodically as information becomes available, for example when complete data on probability of ignition from transmission infrastructure is available.



The Comprehensive Plan uses a weighted overlay analysis to identify areas and produce focal area maps. A weighted overlay analysis is a technique for applying a common scale of values to distinct and varied inputs to create a cohesive and comparable analysis. The weights of the data models and final combined focal areas for the Rio Grande Water Fund were determined using a weighted analysis protocol developed by the Forest Service, state and private forestry. Figure 12 shows the entire state, with watersheds ranked, and Figure 6 shows the Rio Grande Water Fund area, with the focal area priority ranking highlighted for ponderosa pine and mixed conifer forests. See Appendix G for details about the methodology used.

In Their Words



“We would expect water quality to be very bad, and the costs associated with treating the water to be very high, for up to 10 years following a major fire in the municipal watershed. The City would be challenged to use the water for municipal and industrial purposes.”

Rick Carpenter,
City of Santa Fe,
Water Division

PHOTOS: LEFT TO RIGHT: Small streams in forested mountains may respond when tree density is reduced. © Alan Eckert Photography; Rick Carpenter © CDM Smith, Inc.

WHAT WILL HAPPEN IN THE FOCAL AREAS?

This Comprehensive Plan addresses a watershed area that encompasses 7 million acres, with 1.7 million acres of ponderosa pine and mixed conifer forests that could be restored, so the focal areas are needed to identify where the Rio Grande Water Fund and the coordinated, leveraged, multi-partner effort will invest resources. Scaling up restoration ten-fold will be challenging, and efforts must focus on places with the greatest need and where the consequences of delayed action will be most severe.



Project criteria will take the prioritization process a step further by differentiating between proposed projects within a focal area. The New Mexico Statewide Strategy and Response Plan is the basis for the project criteria.^{xxxix} In addition to evaluating risk factors at a finer scale (such as high-severity wildfires and damage to water supplies), the criteria examine project-specific factors that indicate the likelihood of success, such as engagement of local communities, availability of leveraged funding and access for removal of forest products.

The project criteria are intended to foster wise investment of the Rio Grande Water Fund and to provide an open and transparent process for projects to be nominated and selected for funding. The criteria will be included in an application process guidance document for projects in focal areas. The guidance document and a website for applications, to be reviewed by the Rio Grande Water Fund Advisory Board, are expected to be developed in fall 2014. A subcommittee of the advisory board will rank projects from all four focal areas, list projects on the website, and fund projects in order of their ranking.

Within priority/focal areas, the advisory board will use the following criteria to evaluate proposed projects:

1. Condition of or threat to natural resources

- a. Forests that have a high probability of severe wildfire
- b. Streams and riparian areas that can be improved as part of a larger watershed restoration effort

2. Opportunity to act or strategic advantage

- a. Substantial acreage in planning process or ready for treatment
- b. Highly engaged local communities and agency cooperators
- c. Ability to leverage multiple sources of funding
- d. Wildfire risk affected in a large landscape (50,000 acres or more)
- e. Evidence of strategic placement of project
- f. Access for removal of forest products

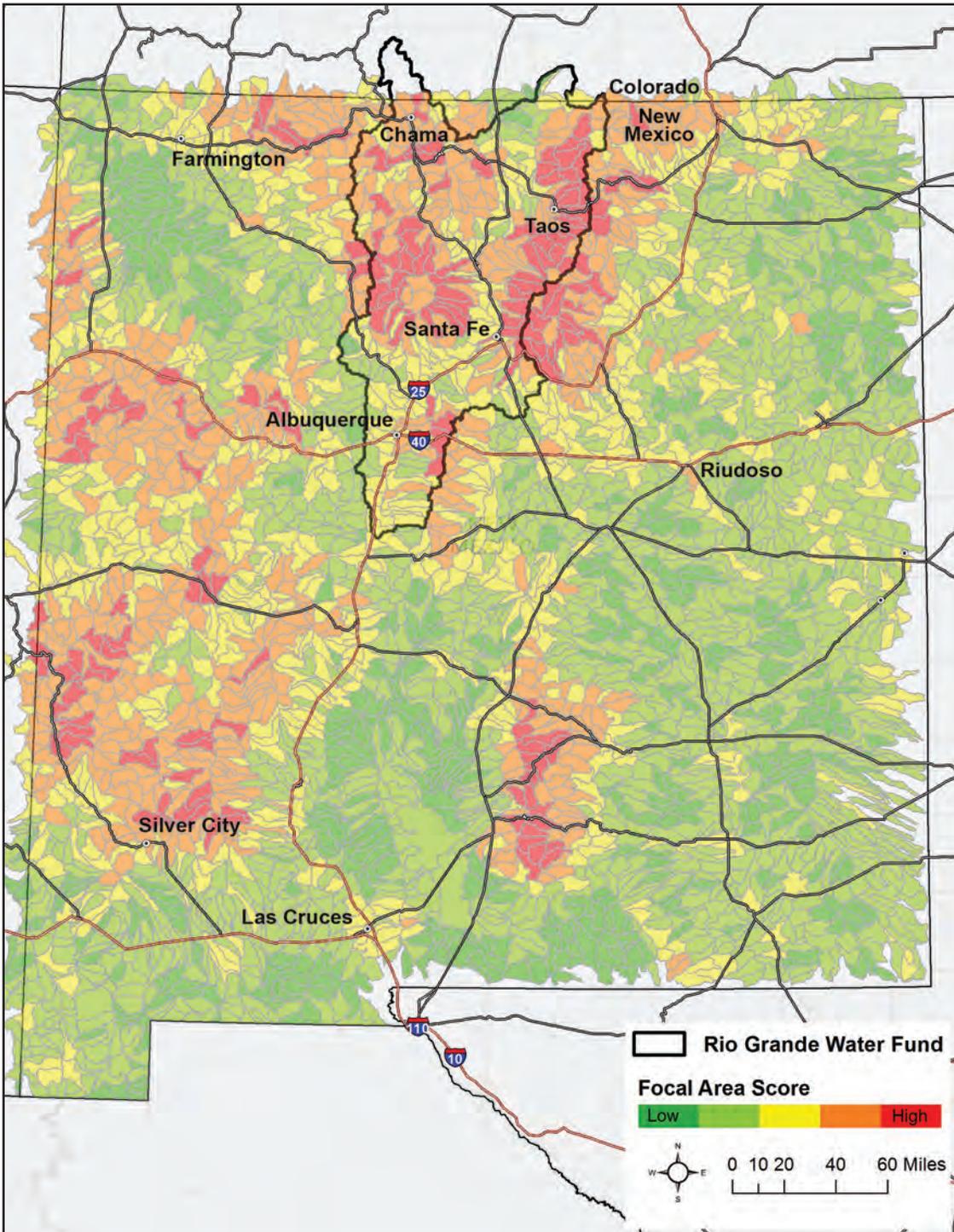
3. Urgency of the project

- a. Water sources are at risk
- b. Communities or significant concentrations of homes are at risk from wildfire, post-fire flooding or disruptions to water supplies

4. Economic development

- a. Areas with high value for recreation and tourism are at risk
- b. Ability to supply wood to existing wood processing businesses
- c. Workforce availability
- d. Areas used for traditional and community wood supply
- e. Potential for new wood-using industry

PHOTOS: Wildlife habitat, outdoor recreation opportunities, and important water sources are some of the criteria that will be used to prioritize funding to projects in the water fund area. **TOP TO BOTTOM:** © Stephen Frick; © Erika Nortemann/TNC; © Alan Eckert Photography



A statewide analysis of five contributing factors—fire threat, risk to water supplies, forest health decline, risk to fish and wildlife habitat, and economic opportunities—shows why the Rio Grande is an initial focus and points to the need for additional action statewide.

Figure 12. The Rio Grande Water Fund will restore some of the most at-risk watersheds in New Mexico. Restoration of high risk areas in other parts of New Mexico is also needed.

In Their Words



“Two-way trust needs to be established to empower each other and get the job of restoring forests and watersheds done.”

Rene Romero,
Fuels Manager, Taos Pueblo

OUTREACH AND EDUCATIONAL PLAN



▶ A working group of education professionals developed the vision for outreach and education as part of the Rio Grande Water Fund. The working group includes educators from Albuquerque Bernalillo County Water Utility Authority, Albuquerque Public Schools, Bosque Ecosystem Management Program, New Mexico Museum of Natural History and Science, New Mexico State Land Office, Rio Rancho Public Schools, River Source, Sandia Mountain Natural History Center, Santa Fe Watershed Association and Valles Caldera National Preserve. The working group vision is to educate and engage the community of water users so that they become active in creating a secure water future. The working group goal is to promote and support educational programs that engage people in protecting storage, delivery and quality of Rio Grande water with a focus on forest health, river ecology and a sustainable water supply.

Specific objectives for outreach and education include:

- Advise the Rio Grande Water Fund on educational strategies and community issues.
- Connect the issues of forest health, wildfire, climate change and water.
- Support events, lectures, workshops and trainings that promote the benefits of a healthy watershed.
- Assist in the acquisition and distribution of funds to support existing conservation education programs and new programs that fill educational gaps.

PHOTOS: LEFT TO RIGHT: Rene Romero
© Photo courtesy of Rene Romero;
Student engagement in monitoring,
data collection and analysis will help
assess the water fund results and
provide accountability to investors.
© Dave Lauridsen

- Support educational programs for youth and adults that:
 - Provide field experiences to help connect people to forests and rivers, from the forested headwater communities to the urban areas downstream.
 - Build upon existing K–12 and university conservation education and STEM programs.
 - Expand coverage of educational programs within the whole Rio Grande Water Fund area.
 - Create a speakers’ bureau for public events and media resources.
 - Develop inter-disciplinary partnerships and leverage existing resources.

A fundamental premise of the working group is that the Rio Grande Water Fund’s outreach and education objectives will be achieved through existing programs wherever possible. Water fund dollars would support educational programs, awarded via a competitive grant process to education providers. The working group developed a set of core concepts that grant applicants will need to meet. These core concepts are:

- A healthy forest and watershed provides important services for people, plants and wildlife.
- It’s important to know where your water comes from, and where it goes after it is used.
- A watershed is a water drainage basin that connects people, animals and plants—ecologically, economically and culturally.
- Water in the Rio Grande and its tributaries supplies drinking water for people in central and northern New Mexico and provides habitat for plants and wildlife throughout the state.
- Most surface water in New Mexico originates as snowpack in the mountains upstream.
- Large fires that burn with high severity in forested mountains can lead to ash and debris flows, which adversely affect downstream water quality.
- Forest thinning and controlled burning are effective ways to reduce the risk of large, severe wildfire, increasing available runoff to streams and rivers, and recharging groundwater.

MARKETING AND COMMUNICATIONS

The Nature Conservancy will create and implement a comprehensive marketing and communications plan for the Rio Grande Water Fund that will result in increased visibility of the project. The plan will initially extend over a 12-month period with the aim of increasing fundraising potential and building support for the Rio Grande Water Fund with multiple audiences. The goal is to tell the water fund story by:

- Raising awareness among water users about where their water comes from; and
- Sharing the experiences of the many New Mexicans who will benefit from the creation of the fund.

Tactics and strategies include: creating talking points and a message blueprint advocating for the water fund; highlighting the water fund in print publications that are disseminated throughout the state; creating digital assets including web features, online slideshows, social media postings and video; pitching the water fund story to local, regional and national media outlets; and providing opportunities for advisory board members and partners to use these materials in their communications and marketing efforts. The Rio Grande Water Fund website will provide a “clearing house” for education outreach.



Water fund dollars would support educational programs, awarded via a competitive grant process to education providers.

PHOTOS: Field experiences will help to reconnect youth and water users to the forests and rivers that supply their water. TOP TO BOTTOM: © Erika Nortemann/TNC; © Kevin Horan; © Dave Lauridsen

MONITORING PROGRAM TO MEASURE PROGRESS



▶ The Rio Grande Water Fund will include and pay for a monitoring program to track the environmental and economic effects of restoration activities, ensure that investments are achieving their anticipated impacts, and enable corrections to management strategies. The extent to which the Rio Grande Water Fund goals and objectives are met depends on the efficacy of models that were used to estimate benefits, the effectiveness of the funded activities, the efficiency of implementation, the return on investments that occur, and the influence of environmental and socioeconomic factors external to Rio Grande Water Fund activities that can significantly affect results.

The monitoring program is designed to provide accountability to donors, investors, agencies, external stakeholders, partners, participating communities, and land and water managers. To provide the best economy, the monitoring program will rely upon historical and baseline studies and ongoing monitoring programs that yield relevant data. The Rio Grande Water Fund will report on the metrics described below. The full monitoring plan is in Appendix H.

MONITORING PLAN FOR RIO GRANDE WATER FUND

Forest Treatments: The Rio Grande Water Fund will track treatment of high-priority forested watersheds with acres treated and cost of treatment. In addition, the Forest Service will continue to monitor restoration and fuels treatment progress using the Fire Regime Condition Class (FRCC), which evaluates the departure from the natural fire regime. Project sites will require long-term maintenance to prevent a recurrence of overgrown forests and watersheds and the associated risks to water supplies. Depending on the forest type and particular location, restored areas will need to be retreated within the life of the water fund every five to 20 years to maintain healthy conditions.

Existing Data: The Forest Service routinely tracks this information as part of their work, but requirements of landowners and their contractors to record and report this information may be necessary as a condition of funding assistance for forest treatments done on private land.

Forested Watershed Fuel Loads: The Rio Grande Water Fund will track the change in pre- and post-treatment fuel loads on a tons-per-acre basis. Additional monitoring parameters may include standard forest measurements for basal area, crown base height, crown bulk density and canopy closure.

Existing Data: The Forest Service routinely tracks this information as part of their work, but requirements of landowners and their contractors to record and report this information may be necessary as a condition of funding assistance for forest treatments done on private land.

Fire Behavior: The Rio Grande Water Fund will assess changes in wildfire behavior relative to untreated areas using percentage tree mortality and percentage of burned area with water-repellant and bare soils, as compared to control or untreated areas. Additionally, the Forest Service will model pre- and post-treatment fire behavior in some treated areas.

Existing Data: When wildfire occurs within or adjacent to treatment areas, the water fund will assess burn severity and subsequent impacts to water resources and report this information at the earliest opportunity after the event. Additionally, the Forest Service will model pre- and post-treatment fire behavior in some treated areas.

PHOTO: As part of its monitoring plan, The Rio Grande Water Fund will assess changes in wildfire behavior relative to untreated areas. © Allen Farnsworth/BLM/USFS

Watershed Function and Water Quality: Although numerous external factors directly and indirectly impact water quality in the Rio Grande, without extensive monitoring it is very difficult to quantify cause and effect. Therefore, monitoring of water yield and water quality will be limited to assessing the effectiveness of forest treatments in a controlled setting, such as a paired basin study.^{xl} At a minimum, the Rio Grande Water Fund will monitor parameters in a paired basin study, including stream flow discharge, precipitation (snow and rain), water clarity, temperature, stand basal area and canopy cover pre- and post-treatment. The water fund will encourage partners to study the effects of forest management actions on other factors, such as groundwater recharge or the movement of contaminants.

Existing Data: Numerous water yield studies have been conducted in the Southwest, some of them highly applicable to the Rio Grande Water Fund. Agencies are conducting ongoing paired basin studies in the Santa Fe Municipal Watershed and on the Valles Caldera National Preserve, where some of the monitoring is completed by the Bosque Environmental Management Program.

Jobs and Economic Development: To assess the progress in developing New Mexico's forest industry and job creation, the Rio Grande Water Fund proposes the following indicators be reported on an annual basis: number of full time, part time and seasonal jobs created; number of businesses created that operate in New Mexico, including those receiving wood supply from a water fund project; amount of wood product used by local communities and businesses; value of leveraged state and local resources committed to forest/watershed restoration; and value of private and public investment in forest industry infrastructure. Periodic sampling and polling can help indicate effects on New Mexico's economy.

Existing Data: Unemployment data by county, as reported monthly by the U.S. Bureau of Labor Statistics, may not adequately reflect the impact of the Rio Grande Water Fund on New Mexico's forest industry.

Rio Grande Water Fund Financing: Sustainable funding is necessary to ensure the water fund meets its goals and objectives within the timeframe agreed upon by stakeholders. While some of the work may be paid for through grants and donations, much of long-term work could be paid for with reoccurring funding from the state legislature, state and federal agencies, and downstream water users such as municipalities/water utilities, agricultural districts and industry. The metrics for evaluating funding will consider two timescales: 1) short-term funding (0-20 years) to finance treatment of high-priority forested watersheds; and 2) long-term funding (beyond 20 years) to finance maintenance of treated areas. For both timescales, the measure is whether sufficient funding is secured to accelerate restoration. The Rio Grande Water Fund will continuously track and provide quarterly reports on funds raised as well as the number of participating municipalities, water utilities, water customers and water fund donors.

Existing Data: Federal and state agencies can provide data on available funds to be used for forest and watershed treatments. Municipal water utilities can also provide data on funds used for restoration.

Outreach and Education: For youth education, the measures of progress will include: number and percentage of students reached in school programs; number and percentage of schools within watershed area participating in programs; number and percentage of youth participating in summer and after school programs; and demonstrated understanding of core forest health concepts. Metrics for adult outreach and education programs will include: dollars from individual donations to the Rio Grande Water Fund; number of people reached through marketing and outreach; number of events sponsored and the number of attendees; number of parents and teachers involved in student education programs; and digital media measures, such as website visits and Facebook likes/shares.

Existing Data: School systems and environmental education providers are already collecting and compiling data about the programs they currently offer to youth and adults.



The Rio Grande Water Fund will include a monitoring program to track the environmental and economic effects of restoration activities, ensure that investments are achieving their anticipated impacts, and enable corrections to management strategies.

PHOTO: TOP TO BOTTOM
Rio Grande cutthroat trout are an important indicator of watershed health. © Ron Loehman; Maintaining and improving the ratio of burned lands to restored watersheds is a measurable goal of the water fund. © Rory Gauthier, National Park Service;

ECONOMIC CONSEQUENCES AND BENEFITS TO NEW MEXICO



To accelerate the pace of this wildfire and water source protection project, \$21 million a year will be needed from all sources—the Rio Grande Water Fund, government revenue and other sources.



▶ The cost of thinning one acre of dense forest is \$700 in most parts of the Rio Grande Water Fund area.^{xi} Multiply \$700 by 30,000 acres of ponderosa pine and mixed conifer forests treated in the water fund area every year, and the total price tag could reach \$420 million over 20 years. To put this large investment in the “natural infrastructure” of forested watersheds into context, Albuquerque recently invested \$450 million in a water treatment plant.^{xii}

The value of investing in forest restoration can be illustrated by the full cost of a single wildfire, such as the 2011 Las Conchas fire which had a price tag estimated at \$246 million, or up to \$2,150 per acre^{xliii}—more than half the cost for 20 years of increased forest restoration and substantially more per acre. Additionally, a recent study estimated the four-year cost (2009-2012) of wildfires in New Mexico at \$1.5 billion, well above the \$420 million investment proposed by this plan.^{xliv}

To accelerate the pace of this wildfire and water source protection project, \$21 million a year will be needed from all sources—the Rio Grande water fund, government revenue and other sources. Currently, about one-third of this amount, or \$6 million annually, is being invested in federal hazardous fuels reduction in the focal areas.^{xlv} Clearly, it is more cost-effective to invest in “prevention” than to pay to “react” to damaging wildfires. Over time, the cost of prevention will decline as a larger forest industry is established. A transition period will be needed, and the Rio Grande Water Fund can fill the need as described in this Comprehensive Plan.

PHOTOS: Future generations depend on secure water for economic prosperity.
© istockphoto

Water is essential for promoting economic well-being and provides a high return on investment. Water is a necessity for New Mexico residents and is needed for most small- and large-scale industry, agriculture and many service activities. Water is a key component of many recreational activities, and is needed to sustain nature itself and the natural areas that make New Mexico a “Land of Enchantment.”

The top 10 benefits to New Mexico from the Rio Grande Water Fund are significant.

1. Water sources will be sustained for residential uses, industry and locally-produced food from agriculture and acequias.
2. Communities and homes in the Rio Grande Valley—from headwaters to urban areas—will be protected from wildfire and post-fire flooding damage.
3. Jobs will be provided in rural New Mexico communities.
4. Sustainable sources of wood will create flooring, animal bedding, pellets for heat, electricity and other locally-sourced products.
5. Habitat will be improved for many forest-dependent species, from elk to salamanders, and for cold-water fish such as trout.
6. Traditional wood uses, such as firewood and fence posts, will be available to meet community needs.
7. Tourism will be sustained as business closures from wildfire are reduced.
8. Outdoor recreation opportunities—skiing, rafting, hunting, fishing and more—will be maintained.
9. Snow storage in forested watersheds, and retention of snowpack into the spring, may be improved, recharging groundwater, boosting forest resiliency and possibly increasing stream flow (under study).
10. The business environment in New Mexico will be enhanced by this long-term plan for secure water for future generations.



PHOTOS:
Securing water in the Rio Grande provides benefits to both people and nature.
TOP TO BOTTOM: © Alan Eckert Photography; © Doug Iverson;
LEFT: Forested watershed restoration will benefit farms and industry, as well as rural and urban communities.
© istockphoto

In Their Words



Large scale forested watershed restoration can be a triple win for New Mexico, providing water security, sustainable forest products and jobs in rural areas.

Martin Haynes,
New Mexico Business
Water Task Force

PATH FORWARD



▶ New Mexico must act now or our watersheds and water supplies will be at great risk for generations to come. This comprehensive plan not only looks ahead, providing a path forward for water security in New Mexico, but also outlines the ecological, social and economic consequences of doing nothing.

Living Plan: The comprehensive plan is envisioned as a “living plan” and in fall 2014 a website will be established to house the plan, studies and other resource materials. Several studies are anticipated to be completed in the next 12 months including:

1. Modeling of watershed function in mixed conifer forests;
2. Modeling of wildfire and debris flow probability in the Sandia and Manzano Mountains, followed by Jemez and west slope of the Sangre de Cristo Mountains; and
3. Survey of Albuquerque area homeowners’ willingness to pay for upstream watershed restoration.

The comprehensive plan will be updated, with engagement of the advisory board, as studies are completed.

PHOTOS: Jobs will be created by scaling up restoration; from wood products to tourism, healthy watersheds are needed to support a healthy economy. LEFT TO RIGHT:
© Susan Sirkus/TNC;
© Karine Aigner

Secure Commitments: The working group focused on structure and governance of the water fund will continue to meet and develop MOUs between participating agencies and organizations. Securing commitments to coordinate and leverage resources will be a top priority through the fall of 2014.

Funding and Restoration: The Rio Grande Water Fund already has received private donations, and a water fund launch event is planned for July 2014 at a demonstration site in the Sandia Mountains. Fundraising will be ongoing. The first Request for Proposals (RFP) for restoration projects to be funded will be circulated in the focal areas in late 2014. A review panel, comprised of contributors to the water fund and agency funding entities, will be assembled to select projects. The amount of funding available for projects will depend on the water fund revenue at the time the RFP is developed. Restoration projects will begin in the 2015 field season.

Policy: The interim committees of the New Mexico legislature will begin meeting in June 2014. Members of the advisory board will provide information to shape a “long-term state funding plan” to be considered in the 2015 session.

Jobs and Economic Development: Opportunities for wood utilization will increase as large-scale restoration projects are planned and implemented. The need for worker training and investment in equipment and facilities will increase as the wood supply and utilization opportunity increase.

Reporting: Ongoing project monitoring will ensure transparency, and the water fund will provide interim and annual reports for donors and investors. Monitoring of baseline conditions for some key indicators is already underway, and a full monitoring program will be in place when the first projects are funded. The water fund advisory board will prepare a progress report in July 2015 and the first annual report will follow one year after projects begin.

These activities will significantly expand upon the current efforts to protect New Mexico’s forests and watersheds. Working together, all affected stakeholders and governments have an opportunity to secure water for the future with this Comprehensive Plan as a blueprint for action. Through the successful implementation of this plan, New Mexico will serve as a model for other states, cities and communities in the West.



PHOTO: Forested watersheds benefit people by securing water and supplying wood products, outdoor recreation and the quality of life cherished in New Mexico. **CLOCKWISE:** © Sue Sitko/TNC; © Alan Eckert Photography; © istockphoto

APPENDICES

Available online at: www.nmconservation.org/RGWF/RGWF_CompPlan_Appendices_v01.pdf

- A. Advisory Board List
- B. Summary of Debris Flow Study
- C. Summary of Watershed Release Function Study
- D. Restoration Activities Eligible for Support
- E. Sample of Planned Restoration Treatments by Ownership
- F. Details about Road Maintenance and Rehabilitation Costs
- G. Summary of Analysis to Identify Focal Areas
- H. Monitoring Plan

GLOSSARY

Benefit transfer: A method of estimating economic values by transferring information from studies already completed in one location or context to another.

Bone dry ton: Wood or forest residue that weighs 2,000 pounds at zero percent moisture content.

Crown fire: A fire that moves across the tops of trees or shrubs, typically killing them, as compared to a surface fire, which stays close to the ground.

Ecosystem services: Benefits people obtain from ecosystems, including: supporting services, such as seed and nutrient dispersal necessary to maintain ecosystems; provisioning services, such as food and water; regulating services that represent important ecosystem functions, such as water filtration; and cultural services that represent non-material benefits, such as recreation and spiritual values.

Environmental impact statement: A public document produced by federal agencies that describes proposed activities on a landscape and discloses how those activities may impact the environment.

Fire-adapted forest: Forest types that evolved with, and are dependent on, periodic fire for tree regeneration, nutrient recycling and diversifying the structure and composition of the forest.

Fuel: Trees and plants that are flammable material and act as fuel for wildfires.

Groundwater: Water originating from rain, melting snow and ice that collects or flows beneath the Earth's surface, filling the porous spaces in soil, sediment and rocks and providing water for aquifers, springs and wells.

Landscape scale: A term commonly used to refer to action that covers a large area.

Low-value material: Woody material from forest restoration treatments that has no commercial value.

Resilience (ecological, forest or watershed): The ability of an ecosystem, forest or watershed to regain structural and functional attributes that have suffered harm from stress or disturbance.

Restoration (forest or watershed): In this plan, "restoration" refers to ecological restoration: the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. Scientific understanding of historic natural conditions guides restoration actions.

Riparian area: The interface between land and a stream or river, often characterized by a green ribbon of plants.

Stewardship contract: A contracting agreement that focuses on end results rather than extracted wood or other resources. Stewardship contracts can bundle activities and involve interested community groups as well as traditional forest businesses.

Surface water: Water found on the Earth's surface, such as in a stream, river, lake or wetland.

Values at risk: Economic, environmental and social values that people care about, and that are at risk of being degraded or lost if the pace and scale of forest restoration is not increased.

Watershed: The drainage area of a landscape where water from rain or melting snow and ice flows downhill into a body of water, such as a river, lake, reservoir, wetland or aquifer.

Watershed function: The functions of a watershed are to: collect water that falls as rain or snow; store water and snow in various amounts and for different lengths of time; release water as runoff; filter and clean stored water and runoff; and provide habitat for plants and animals.

ENDNOTES

- ⁱ See: Balice, R. G., K. D. Bennett, M. A. Wright. 2004. Burn Severities, Fire Intensities and Impacts to Major Vegetation Types from the Cerro Grande Fire. Los Alamos National Lab, LA 14159. See also: Inciweb, 2013. Las Conchas Fire Incident Overview online from the Incident Information System at <http://www.inciweb.org/incident/2385/> and Whitewater Baldy Fire Incident Overview online from the Incident Information System at <http://www.inciweb.org/incident/2870/>
- ⁱⁱ New Mexico Statewide Resources Assessment generated substantial data in 2010 about forest and watershed health that was used and updated in this Comprehensive Plan. The assessment is organized around three themes—conserve working landscapes, enhance public benefit from natural resources and protect watersheds from harm—that are similar to the vision, goals and objectives in this plan. View assessment at: <http://www.emnrd.state.nm.us/SFD/statewideassessment.html>
- ⁱⁱⁱ This Comprehensive Plan for the Rio Grande Wildfire and Water Source Protection has drawn extensively from existing plans, and can be used to inform future plans, such as the Statewide and Regional Water Plans slated for revision soon.
- ^{iv} For a map and ranking of watershed condition class, see the USDA Forest Service, Southwest Region: http://www.fs.fed.us/publications/watershed/maps/R03_WCC_FS_Lands_v2.pdf
- ^v See article on Albuquerque in: <http://www.bizjournals.com/albuquerque/print-edition/2013/07/05/where-will-abqs-water-come-from.html?page=all>; and personal communications with Rick Carpenter, City of Santa Fe Water Division staff.
- ^{vi} See the published work of scientists Craig Allen, Wally Covington, Don Falk, Phil Omi, Tom Sisk, Tom Swetnam and many others.
- ^{vii} Swetnam, T. and C. Baisan. 1996. Historical fire regime patterns in the southwestern United States since AD 1700. In: CD Allen (ed) *Fire Effects in Southwestern Forest: Proceedings of the 2nd La Mesa Fire Symposium*, pp. 11-32. USDA Forest Service, Rocky Mountain Research Station, General Technical Report RM-GTR-286.
- ^{viii} Fule, P. Z., W. W. Covington and M. M. Moore. 1996. Determining Reference Conditions for Restoration of Southwestern Ponderosa Pine Forests. *Ecological Applications*, 7(3), pages 895-908; and Allen, C. D., M. Savage, D. A. Falk, K. A. Suckling, T. W. Swetnam, T. Schulke, P. B. Stacey, P. Morgan, M. Hoffman, J.T. Klingel. 2002. Ecological Restoration of Southwestern Ponderosa Pine Ecosystems: A Broad Perspective. *Ecological Applications* 12(5): 1418 – 1433.
- ^{ix} Westerling, A.L., H. G. Hidalgo, T. W. Swetnam, D. R. Cayan. 2006. Warming and Earlier Spring Increase in Western U.S. Forest Wildfire Activity. *Science*. Volume 313. August 18, 2006; and Williams, A.P., C.D. Allen, C.I. Millar, T.W. Swetnam, J. Michaelsen, C.J. Still, and S.W. Leavitt. 2010. Forest responses to increasing aridity and warmth in the southwestern United States. *Proceedings of the National Academy of Sciences of the United States of America* 107(50): 21289-94.
- ^x Harpold, A.A., J.A. Biederman, K. Condon, M. Merino, Y. Korgaonkar, T. Nan, L.L. Sloat, M. Ross and P.D. Brooks. 2013. Changes in snow accumulation and ablation following the Las Conchas Forest Fire, New Mexico, USA. *Ecohydrology*, published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/eco. 1363.
- ^{xi} Leopold, Luna. 1997. *Water, Rivers and Creeks*. University Science Book. Sausalito, CA.
- ^{xii} Veenhuis, Jack E., Effects of wildfire on the hydrology of Capulin and Rito de los Frijoles Canyons, Bandelier National Monument, New Mexico, U.S. Geological Survey Water-Resources Investigations Report 02-4152, 39 pages; and Cannon, S.H. and S.L. Reneau. 2000. Conditions for generation of fire-related debris flows, Capulin Canyon, New Mexico. *Earth Surface Processes and Landforms* 25: 1103-1121.
- ^{xiii} Westerling, A.L., H. G. Hidalgo, T. W. Swetnam, D. R. Cayan. 2006. Warming and Earlier Spring Increase in Western U.S. Forest Wildfire Activity. *Science*. Volume 313. August 18, 2006; Breshears, D. D., N. S. Cobb, P. M. Rich, K. P. Price, C. D. Allen, R. G. Balice, W. H. Romme, J. H. Kastens, M. L. Floyd, J. Belnap, J. J. Anderson, O. B. Myers, and C. W. Meyer. 2005. Regional vegetation die-off in response to global-change-type drought. *Proceedings of the National Academy of Sciences of the United States of America* 102: 15144-15148; and Barnett, T. P., D. W. Pierce, H. G. Hidalgo, C. Bonfils, B. D. Santer, T. Das, G. Bala, A. W. Wood, T. Nozawa, A. A. Mirin, D. R. Cayan, and M. D. Dettinger. 2008. Human-induced changes in the hydrology of the western United States. *Science* 319: 1080-1083.

- ^{xiv} Walter, Kara and Janie Chermak. 2014. *The Cost of A Wildfire in the West: 2011 Las Conchas Fire*. University of New Mexico, Economics Department.
- ^{xv} Western Forestry Leadership Council. 2010. *The True Cost of Wildfires*. www.wflcweb.org
- ^{xvi} Weigel, Lori and Metz, Dave. 2014. *Conservation in the West: New Mexico Report*. The Colorado College State of the Rockies Project. Available for download at: <http://www.coloradocollege.edu/other/stateoftherockies/conservationinthwest/statereports/NewMexico.dot>
- ^{xvii} Data provided by the New Mexico Rural Water Users Association on May 14, 2014. Information is approximate and systems may have formed or dissolved since the data was created.
- ^{xviii} Finney, M.A., R.C. Seli, C.W. McHugh, A.A. Ager, B. Bahro, J.K. Agee. 2007. Simulation of long-term landscape-level fuel treatment effects on large wildfires. *International Journal of Wildland fire* 16(6) 712-727.
- ^{xix} Estimate by the Nature Conservancy of thinning treatments that cut and remove overgrown trees, based on personal communications with federal and state land managers, and on federal and state agency reports of acres treated annually.
- ^{xx} See: <http://www.nature.org/ourinitiatives/regions/latinamerica/water-funds-of-south-america.xml>
- ^{xxi} Carpe Diem West. 2011. *Watershed Investment Programs in the American West. An Updated Look: Linking Upstream Watershed Health and Downstream Security*. <http://www.carpediemwest.org/sites/carpediemwest.org/files/WIP%20Report%20Design%20FINAL%2011.15.11.pdf>
- ^{xxii} Derr, Tori, Ellis Margolis, Melissa Savage, Dale Lyons, Pamela Dupzyk, and Laura McCarthy. 2009. *Santa Fe Municipal Watershed Plan: 2009-2029*. City of Santa Fe, February 18, 2009.
- ^{xxiv} Finney, M.A., McHugh, C.W., Grenfell, I.C. and others. 2011. A simulation of probabilistic wildfire risk components for the continental United States. *Stochastic Environmental Research and Risk Assessment*; 25 (7):973-1000.
- ^{xxv} Researchers include Dr. Mark Stone, Dr. Clifford Dahm, and Dr. David Van Horn at University of New Mexico and Dr. Robert Parmenter at the Valles Caldera National Preserve with funding provided by the New Mexico Interstate Stream Commission and the Southern Rockies Landscape Conservation Cooperative through the U.S. Bureau of Reclamation.
- ^{xxvi} This analysis assumes treatments are not in ponderosa pine forests that are designated Wilderness, recently burned or treated, or are very steep.
- ^{xxvii} Median use by Albuquerque single family homes in 2009 was 0.243362 acre-feet. <http://www.aquacraft.com/sites/default/files/pub/Aquacraft-%282011%29-Albuquerque-Single-Family-Water-Use-Efficiency-and-Retrofit-Study.pdf>
- ^{xxviii} The New Mexico Forest Restoration Principles are available for download at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5207898.pdf and the Forest Service General Technical Report 310 is available at http://www.fs.fed.us/rm/pubs/rmrs_gtr310.html. Forest diversity in this Comprehensive Plan includes stand diversity, within stand diversity, snags, downed logs, size and age class diversity, and tree species diversity.
- ^{xxix} *After Wildfire: A Guide for New Mexico Communities* is available at www.afterwildfirenm.org
- ^{xxx} New Mexico state water planning statute directives, NMSA §72-14-3.1(C)
- ^{xxxi} For details see websites www.chamapeak.org and www.sanjuanchama.org.
- ^{xxxii} See U.S. Fish and Wildlife Service, *Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Jemez Mountains Salamander*, Final Rule published in the Federal Register November 20, 2013 and available at <https://www.federalregister.gov/articles/2013/11/20/2013-27736/endangered-and-threatened-wildlife-and-plants-designation-of-critical-habitat-for-the-jemez>

^{xxxiii} See maps at <http://chamapeak.org/pdf/Forest%20Treatment%20Poster%20Ownership.pdf>
<http://chamapeak.org/pdf/Forest%20Treatment%20Poster%20v2.pdf>

^{xxxiv} Racher, B.J. 2014. Personal communication. President, New Mexico Forest Industry Association. racher@resource-management.us.

^{xxxv} Hayes, S.W., T.A. Morgan, E.C. Berg, J.M. Daniels, and M.T. Thompson. 2012. The Four Corners Timber Harvest and Forest Products Industry, 2007. USDA Forest Service Rocky Mountain Research Station, Resource Bulletin RMRS-RB-13.

^{xxxvi} Racher, B.J. 2013. Estimates developed for the New Mexico Legislative Interim Jobs Council for the Forest Industry. racher@resource-management.us.

^{xxxvii} Information on the Nature Conservancy and its history of developing water funds is available at: <http://www.nature.org/ourinitiatives/habitats/riverslakes/water-funds-investing-in-nature-and-clean-water-1.xml>

^{xxxviii} Data to assess the probability of ignition resulting from proximity to transmission was not available for this draft. When transmission data is available, the model will be updated.

^{xxxix} New Mexico Department of Energy, Minerals and Natural Resources, Forestry Division. 2010. New Mexico Natural Resource Assessment: <http://www.emnrd.state.nm.us/SFD/statewideassessment.html>

^{xl} Ideally, monitoring will occur uninterrupted in both basins for at least five years prior to treatments, in order to establish baseline water yield and water quality responses to precipitation.

^{xli} The Nature Conservancy and New Mexico Forest Industry Association estimate that as restoration treatments are scaled up to 30,000 acres per year, the average cost for mechanical thinning will be \$700 per acre, recognizing that treatments in some wildland urban interface areas and on very steep, remote sites may cost significantly more (e.g. \$1,000-2,000 per acre).

^{xlii} See article: <http://www.bizjournals.com/albuquerque/print-edition/2013/07/05/where-will-abqs-water-come-from.html?page=all>

^{xliii} Walter, Kara and Janie Chermak. 2014. The Cost of A Wildfire in the West: 2011 Las Conchas Fire. University of New Mexico, Economics Department.

^{xliv} Impact DataSource. 2013. The Cost of Wildfires in New Mexico. January 24, 2013. Austin TX.

^{xlv} Statewide the USDA Forest Service invested \$12 million in hazardous fuels reduction in New Mexico in federal fiscal year 2012 (Source: Pat Jackson, USDA Forest Service, by email in October 2013). If this appropriation stays at its current level, about half is invested in the Rio Grande Water Fund area. In addition, the New Mexico Legislature made a one-time, statewide appropriation in 2014 of \$6.2 million for forest and watershed restoration.

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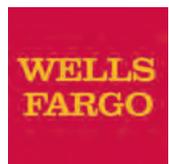
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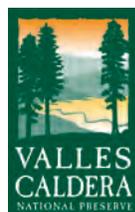
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