Restoring Rivers in the West

Environmental Benefit, Economic Opportunity

By Lucy Emerson-Bell

The 2008 Colorado College State of the Rockies Report Card

Key Findings

•Resource extraction in the Rockies has left a legacy of environmental degradation that can be turned into opportunities to revitalize communities.

•Approximately 40 percent of surface waters in the western U.S. are contaminated from acid-mine drainage.

•Thousands of miles of low-use forest roads in the Rockies provide no access benefits while damaging water quality and fisheries.

•Many of the region's dams have met or exceeded their planned lifespans and should be evaluated for breaching or removal.

•Decommissioning abandoned mines, low-use forest roads, and obsolete dams can contribute to a growing "restoration economy" throughout the Rockies.

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Restoration work is not fixing beautiful machinery, replacing stolen parts… welding and rewriting. It is accepting an abandoned responsibility. It is a humble and often joyful mending of biological ties, with a hope clearly recognized, that working from this foundation we might, too, begin to mend human society. [1]

–Barry Lopez

Introduction

The resource-rich Rockies region has a history of extraction that in places has left a legacy of environmental degradation. The mining boom of the nineteenth and twentieth centuries contributed to the settlement of the Rockies, but also to the contamination of its land and water. Abandoned mines continue to contaminate surface water through acid-mine drainage. The logging industry created many jobs but left forests stripped bare. Roads built to access isolated areas with valuable resources still remain, although a majority are no longer used. Instead, their presence leads to erosion and landslides causing sedimentation and the degradation of surface waters. Dams built to reduce floods and provide energy have transformed majestic rivers into enormous bathtubs, triggering dramatic hydrological change and severely impacting fisheries. Infrastructure once built to accommodate extraction under the ideals of Manifest Destiny is now aging.

Though troubling in many respects, this legacy of resource management policies over the last century can also provide opportunities for a new era of environmental restoration. As environmental historian Dan Flores comments, "If…management of Western resources was the great conservation theme of the late nineteenth century, and preservation of select pieces of the West that of the twentieth, then restoration may well be that of the twenty-first."[2]

Although restoration of a diverse number of ecosystems in the Rockies may be warranted, the West's surface waters have faced particular degradation as they have been contaminated by heavy metals, fragmented and thermally altered by dams, and compositionally transformed by roads and sedimentation. Water is the lifeblood of this dry region and maintaining water quality is of particular importance for the arid, rapidly-growing Rockies. Meeting water demands for this growing region will require restoring riparian ecosystems. According to the United States Geological Survey (USGS), "the definition of water availability has been expanded to include sustaining riparian ecosystems and individual endangered species, which are disproportionately represented in the Western States."[3] Ensuring clean and available water sources will be a limiting factor and key challenge for the long-term success of this region.

The *2007 State of the Rockies Report Card* provides research on agriculture to urban water transfers. To ensure water sustainability for future use that report noted that "water must be provided to natural hydrologic and ecological systems."[4] In a region where water is a scarce resource, every drop is accounted for. What is not always accounted for are the consequences negligence or overuse have had on riparian ecosystems. This section of the *2008 State of the Rockies Report Card* investigates the quality of surface water region-wide. Specifically, this chapter examines threats to riparian ecosystems and the sustainable supply of clean water. We address the possibilities for and benefits from a restoration industry through job creation, increased recreation, and tourism.

Water quality in the Rockies is of particular importance since this region contains the headwaters and drainage systems of many of the United States' major rivers. (See Figure 1.) The conditions of the rivers in this region have national and even international impacts. New Mexico, for example, feeds the headwaters of three major systems: the San Juan and Gila Rivers flow into the Colorado, the Canadian River contributes to the Mississippi, and much of the Rio Grande-Pecos basins drain the interior of the state.[5]

In 2002, metals were the number one impairment of surface waters in the Rockies, sediment came second, and thermal impairments were the third most com-

Figure 1
Rockies Contributions to National Watersheds
Source: National Atlas of the United States, USGS

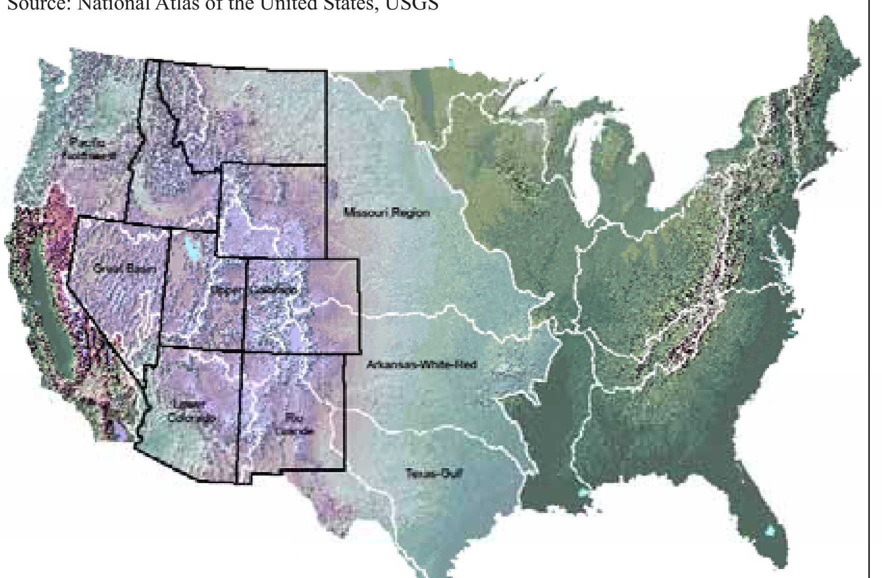
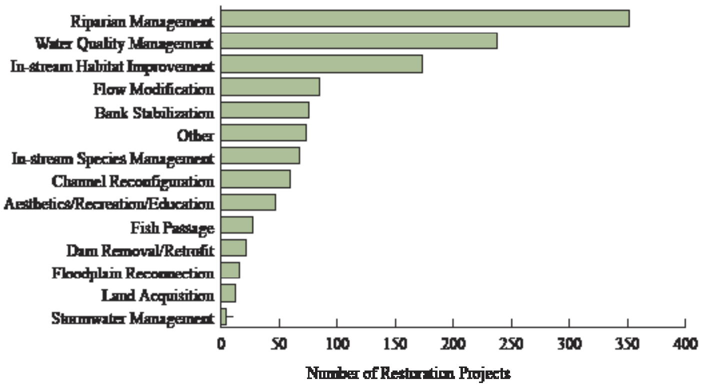


Figure 2
Number of River Restoration Projects in the Rockies by Project Intent, 2006
Source: Calculated from National River Restoration Science Synthesis Statistics



mon.[6] While impairments cannot always be directly attributed to one specific source, across the West most metal impairments (other than mercury) have been caused from existing or abandoned mine sites. Sediment impairments can be derived from multiple sources such as from agriculture and grazing practices, but the abundance of abandoned logging roads contributes directly to the sedimentation of surface waters.[7] Dams also contribute to the problem as sediment accumulates upstream of an impoundment.[8] Additionally, dams are one of many sources that cause thermal impairments as they alter river temperature by forming shallow, warm pools, or deep, cold pools of water.[9] This report focuses on mines, dams, and roads due to their abundance in the Rocky Mountain West and the scale of environmental impacts they have on surface waters.

Failing dams and abandoned mines and roads are becoming an economic liability due to costly maintenance, threats to human health, and contamination of municipal water sources. Restoration to improve watersheds can be costly, but a growing restoration industry could turn this liability into an asset. The economic motives of the Old West may have caused environmental damage, but restoration projects intended to treat what came before have the opportunity to create jobs directly, as well as encourage the economy of a New West by generating an amenities-based economy including family-wage, high-skill jobs, and increased tourism and recreation. In its Restoration Economy Policy Resolution, the Western Governors' Association states that, "the Restoration Economy of the West is emerging as an important component of the region's recent economic growth through activities that provide high-paying jobs throughout the restoration cycle."[10]

River restoration, in particular, is becomming a profitable business.[11] Restored riparian ecosystems benefit the local economy by providing employment and improving fishing and water-based recreation. Restored ecosystems also continue to generate benefits, since intact ecosystems offer an idealized image of the West, attracting tourists to the region and providing business opportunities. In addition, they can benefit communities because healthy rivers can increase property values. According to the Western Governors' Association, "Large intact and functioning ecosystems, healthy fish and wildlife populations, and abundant public access to natural landscapes are a significant contributing factor to the West's economic and in-migration boom."[12] Rivers connect humans to their natural surroundings. In many places, healthy rivers are culturally significant. As geographer William Graf notes, "Free-flowing rivers are broadly attractive to modern American society that attaches numerous positive social values to natural river landscapes."[13]

Scope of Restoration

Environmental restoration projects vary in magnitude and design. Examples of river restoration include channel engineering, removal of heavy metals, habitat improvement, and bank stabilization. The ultimate goal of river restoration should be to improve surface waters that "no longer perform essential ecological and social futions such as mitigating floods, providing clean drinking

Figure 3
Impaired Watersheds in the Rockies, TMDL Listings from State Reports
Source: TMDL listings from individual state 303(d) reports were compiled from the most recent year available: Arizona (2004), Colorado (2006), Idaho (2002), Montana (2006), Nevada (2004), New Mexico (2006), Utah (2006), and Wyoming (2006).

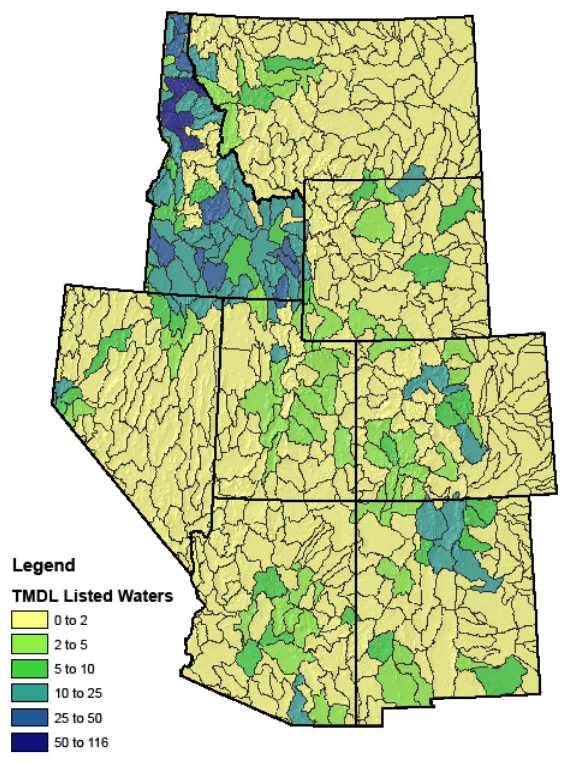
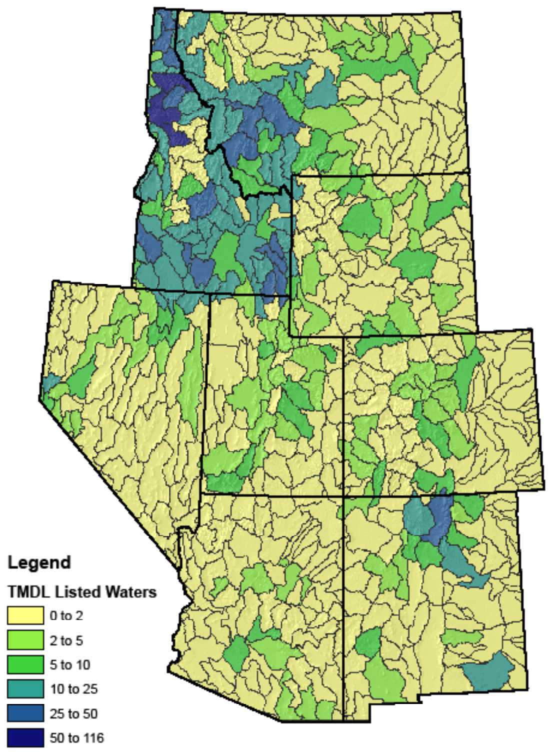


Figure 4
Impaired Watersheds in the Rockies,
TMDL Listings from EPA Reports
Source: US EPA TMDL Project, 1998-2004



water…and supporting fisheries and wildlife."[14] Some projects integrate human uses, such as removing a dam and establishing a whitewater park, while others constrain human uses, such as restricting development along streambanks. There are currently more than 37,000 river restoration projects occurring nationally, costing more than $1 billion annually.[15] These include projects by federal agencies, non-governmental groups, and citizen volunteers, and range in scope from entire wetlands to minor streams.[16] Nearly one thousand of these projects are taking place in the Rockies, primarily for riparian management—including revegetation of riparian zones or removal of exotic species.[17] (See Figure 2.)

Legislation and Impediments to Restoration

Legal protection of rivers first reached prominence with the passage of the Wild and Scenic Rivers Act in 1968. The Act declares that "selected rivers of the Nation…shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations." Today this law protects nearly 11,000 miles of rivers from dams.

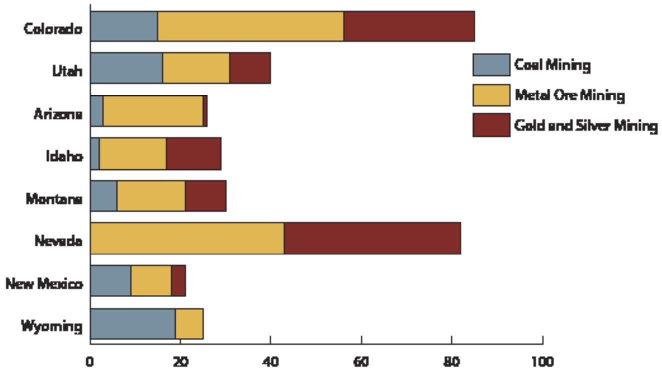
The Clean Water Act (CWA) was passed in 1972 with the purpose "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[19] Despite progress attained under this Act, the need for river restoration remains high: more than one-third of rivers in the United States are listed by the U.S. Environmental Protection Agency (EPA) as impaired or polluted.[20] Under the CWA, surface waters are protected from excessive levels of point-source pollution based on their designated use, but the act also creates liability issues which may scare away restoration projects. Some rivers are simply so polluted that full remediation is nearly impossible. Although the CWA succeeded in improving water quality from 1971 levels, the Act has failed more recently in guaranteeing quality water. Rivers are so polluted that if they continue in their current state, by 2016 U.S. rivers will be as dirty as they were in the mid-1970s.[21] While a complete assessment of surface waters is required under the Clean Water Act, since it was amended in 1977, only about one-third of the nation's surface waters have been assessed.[22] According to the EPA, in 2002 only 17 percent of the waters in the Rockies had been assessed, but each state's water quality department claims to have inventoried a higher percentage since then.[23]

Inconsistencies in Regulation

Rivers transcend state boundaries, but laws regulating their conditions vary with state lines. According to section 303(d) of the Clean Water Act, each state is required to establish standards for each designated use of the surface water, whether it is allocated for drinking water or for boating. If a waterbody does not meet the standards, it is designated "impaired." The state water quality department then sets a Total Maximum Daily Load (TMDL) standard to limit the concentration of effluent discharged into the impaired water body. Impaired surface waters and known sources of impairment are published every two years by each state's 303(d) lists. From data compiled by each state's water quality department websites, only seven percent of the rivers in the Rockies region are impaired, which is significantly lower than the nation's total. However, by the EPA's count, the average number of impaired waterbodies in the Rockies region in 2004 was 37 percent (see Figure 3 and Figure 4 for comparison).

Since regulations vary by state, the assessment procedures are not systematic and many states lack qualified data collectors.[26] In addition, the actual health of the nation's rivers is exceedingly difficult to gauge, since impairment data only reflects the relatively small percentage that have been assessed. As the EPA water quality website states, "It is not appropriate to use the information in this database to make statements about national trends in water quality. The methods states use to monitor and assess their waters and report their findings vary from state to state and even over time. Many states target their limited monitoring resources to waters they suspect are impaired and, therefore, assess only a

Figure 5
Number of Coal, Metal Ore, and Gold and Silver Mining Establishments by Rockies State, 2002
Source: 2002 Economic Census of Mining



small percentage of their waters.*"*[27] It is therefore extremely challenging to accurately portray the conditions of surface waters. In addition, of all river restoration projects nationwide, only ten percent have any form of assessment or monitoring.[28] Restoration may be needed to improve watersheds, but in order to avoid wasting money, time, and effort, pre- and post-monitoring programs are essential.[29] How can we ensure the quality of America's surface waters if many are not adequately assessed or monitored? Perhaps, with the arrival of the twenty-first century, a new page should be turned for the protection of surface waters. We may need new policies to update and promote monitoring, assessment, and restoration standards.

Ancillary Legislation

To improve surface waters, laws must reflect new priorities to encourage better management practices and contemporary values. Recent legislation has allocated funding for watersheds in certain states and in national forests to deliver more stringent standards than those of the Clean Water Act. On December 26, 2007, Congress allocated $39 million for road removal projects in national forests, including land in the Rockies, specifically to restore storm-damaged watersheds and fisheries.[30]

Another type of legislation that promotes river restoration is the Conservation Reserve Enhancement Program. Through this legislation, the Department of Agriculture's Farm Service Agency pays farmers to engage in conservation projects such as planting riparian buffers and native species on their land and removing invasive species already in place.[31, 32] Since the 1990s the Bureau of Land Management (BLM) has inventoried over 8,000 abandoned hardrock mines, which they prioritize for the most environmentally-damaged watersheds. The BLM is currently working with states to clean up roughly a dozen BLM abandoned mines annually. The agency receives about $10 million annually from federal and congressional appropriations.[33]

Each state may decide to implement more stringent standards than those stated by the CWA. In 2000, the Lake Tahoe Restoration Act authorized $300 million over a decade to fund erosion control, wetlands restoration, and forest health projects of the lake and its tributaries in order to preserve the clarity and quality of the lake described by Mark Twain as offering "the fairest picture the whole Earth affords." Algal growth from increased development and additional anthropogenic influences has severely decreased water clarity and quality since the 1960s.[34]

One piece of legislation that could encourage restoration is a "Good Samaritan" Act. This would allow environmental groups, counties, or other entities to obtain a permit to remediate surface waters with limited liability. The Western Governors' Association and other nonprofit organizations promote this approach and some, such as Trout Unlimited, already do remediation as "Good Samaritans" with the hope that charges will not be pressed. However, other organizations believe that a Good Samaritan Act could provide loopholes for mining companies to remine waste under the guise of remediation while exacerbating conditions instead of improving them.[35]

Mining

Metal mining is the leading source of toxic pollution in the United States. The hard-rock mining industry alone released 3.5 billion pounds of toxic pollution in 1998, about half of all toxic pollution released that year in the U.S.[36] Hard-rock mining requires the extraction of certain metals, minerals, and ore from the earth. The environmental impacts of mining are especially significant to the Rockies region. Historian Patricia Limerick, Director of the Center of the American West, observes, "No other industry changed the West as rapidly and as profoundly as did the gold and silver rushes of the nineteenth century."[37]

Figure 6
Total Number of Mines per Rockies State by Production Status, 2005
Source: USGS

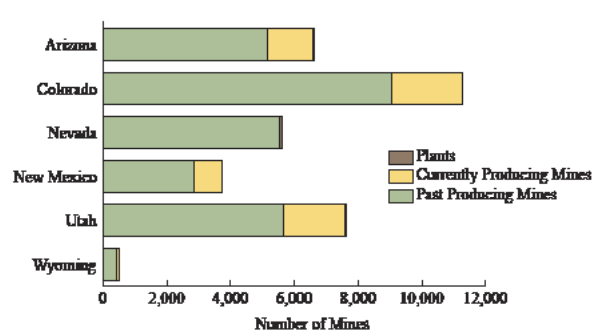
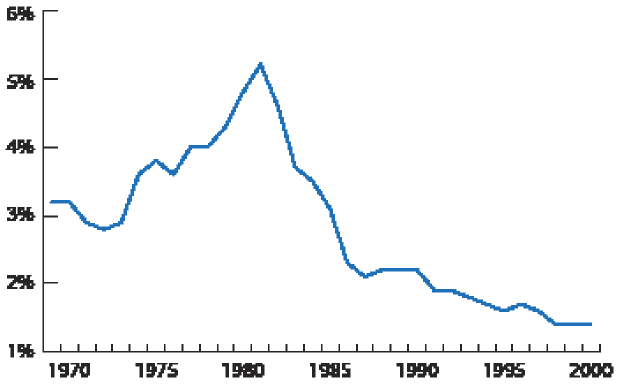


Figure 7
Personal Income Derived from Mining as a Percent of All Personal Income, 1969-2000
Source: US Department of Labor, Bureau of Labor Statistics



The EPA states that mines are "one of the largest sources of water pollution in the (West)."[38] Today many Rockies states continue to lead the nation in the production of certain minerals, including copper, gold, silver, and molybdenum through hard-rock mining. (See Figure 5.) The combination of mining operations of today and abandoned mines from the past continue to threaten the fragile ecosystems and degrade the water quality of the West.

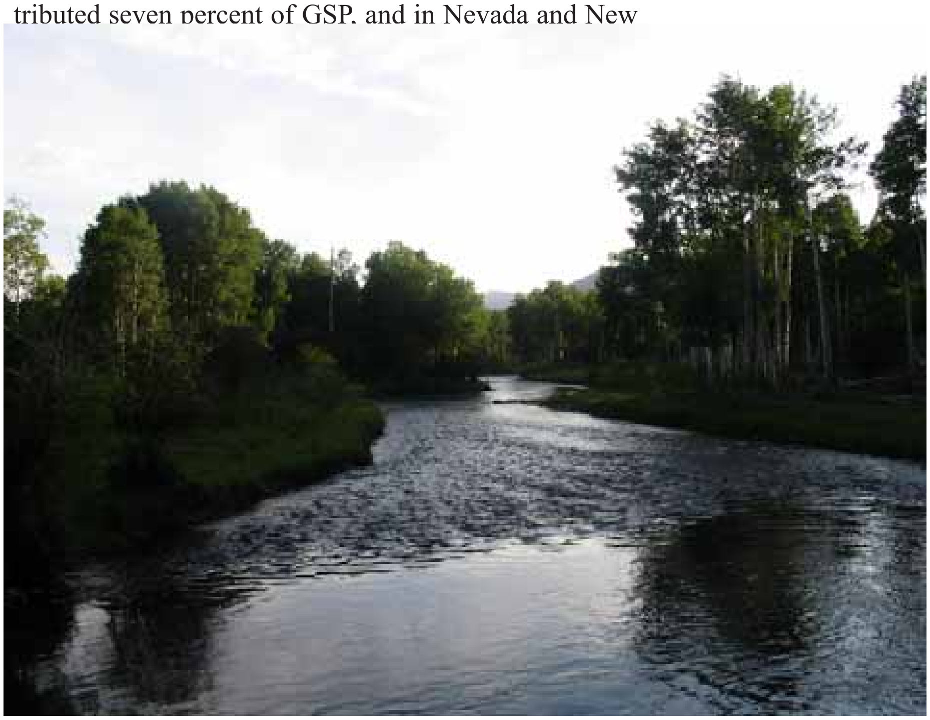
The mining industry in the Rockies is now a fraction of what it once was. About 75 percent of the total mines in the Rockies are past producers or non-operational.[39] (See Figure 6.) In addition, income from mining now contributes a smaller percent to personal income in the Rockies than it has in the past.[40] (See Figure 7.) That said, the Gross State Product (GSP) from mining in states with less diverse economies has still been reasonably high in recent decades. As of 1992, mining in Montana contributed seven percent of GSP, and in Nevada and New Mexico it made up nine percent of the total.[41]

Current and past producing mines are heavily concentrated in this region. (See Figure 8.) Presently, approximately 350 million acres of land in the Rocky Mountain West are open to mining.[42] Since 1964, close to 300,000 acres of land in the Rockies have been privatized or patented for mines.[43] According to the U.S. Geological Survey, in 2005 there were 2,212 producing mines in Colorado, more than any other Rocky Mountain state, but this number is only a fifth of the total number of current and past-producing mines in Colorado.[44] (See Figure 6.)

Abandoned for Use but Continuous Abuse

Abandoned mines significantly threaten water quality, especially when no party is held accountable for environmental degradation. The EPA estimates that there are 500,000 abandoned hard-rock mines in the West.[45] Many abandoned hard-rock mine sites are so severely polluted and dangerous that by 2003, 87 were listed on the Superfund National Priorities List.[46] The EPA has an Abandoned Mine Land program to work with federal land management agencies, mine owners, and communities to organize voluntary cleanup and remediation of land and water surrounding watersheds contaminated from mining.[47]

Mine cleanup is expensive; the estimated remediation costs for all the abandoned and inactive mines nationally ranges from $32 to $72 billion.[48] In Colorado the annual value of mining, excluding oil and gas, is just over $1 million; meanwhile, Colorado's Inactive Mine Reclamation Program spent more than $18 million on abandoned mine remediation in 2002 alone.[49] The numbers vary, but it has been estimated that about 16,000 miles – or 40 percent – of the surface waters in the Western United States are contaminated by metals from acid-mine drainage.[50]

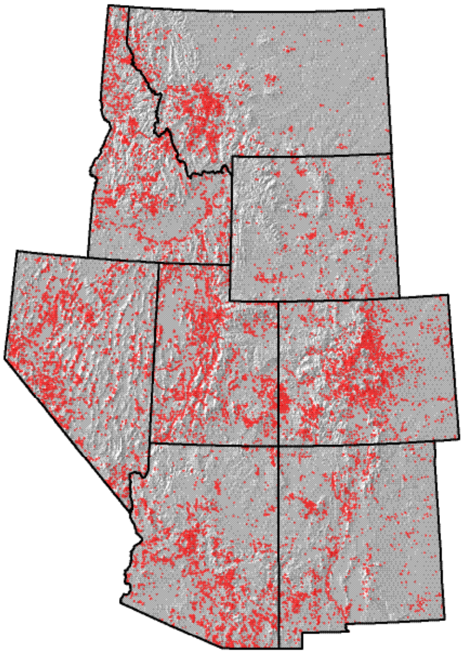


Lake Creek, Snake River Ranch, Wyoming © Turner Resor

Acid Mine Drainage

Acid mine drainage is caused by hardrock metal mining when metals oxidize in sulfide ore to form sulfuric acid. The sulfuric acid dissolves metals within the rock, catalyzing heavy metals and other contaminants. This yellowish-orange leachate can then enter surface waters and percolate into groundwater. The presence of heavy metals in water may render it unfit for drinking, destroy aquatic habitat, or kill organisms upon exposure. Abandoned mines can continue to pollute

Figure 8
Past and Current Mining in the Rockies, Metallic and Non-Metallic Mining Operations (Past Producers, Current Producers, and Processing Plants)
Source: Mineral Resource Data System, USGS, 2005



even when no longer operational. Acid drainage develops gradually and can form anywhere sulfides are exposed to air and water such as in waste rock piles, mine tailings, open pit mines, or underground tunnels.[51] Acid mine drainage affects surface water and associated ecosystems throughout the Rockies.[52] (See Figure 8).

Open Pit Mines

Open pit mines are created when the surface is excavated to extract ore. They are the predominant means for extracting gold and copper. The mines can fill with groundwater, which oxidizes and becomes toxic, and may contaminate shallow wells and groundwater, threatening wildlife. Decades of copper mining created a mile-wide toxic lake in Butte, Montana's Berkeley Pit, one of the oldest and largest open pit mines in the U.S. In 1995, a flock of 342 migrating snow geese landed on the waters of the Berkeley Pit and quickly died from exposure to acid-mine drainage and heavy metals.[53]

Riparian and Watershed Effects

Acid mine drainage and toxic loading of heavy metals can decimate native fish populations, aquatic insects, and vegetation.[54] Toxic metals released from mining operations can also be re-dissolved in the water column, posing a continual threat to water quality. Toxic chemicals used to remove a target metal, such as cyanide for the extraction of gold and copper from ore, can also lead to contamination problems.[56]

Polluted watersheds not only affect wildlife, but they can jeopardize municipal water sources from both surface and ground water. The USGS estimates that in 2000, 79 percent of the nation's 408 billion gallons of water used per day was derived from surface water while the remainder came from groundwater.[57] The threat to water quality is of particular importance in the Rockies, with its rich history of mining operations and a climate where water scarcity is typical. Mining below the water table can pollute critical shallow aquifers as surface materials infiltrate and flow into groundwater. The West's national forests are the single largest provider of municipal water for some 66 million people in 33 western states, but also contain nearly 7,600 abandoned mines that present a severe threat to sustainable water sources.[58] Remediation of abandoned mines in the national forests therefore is crucial for municipal water sources and for supporting the natural quality of these lands.

Mining operations can reduce both the quality and the quantity of water. For example, water is extracted to prevent open pit mines from filling with water. One study found that mines in Nevada withdrew more than 580 billion gallons of water from 1986 to 2000 — more than enough to supply New York City's tap water for a year.[59] With the help of mining, groundwater levels in Nevada have dropped about 1,500 feet during the past decade.[60]

Figure 9
Major Dams, Primary Uses, and Normal Reservoir Storage Capacity in the Rockies (acre-feet)
Source: National Atlas of the United States

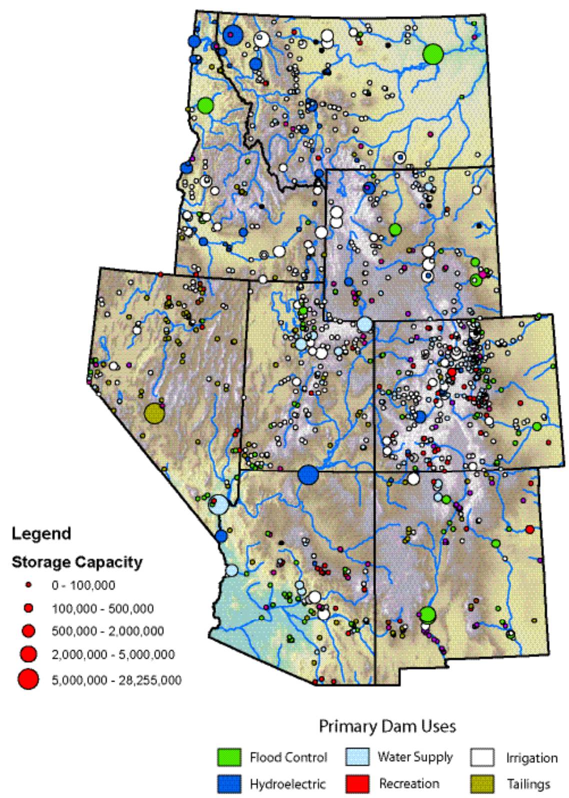


Figure 10
Major Dams and Normal Reservoir Storage Capacity in the Rockies (acre-feet)
Source: National Atlas of the United States

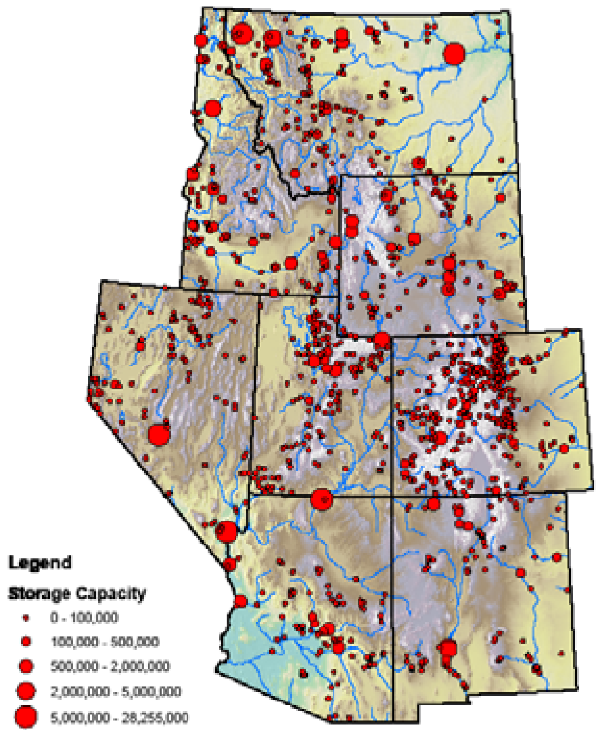
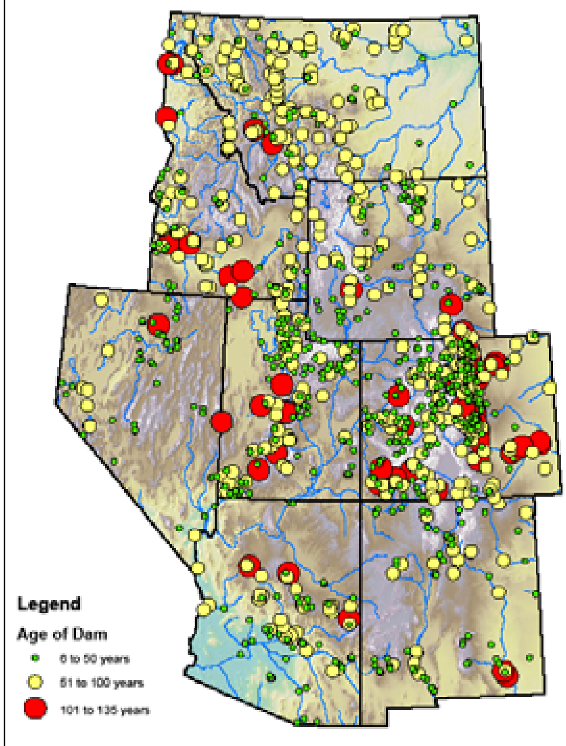


Figure 11
Age of Dams in the Rockies
Source: National Atlas of the United States



Dams – Historical and Current Status

Dams can serve important purposes for hydropower, irrigation, water storage, or flood control, but many dams nationwide are obsolete or no longer function as planned. Those that no longer benefit society but threaten ecosystems should be considered prime candidates for removal. Nationally, dams supply 269,000 megawatt hours of energy, about seven percent of total electrical generation in the U.S. in 2005.[61] They provide water for irrigation to transform dry land into productive farms and help prevent flooding. Dams store water for arid metropolitan areas, such as Phoenix and Las Vegas, allowing these cities to persist in an arid region. In the Rockies, 40 percent of all dams are used for irrigation. Although only five percent of the dams in the Rockies are used for hydroelectric power, these dams have massive storage capacity in the reservoirs they create, holding 25 percent of the total water stored by dams in the region (see Figure 9 and 10 for purpose and storage capacity). Many dams no longer serve their intended purposes and may be suitable candidates for breaching or removal.

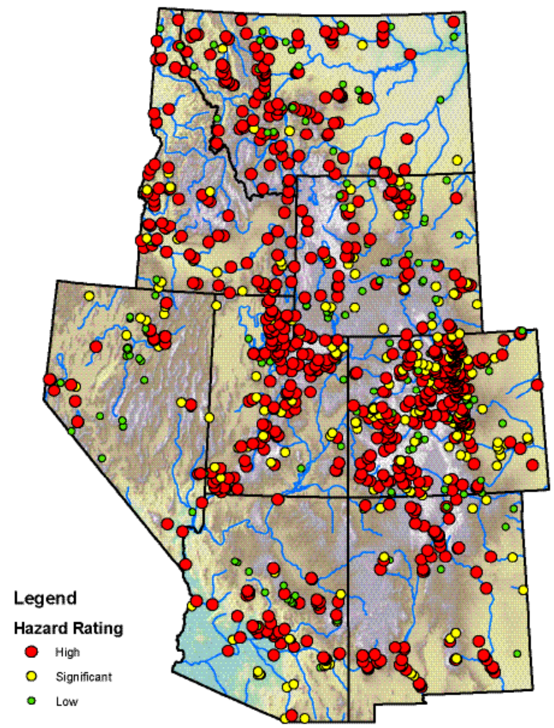
Scale of Dams

The National Inventory of Dams has counted 79,000 dams nationwide. Of these, 8,100 are considered “major” dams—50 feet or taller, with a normal storage capacity of 5,000 acre-feet or more and a maximum storage capacity of at least 25,000 acre-feet.[62] With 1,300 dams, the Rockies region contains more major dams than any other census division in the country (See Figure 10). The majority of dams in the Rockies region were built in the 1960s, following an early peak in 1905 (Figure 11). Even though the great dam-building era has passed, the dams that still stand continue to impact the environment. The size of the dam and its age can indicate its potential lifespan and hazard—aging dams are more inclined to failure and can present substantial risks. From an engineering perspective, most small and medium size dams will only last about 50 years, while the lifespan of large dams is controlled by the rate of sedimentation in their reservoirs and typically last longer.[63] (See Figure 12 for relative dam hazard).

Large Dams and Their Large Environmental Impacts

Dams with large storage capacities create unnatural reservoirs where a river once flowed. This drastically changes the flow, temperature, and evaporation rates of the river. The ratio of reservoir storage capacity to mean annual runoff is an informative measure of the potential hydrologic impact of dams. In the U.S., the highest ratio of storage capacity to mean annual runoff occurs in the Rockies, the Great Plains, and the Southwest.[64] In the Rockies, large dams can store three to four times the mean annual runoff. Due to this enormous reservoir capacity, water from the region may be exported elsewhere, while damaged riparian ecosystems remain in the region. As William Graf remarks, “The plains,

Figure 12
Dam Hazard Ratings in the Rockies
Source: National Atlas of the United States, National Inventory of Dams



mountains, and southwestern areas export water…while retaining the environmental costs. The environmental costs of dams in the form of disrupted downstream hydrologic and biotic systems are likely to be greater in these regions than elsewhere."[65]

Waterways in the Rockies flow through both mountains and deserts, therefore, a range of riparian ecosystems face disruption from dams. Dams are a major threat to many fish populations, mainly by restricting migratory routes, but also by altering temperature, destroying habitat, and reducing water quality and quantity. Dams restrict downstream flow and natural flooding events, which are crucial processes for removing salt and debris, rebuilding the river banks, and the generation of fertile sediment. With altered flow regimes, invasive species can dominate.

Hazards

The National Inventory of Dams classifies major dams by hazards they pose to the environment, to human life, and to the economy from failure or misoperation. A failure can occur with old, disintegrating dams or in a flooding event. In the event of failure, "high" hazard dams are classified as likely to cause human and economic casualties.[66] The Rockies contain 18 percent of the nation's "high" hazard dams, more than any other region. Thirty percent of the region's high hazard dams are in Colorado.[67] (See Figure 12.) Many of the region's dams are considered high hazard due to their large storage capacity. (See Figure 10.)

Dam hazards are more than a theoretical concern and dam failures can lead to significant destruction. When Idaho's Teton Dam collapsed in 1976, it wiped out several towns and killed 14 people.[68] Many dams nationwide appear to be in danger of failing. The American Society of Civil Engineers graded the condition of the dams in the United States and assigned an overall grade of a "D" in their 2001 Report Card.[69] It could cost almost $10 billion over the next decade to repair the deteriorating dams nationwide. In some instances, complete removal is a less expensive option than repair.

Economic Revival through Healthy Rivers

The West has become a destination for those inclined towards the outdoors, open space, and scenic views. Resource extraction has not proved to be a long-term economic solution in many mountain towns, but in many cases restoration programs could provide a more durable route to economic vitality. University of Montana economist Thomas Power projects that closing and cleaning up mines can reinvigorate local economies by attracting residents drawn to natural amenities, including clean, healthy ecosystems.[70] River restoration projects have the ability to improve struggling economies by stimulating a recreation industry and can create economic incentives that spur community involvement and encourage citizens to protect rivers for future use.

A study conducted by John Loomis of Colorado State University determined the economic benefits of river recreation in southwestern Wyoming and southeastern

Case Study: Mike Horse Dam

Mike Horse Dam is a 500-foot-long tailings dam straddling the Blackfoot River near its headwaters along the Continental Divide in Montana. It was built in the 1940s from metal-laced mine tailings to contain toxic mining waste and for decades has leaked acid-filled wastewater into the river.[1] Made famous by Norman Maclean's story, "A River Runs Through It," the Blackfoot River is an important water source for irrigation, ranching, and for recreation, but the dam provides no hydropower and the reservoir it holds does not supply drinking water.

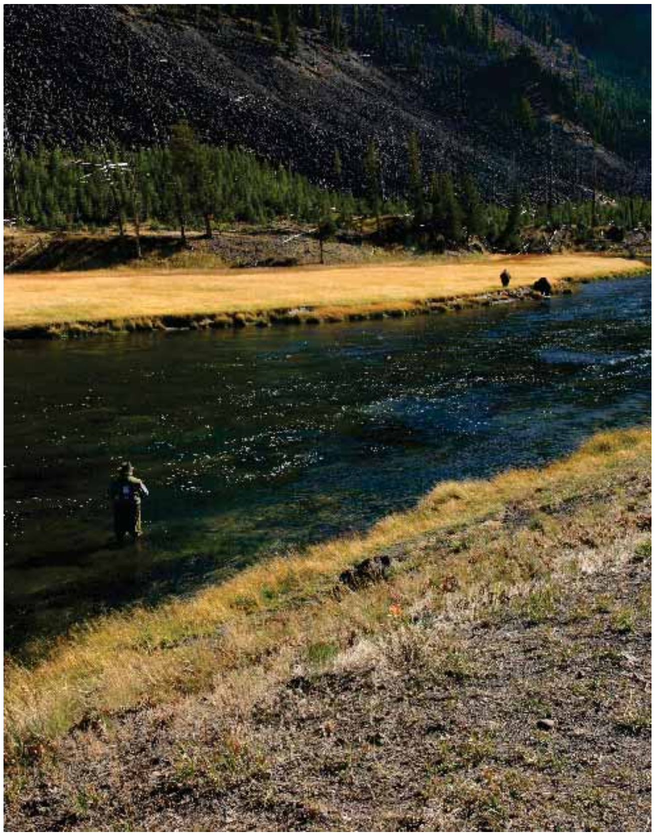
In 1975 a flood breached the Mike Horse dam, releasing 100,000 tons of toxic tailings into Mike Horse Creek and ten miles down the Blackfoot River. The mining corporation ASARCO rebuilt the dam shortly thereafter.[2] Mike Horse Dam is now a Superfund site and contains two million cubic yards of contaminated material. Populations of cutthroat, brown, and brook trout were decimated after the dam failed, and more than a decade later the number of cutthroat trout one year and older was still 25 percent below that of pre-flood levels. A study conducted sixteen years after the breach found significant cadmium contamination in stone flies and brown trout located more than 46 miles downstream from the dam.[3]

Millions of dollars worth of restoration efforts conducted by Trout Unlimited and other groups along the Blackfoot have cleaned the stream banks and increased the native trout populations. These efforts have helped mend more than 350 stream miles and the Blackfoot River fishery is showing improvement.[4] However, a Forest Service report indicates that a repeat of the 1975 dam failure is not just possible, but likely.[5] The Forest Service manages the land below the impoundment and determined that the dam has been eroding from within for about 15 to 20 years.[6]

Watershed and fisheries groups now advocate the removal of Mike Horse Dam, a project estimated to cost tens of millions of dollars.[7] They need only look downstream to the confluence of the Blackfoot and Clark Fork Rivers to get a sense of what such a task might entail—the aging Milltown Dam is currently being removed, and along with it, some 2.6 million cubic yards of contaminated river sediments.

[1]The Clark Fork Coalition website. http://www.clarkfork.org/programs/mike_horse_mine.html. See also: Schnitzer, Russ and Rob Roberts, "Settled, Mined & Left Behind." Report from Trout Unlimited's Public Land Initiative: 14. Viewed online July 14, 2007.
[2]The Clark Fork Coalition website. http://www.clarkfork.org/programs/mike_horse_mine.html
[3]Schnitzer, Russ and Rob Roberts: 14.
[4]Schnitzer, Russ and Rob Roberts: 14.
[5] Mike Horse Dam: A Threat to The Blackfoot, A Threat To Our Communities. Produced by the Clark Fork Coalition. Viewed online at http://www.clarkfork.org/programs/mike_horse_mine.html
[6] Clark Fork Coalition: Programs, Watershed Cleanup and Restoration http://www.clarkfork.org/programs/mike_horse_mine.html
[7]Moore, Michael. "Group presses for Mike Horse Dam removal." *The Missoulian*. http://www.missoulian.com/articles/2005/06/11/news/top/news01.txt

Idaho: fishing and boating on the Upper Snake River creates 1,460 jobs and provides $46 million in income. Dr. Loomis's study found that if river conditions improved so anglers could catch twice as many fish, the total number of jobs would nearly double, providing $77 million in total income and creating incentives for improving the natural riparian habitat.[71] The fishing industry in the Rockies currently contributes $4.5 billion to the regional economy.[72] River restoration can reestablish natural hydrology and temperature, reduce sedimentation, and decrease concentrations of heavy metals, thus improving fish populations (See Case Study: Mike Horse Dam).



Whitewater Parks

Where dam removal occurs, river restoration projects can also boost the economy by constructing whitewater parks on stretches of free-flowing river formerly covered by reservoirs. There are currently about 35 whitewater parks nationwide, and 25 of these are located in the Rockies.[73] The Colorado River Outfitters Association reports that in 2006 rafting in Colorado contributed a net benefit of $139 million.[74] Whitewater parks can also stimulate suffering fish populations by reintroducing

Case Study: The Arkansas River, Pueblo, Colorado

A 12-foot diversion dam was modified on the Arkansas River in order to develop an $800,000 white water park, the Arkansas River Legacy Whitewater Park. The dam on the Arkansas remains and serves its original purpose, but eight structures were added to support whitewater recreation and enhance fish habitat. The whitewater park engineers made the rapids passable for fish and have found that the structures aerate the river, thus improving conditions for aquatic species.[1] In addition, nearly a mile of riverbank was restored. The City of Pueblo now hosts a major whitewater festival and benefits from recreation-related tourism the whitewater park attracts.[2] According to Shane Sigle, a park designer, the whitewater park in Pueblo is the best restoration project of its kind in which a dam was altered, and in-stream habitat improved, and the river has demonstrated signs of recovery.[3]

Approximately ninety miles upstream on the Arkansas River, Salida, Colorado, also features a whitewater park, and water-based recreation has become a $55 million business.[4] In the summer of 2000, more than 300,000 people took commercial raft trips down the Arkansas River (which features many miles of natural whitewater in addition to the constructed parks).

[1]Recreation, Engineering and Planning website. http://www.wwparks.com/projects.html
[2]Recreation Engineering and Planning. http://www.wwparks.com/dam_projects.html
[3]Shane Sigle, designer at Recreation Engineering and Planning, Interview, June 20, 2007.
[4]Sherry Devlin. "Two Rivers proposal would return Milltown Dam to its free-flowing state," *The Missoulian.* February 22, 2001.

rapids that aerate the water and increase transportation of fine particles. Deep pools formed beneath whitewater park rapids provide protection and habitat for juvenile and adult fish, particularly beneficial to certain salmonid species that are imperiled in the Rockies region[75] (See Case Study: The Arkansas River).

Criteria for Dam Removal

With the dam-building era winding down and the impacts of dams more keenly realized than ever before, a number of dams now face removal. According to Rebecca Wodder, President of American Rivers, "Every study has shown that dam removal is the best — and probably only — way to restore the salmon. Dam removal is far less costly than other salmon recovery alternatives such as severe new restrictions on logging, farming and fishing."[76] Although dam removal can cause initial shocks to ecosystems, in the long run it provides a more viable solution than alternatives, such as installing fish ladders or bussing loads of anadromous fish around a dam. Repair is another option for some aging dams, but removal ought to be considered for dams that are obsolete or particularly harmful environmentally, as well as older, smaller dams more inclined toward disintegration. For many smaller dams, sediment build-up compromises their integrity so decommissioning and removal makes sense.[77] The Federal Energy Regulatory Commission (FERC) requires licenses for hydroelectric dams, which are valid for 30- to 50-year periods, then evaluated for re-licensing. FERC evaluates renewals based on criteria such as the integrity and productivity of the dam and the extent of environmental impact. Though removal of even obsolete dams can be contentious, the FERC relicenseing process creates an opportunity to reassess the merits of keeping aging dams in place.

Forest Roads

An estimated 523,000 miles of roads fragment America's national forests.[78] (See Figure 13.) Built for resource extraction, recreation, or transportation, a majority of the roads in the national forests are abandoned or receive little to no use. The Forest Service is the largest road management agency in the world, but can only afford to maintain about 20 percent of its roads.[79] Forest Service inventories are often incomplete, lacking information needed to assess road use and environmental impacts[80] (See Figure 13 for reference to "unknown roads").

Since 1988 the Forest Service has removed or decommissioned approximately 10,000 miles of road, but it estimates that 100,000 to 186,000 miles of roads are unnecessary and eventually could be decommissioned as well.[81] Both road maintenance and road removal can be expensive; removal of small roads averages $7,500 per mile,[82] medium-sized roads can cost from $40,000 to $70,000, and major roads can cost from $100,000 to $250,000 per mile.[83] The Forest Service has prioritized road removal and maintenance based on roads' use and environmental impact. "Single purpose roads" are the main focus of decommissioning, but smaller, decrepit roads are also candidates for removal. (See Figure 13.)

Effect of Roads on Water Quality

The presence of roads can produce a range of impacts on riparian ecosystems and water quality. On a broad scale, roads cause landslides that pollute aquatic habitat and municipal water sources with sediment runoff. In addition, they can alter the overall hydrology in a watershed, change groundwater availability, change timing of peak flows, and redirect water flows.[84] Roads have been found to increase the frequency, timing, and magnitude of disturbances, such as landslides and debris flows to aquatic habitat by 30 to 300 times the natural rate, depending upon terrain.[85] Erosion occurs due to the presence of roads when water that would otherwise be absorbed in the ground is concentrated, causing magnified runoff into surface waters.[86] Several studies of roads in the Pacific Northwest found that untreated roads can produce four times the amount of erosion than that produced by recontoured roads, where stream crossings or

Case Study: Clearwater National Forest, Clearwater River Basin, Idaho

The Clearwater National Forest covers some 1.8 million acres in north-central Idaho. Criss-crossing the forest are about 6,000 miles of road, mostly built between 1950 and the 1970s. Many of these roads are so-called "jammer" roads, built by the timber industry for use during brief periods of intensive logging. These low-volume roads now receive little maintenance and many are failing, in poor condition, or impossible to drive. In 1995 and 1996, a series of heavy rains caused severe landslides across the forest. Subsequent assessments determined that 60 percent of these slides were triggered by overgrown, abandoned roads. However, on ten kilometers of road that had been recontoured and removed prior to the floods, no landslides occurred.

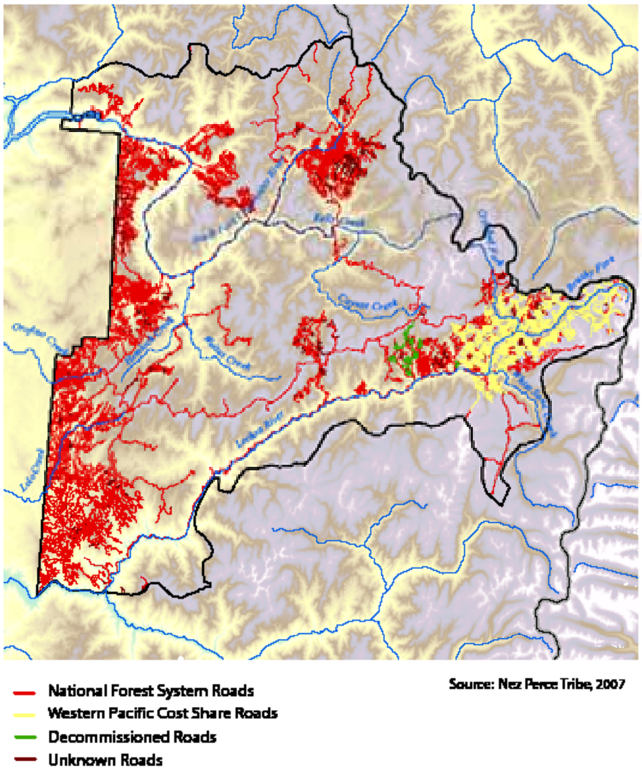
In response to these events, the Clearwater National Forest and Nez Perce Tribe have been working together on an intense road removal program to reduce road concentrations in the watershed. In addition to decreasing the risk of landslides, the program is designed to protect salmon and trout species by decreasing road-related sedimentation. The project started by mapping the roads in the forest and prioritizing them based on use and relative environmental impact. Roads classified as "high priority" were in areas of high road density and located near stretches of river that were important fish habitat. The agencies then began removing unnecessary roads that were prone to failure. On average, the program reclaims about 40 miles of roads per year.

The Clearwater National Forest and Nez Perce Road Removal Project has been heralded as a model road removal project. Not only has it been successful in gaining community support—in part by hiring locals to conduct the road removal work —the partners have also demonstrated success in reducing landslides and lowering sediment risks. Post-removal monitoring has also found increased wildlife and more native vegetation on treated roads. Future challenges include funding and finding the labor necessary to physically remove or decommission the roads.

[1]Watershed Consulting, LLC. "Assessment of the Road Obliteration Program on the Clearwater National Forest, Idaho." August, 2002. Pg 5. http://www.wildlandscpr.org/files/uploads/PDFs/ClearwaterReport.pdf
[2]Rebecca Lloyd, hydrologist with the Nez Perce Tribe, Interview, June 27, 2007.
[3]Rebecca Lloyd, Interview, June 27, 2007.
[4]McClelland D, Foltz R, Falter C, et al. 1997. "Relative effects on a low-volume road system of landslides resulting from episodic storms in northern Idaho." Transport Res Rec 2: 235-43.
[5]Rebecca Lloyd, Interview, June 27, 2007.
[6]Rebecca Lloyd, Interview, June 27, 2007.
[7]"Investing in Communities, Investing in the Land: Summary Report." www.wildlandscpr.org/node/68/print
[8]Rebecca Lloyd, Interview, June 27, 2007 .

Road Removal in the Clearwater National Forest, Montana

Figure 13
Rivers, Creeks, and Roads in the
Clearwater National Forest, Idaho
Source: Nez Perce Tribe, 2007



road cuts have been returned to a more natural condition.[87] In Idaho, 94 percent of the streams considered water-quality impaired are located in roaded areas. Because roads create a dramatic impact on riparian habitat and fisheries, many road removal projects focus directly on river and watershed restoration.[88] (See Case Study: Clearwater National Forest.)

Cost-Benefits of Removal

Studies have found that roadless areas are crucial for maintaining intact fish habitat. A report published by Trout Unlimited found that 74 percent of current steelhead trout habitat is located in roadless areas. As Scott Stouder of Trout Unlimited notes, "The best habitat for fish and wildlife is in roadless areas. It's pretty simple."[89] Removing unused or abandoned roads can reduce threats to the riparian ecosystem and restore ecosystem services such as water purification and flood control. This is substantially cheaper than building a municipal filtration facility to treat water and could save the Forest Service millions of dollars by reducing the frequency and intensity of landslides. In some cases, the cost of removing sediment from surface waters can be significantly greater than the cost of preventing erosion. According to a report published by the nonprofit organization Wildlands CPR, "Removing roads, which stops soil-erosion and sedimentation, is more cost-efficient than repairing damaged waterways, restoring habitat, and recovering threatened and endangered species."[90]

Old, low-volume roads are a symbol of aging extractive industries, which continue to haunt the ecosystems of the West. Nevertheless, they present new opportunities for restoration of the environment and of rural economies. Road removal projects require skilled labor and long-term employment of local workers, including workers displaced from the original road construction projects or from the timber industry. Reports estimate that 14.5 direct jobs are created, plus additional jobs created in the community, for every $1 million spent on road removal or restoration.[91] If a national forest road removal program treated 9,300 miles of road annually, in two decades the Forest Service could rid itself of all 186,000 miles of road it identified for decommissioning. Such a plan would cost approximately $93 million annually — at an average cost of $10,000 per mile of road removed — but would also generate more than 3,000 living-wage jobs that would go primarily to rural communities that have suffered from recent declines in extraction-based economies.[92]

Conclusion

The Rockies region was settled in large part through policies designed to develop its natural resources. The Homestead Act, the 1872 Mining Act, and other early laws promoted the land for its many uses to attract settlers. Since land essentially cost nothing, it was often treated as if it had no value. In some cases, this attitude and some laws, such as the General Mining Act of 1872, still exist today.

Rivers are the life of the dry Rocky Mountain West. By refocusing the attention of resource management in the Rockies to emphasize restoration – particularly of the region's precious waterways – we may find that the legacy of mining, damming, and road-building can translate into the economic boom of the future. Only this time, the boom could benefit the environment rather than leave it in need of repair.

Endnotes and Citations

[1]Lopez, Barry. "Waiting on Wisdom." Writers of the West Speak on Behalf of Utah Wilderness, Stephen Trimble and Terry Tempest Williams, compilers. 46-49. Minneapolis: Milkweed Press: 1996.
[2]Flores, Dan. *The Natural West*. (Norman, OK: University of Oklahoma Press, 2001), 186.
[3]Mark T Anderson and Lloyd Woosley Jr. "Water Availability for the Western United States—Key Scientific Challenges:" *U.S. Geological Survey Circular* 1261 (2005): 85.
[4]McMahon, Tyler. "Water Sustainability in the Rockies: Agriculture to Urban Transfers and Implications for Future Water Use." *2007 State of the Rockies Report Card*: 31.
[5]"New Mexico's 2006 303 (d) Integrated Report,." Ed. Stephanie Stringer, Surface Water Quality Bureau, http://www.nmenv.state.nm.us/SWQB/303d-305b/2006-2008/index.html. (accessed June 2007).
[6]Section 303(d) List Fact Sheet." EPA website. http://iaspub.epa.gov/waters/region_rept.control?p_region=8#IMP, July 6, 2007.
[7] Hermann Gucinski,Michael J. Furniss, Robert R. Ziemer and Martha H. Brookes, eds., Forest Roads: *A Synthesis of Scientific Information*. June 2000. Gen. Tech. Rep. PNW-GTR-509. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 6.
[8]Jim Berkely, impairment specialist at EPA, phone interview, 25 June 2007.
[9]Jeffery P Cohn. "Resurrecting the Dammed: A Look at Colorado River Restoration." *Bioscience* 999, (2001): 51.
[10]Western Governors' Association Policy Resolution 06-18: "The Restoration Economy," June 13, 2006. www.westgov.org/wga/policy/06/restoration.pdf
[11]E.S.Bernhardt, M. A. Palmer, J. D. Allan, G. Alexander, K. Barnas, S. Brooks, J. Carr, S. Clayton,

C. Dahm, J. Follstad-Shah, D. Galat, S. Gloss, P. Goodwin, D. Hart, B. Hassett, R. Jenkinson, S. Katz, G. M. Kondolf, P. S. Lake, R. Lave, J. L. Meyer, T. K. O'Donnell, L. Pagano, B. Powell and E. Sudduth. "Synthesizing U.S. River Restoration Efforts," *Science* 308 (2005): 636.

[12]Western Governors' Association Policy Resolution, "The Restoration Economy," 06-18. June 13, 2006. www.westgov.org/wga/policy/06/restoration.pdf

[13]William Graf. "Geomorphology and American dams: The scientific, social, and economic context." *Geomorphology* 71 (2005): 20.

[14]Margaret Palmer and J. David Allan. "Restoring Rivers: Policy Recommendations to Enhance Effectiveness of River Restoration." *National Academy of Science Journal: Issues in Science and Technology*. Winter 2006

[15]This data is compiled by the National River Restoration Science Synthesis database at http://nrrss.nbii.gov/.

[16]Restoring Rivers.org: "Improving the Science of River Restoration." http://restoringrivers.org/oldsite/project_description.html.

[17]Restoring Rivers.org: http://restoringrivers.org/oldsite/glossary/intentsandgoals.html.

[18]"National Wild & Scenic Rivers System," www.rivers.gov (accessed 30 July 2007)

[19]The Federal Water Pollution Control Act. The Clean Water Act. 33 U.S.C. 1251 et seq Section 101 (a): 2. Amended Nov. 27, 2002.

[20]Palmer and Allan 2006, 41.

[21]Palmer and Allan 2006, 41.

[22]"Clean Water Act Status—Content Descriptions." http://www.scorecard.org/env-releases/water/cwa-report-descriptions.tcl#report [31 July 2007].

[23]2002 National Assessment Database. http://www.epa.gov/waters/305b/states.html. (accessed 19 June 2007.)

[24]This report compiled data on impaired rivers from the EPA website and from each individual states' water quality department websites which often contained more current 303 (d) lists, while data on the EPA website is still from 2002. However, the EPA listings of impaired rivers are more severe than the state's reporting.

[25]U.S. EPA National Assessment Database: http://www.epa.gov/waters/305b/index.html.

[26]Taylor Greenup, Water Quality Specialist, Montana Department of Environmental Quality, email message, 26 July 2007.

[27]"Assessing Water Quality, (Questions and Answers)" http://www.epa.gov/waters/305b/assessing_quality.html. (Accessed 18 July 2007).

[28]Bernhardt et al. 2005, 636.

[29]Gillilan, S., K. Boyd, T. Hoitsma and M. Kauffman. "Challenges in developing and implementing ecological standards for geomorphic river restoration projects: a practitioner's response to Palmer et al.," Journal of Applied Ecology 42(2), (2005): 223.

[30]Walder, Bethanie, personal communication with Executive Director, Wildlands CPR. 30 December 2007.

[31]Palmer and Allan, 2006, 42.

[32]Martha Kauffman, Hydrologist, Interview in Bozeman, MT. 13 July 2007.

[33] Patricia Limerick, Joseph N. Ryan, Timothy R. Brown and T. Allan Comp. "Cleaning up Abandoned Hardrock Mines in the West: Prospecting for a Better Future." The Center of the American West: 7. 2005.Viewed online at: http://www.centerwest.org/publications/pdf/mines.pdf. [15 February 2008].

[34] Jeff Delong, "Tahoe Restoration Act Clears Congress." *Reno Gazette-Journal*. October 28, 2000.Viewed online at http://www.rgj.com/news2/stories/news/972783798.php.

[35] Robert Roberts, Western Field Representative with Trout Unlimited, phone interview, August 1, 2007.

[36]Environmental Protection Agency, "Mine Waste Technology". Viewed online at: http://www.epa.gov/hardrockmining/annual/annual2004/introduction.htm. (Accessed July5, 2007).

[37]Limerick et al. 2005, 2.

[38] "EPA takes major step forward on cleaning up abandoned mines." http://yosemite.epa.gov/opa/admpress.nsf/e87e8bc7fd0c11f1852572a000650c05/fce61d72c91cc8d1852572f2006a7448!OpenDocument. (Accessed June 6, 2006.

[39]U.S. Geological Survey, Mineral Resources Data System: U.S. Geological Survey, Reston, Virginia. 2005.

[40]National Data on Mining http://data.bls.gov/PDQ/servlet/SurveyOutputServlet.

[41] "Environmental Protection Agency's National Hardrock Mining Framework," Appendix A. p A-18. September, 2007. http://www.epa.gov/superfund/programs/aml/policy/index.htm.

[42]Robert McClure and Andrew Schneider. "The General Mining Act of 1872 has left a legacy of riches and ruin." *The Seattle Post Intelligencer,* 11 June 2001. http://seattlepi.nwsource.com/specials/mining/26875_mine11.shtml

[43]McClure and Schneider, "The General Mining Act of 1872 has left a legacy of riches and ruin." 2001.

[44]U.S. Geological Survey Mineral Resources Data System: U.S. Geological Survey, Reston, Virginia. 2005.

[55]McClure and Schneider, "The General Mining Act of 1872 has left a legacy of riches and ruin." 2001.

[46]Environmental Protection Agency Executive Summary: "Implementation, Information, and Statutory Obstacles Impede Achievement of Environmental Results" National Hardrock Mining Framework. Report No. 2003-P-00010. August 7, 2003: i.

[47]They do not cover coal mine remediation because even though coal mining can result in significant environmental impacts, the Department of the Interior's Office of Surface Mining is the authority responsible for coal contamination. EPA Abandoned Mine Land Basic Information http://www.epa.gov/superfund/programs/aml/basicinf.htm.

[48]"2004 Mine Waste Technology Program Annual Report" Prepared by MSE Technology Applications, Inc. for the Environmental Protection Agency Office of Research and Development
http://www.epa.gov/hardrockmining/annual/annual2004/introduction.htm.

[49]Limerick et al., 2005, 2. This does not, however, account for the billions of dollars made and economic gains in the Rockies region from past mining opportunities.

[50]See, for example, U.S. Geological Survey, 2005, Mineral Resources Data System: U.S. Geological Survey, Reston, Virginia; Berger, Dan. 2006. *Working for Change: Abandoned Mine Reclamation Work is Waiting for Legislation to Catch Up With History.* New West: 2. Viewed online at: http://www.tu.org/site/c.kkLRJ7MSKtH/b.3205851/apps/s/content.asp?ct=4255193; Schnitzer, Russ and Robert Roberts. 2004. *Settled, Mined, & Left Behind.* Trout Unlimited's Public Land Initiative: 8. Viewed online at: www.centerwest.org/projects/mines/pdf/trout1.pdf

[51]Earthworks, "Hard-rock mining, Acid Mine Drainage" http://www.earthworksaction.org/pubs/FS_AMD.pdf.

[52]2002 United States Economic Census. http://www.census.gov/econ/census02/data/co/CO000_21.HTM.

[53] Robert McClure and Andrew Schneider, "More Than a Century of Mining has left the West Deeply Scarred," *Seattle Post-Intelligencer*, June 12, 2001.

[54]Russ Schnitzer and Robert Roberts. "*Settled, Mined, & Left Behind.*" Report from Trout Unlimited's Public Land Initiative. 2004: 8. Viewed online at: www.centerwest.org/projects/mines/pdf/trout1.pdf +

[55]"Abandoned Mine Site Characterization and Cleanup Handbook." U.S. EPA Headquarters and Regions 8, 9, and 10. EPA 910-B-00-001, 409 pp, 2000 http://www.epa.gov/superfund/resources/remedy/pdf/amscch.pdf.

[56]McClure and Schneider. "The General Mining Act of 1872 has left a legacy of riches and ruin," 2001

[57]McMahon: 2007, 32.

[58]Limerick et al.: 2005, 33.

[59]McClure and Schneider. "More Than a Century of Mining has left the West Deeply Scarred," 2001

[60]McClure and Schneider. "More Than a Century of Mining has left the West Deeply Scarred," 2001.

[61]Net Generation by State, http://www.eia.doe.gov/cneaf/electricity/epa/generation_state.xls. (Accessed August 5, 2007).

[62]National Atlas of the United States. http://www.nationalatlas.gov/mld/dams00x.html. An acre-foot is the amount of water that would cover an acre of land to a depth of one foot. It is equivalent to 325,850 gallons or 1.2 million liters.

[63]William Graf, Foundation University Professor, Chair and Professor of Geography at University of South Carolina, email correspondence, July 8, 2007.

[64]William L. Graf. "Dam Nation: A Geographic Census of American Dams and their Large-Scale Hydrologic Impacts." *Water Resources Research* 35, 4 (1999): 1309.

[65]Graf.: 1999, 1308.

[66]National Atlas, National Inventory of Dams. http://www.nationalatlas.gov/mld/dams00x.html.

[67]National Atlas of the United States. USGS.

[68]*Atlas of the New West*. Center of the American West. Boulder, CO. (1997): 86.

[69] David Sharp. "Dam Nation," *Via Magazine.*(2004): 3.

[70] Ernest Atencio. "The Mine that turned the Red River Blue." *High Country News*: August 28, 2000.

[71]"The Active Outdoor Recreation Economy" from the Outdoor Industry Foundation, Fall 2006. http://www.americanwhitewater.org/resources/repository/Final_OIA_EC.pdf.

[72] "The Active Outdoor Recreation Economy" from the Outdoor Industry Foundation, Fall 2006. http://www.americanwhitewater.org/resources/repository/Final_OIA_EC.pdf.

[73]Mike Clark of Trout Unlimited and Kevin Colburn. "Recreation and Economics" powerpoint presentation presented at the 2005 River Rally on behalf of American Whitewater. http://www.americanwhitewater.org/content/Wiki/stewardship:recreation_economics.

[74]"Executive Summary: Commercial River Use in Colorado: 2006 Year End Report." http://www.croa.org/pdf/2006_Commercial_Rafting_Use_Report.pdf [15 February 2008].

[75]Shane Sigle, design member at Recreation Engineering and Planning, Phone Interview, June 20, 2007.

[76] Storm Cunningham. *The Restoration Economy: The Greatest New Growth Frontier*. (San Francisco, CA: Berrett-Koehler Publishers: 2002): 83.

[77]Glen Canyon Institute website. http://www.glencanyon.org/library/riverrestoration.php.

[78] David G. Havlick *No Place Distant: Roads and Motorized Recreation on America's Public Lands*. (Washington, D.C., Island Press. 2002.). Only about 380,000 miles of these roads are actually managed by the U.S. Forest Service – the rest are under private, city, state, or other federal control.

[79]Havlick, 2002.

[80]Gucinski et al.: 2000, 7.

[81]Daniel M. Ihara, Steven C. Hackett and John J. Manning. "Reinvestment in Jobs, Communities and Forests: The Benefits and Costs of a National Program for Road Removal on U.S. Forest Service Lands, A Preliminary Analysis." Prepared by The Center for Environmental Economic Development (Arcata, CA) for Wildlands CPR. 2003. Viewed online at: http://www.wildlandscpr.org/files/uploads/PDFs/NFS-RoadRmoval.pdf: 18. (Accessed 15 February 2008).

[82]Wildlands CPR. n/d. "Investing in Communities, Investing in the Land: Summary Report." http://www.wildlandscpr.org/files/uploads/PDFs/neweconomicsreport.pdf: 6. (Accessed 15 February 2008).

[83]Bethanie Walder, personal interview, 30 December 2007.

[84]T.A.Switalski, J.A. Bissonette, T.H. DeLuca, C.H. Luce, and M.A. Madej. "Benefits and impacts of road removal." *Frontiers in Ecological Environment* 2 (2004): 21.

[85]Gucinski et al.: 2000, 7.

[86]Rebecca Lloyd, hydrologist with the Nez Perce Tribe, Phone Interview, 27 June 2007.

[87]Al Bloom. "An Assessment of road removal and erosion control treatment effectiveness: a comparison of 1997 storm erosion response between treated and untreated roads in Redwood Creek Basin, northwestern California." Arcata, CA.: Humboldt State University. 1998.

[88]USDA Forest Service. Forest Roads: 25.

[89]Brett Prettyman. "Tight Lines: Value of keeping lands roadless? Just ask Idaho's thriving species." Trout Unlimited. 24 April 2007. http://www.tu.org/site/apps/s/content.asp?c=7dJEKTNuFmG&b=1406395&ct=3823551.

[90]Ihara et al.: 2003, 19.

[91]Bethanie Walder, personal communication, 30 December 2007.

[92] Josh Hurd. "Road Removal and the New Economy." *The Green Magazine*. Winter 2006. Viewed online at: http://www.dartmouth.edu/~tgm/2006/03/06/road-removal-and-the-new-economy/ [15 February 2008].

Stormy Gulch, San Juan Range, Colorado © Ryan Schumacher

By Bethanie Walder

Boom and bust economic cycles are a well known feature in the Rocky Mountain West, triggered by intense periods of logging, mining, and other forms of resource extraction from public and private lands. Investing in and developing a robust, dynamic restoration sector of the economy ("restoration economy" for short) provides an opportunity to move beyond boom and bust cycles and to help stabilize rural, resource-dependent economies. A comprehensive restoration economy includes both the restoration of watersheds and the uplands that feed them, as well as the revitalization of the built environment in local communities. Investment in restoration is not intended to replace existing economic opportunities, but will add to these in the West.

The restoration economy includes many different components, beginning with an assessment of the current health of the natural and built environment. Once that is determined, practitioners can identify opportunities and techniques for restoring those environments to a more healthful and resilient condition. Restoration requires skilled workers who can be trained through university, union, or other programs. Universities across the region can also help monitor restoration efforts and develop new restoration technologies. In addition, a complex restoration economy will be adaptive, changing in response to monitoring results and ensuring that restored areas are maintained over the long-term.

A restoration economy includes components such as road removal, dam removal, forest thinning, mine reclamation, brownfields cleanup/redevelopment, and more. Many of the jobs created through a diverse, comprehensive restoration economy will be high-wage, high-skill jobs. Some of the restoration jobs, like those requiring heavy equipment and earth-moving machines, will be suitable only to local contractors, making a component of these jobs truly local in nature. This is another key element to reduce boom and bust economic cycles.

Road removal provides one excellent example of the potential for restoration to be a true component of economic growth in the Rockies and beyond. In 2000, the U.S. Forest Service published a long-term transportation policy that called for removing up to 186,000 miles of roads from their overall system (380,000 miles) over a 20-40 year time period. Wildlands CPR, a nonprofit organization that promotes road removal, commissioned an economic report to assess the potential benefits of such a road removal program. This report found that more than 3000 jobs could be created, per year throughout the economy, if the agency invested approximately $90 million/year in road removal. But the work would not stop in 20 years—once the agency gets their road system down to a manageable number, they should be able to better maintain their remaining roads, providing a number of permanent jobs in rural communities.


Montana Conservation Corps revegetating removed road © Adam Switalski, courtesy of Wildlands CPR

Removing those roads would have other economic benefits besides just providing immediate jobs to high-wage, high-skill workers. Road reclamation is one of the key steps for restoring clean drinking water for approximately 60 million Americans who depend

Ripped Road on the Centennial Demonstration Forest of Northern Arizona University © Adam Switalski, courtesy of Wildlands CPR

on national forest watersheds for their water in nearly 3,400 communities. The City of Seattle, for example, has chosen to invest in road removal in their watershed to ensure that they do not have to build a multi-million dollar water filtration plant and then maintain and run that plant in perpetuity. Their $6 million investment in restoration work over the next 20 years will save many more millions of taxpayer dollars over the long run.

With the prospect of increasingly frequent and severe storms in coming years, communities along the Pacific Coast and into the interior West face an urgent need to deal with their undermaintained, aging, and failing forest road systems. The longer these roads remain on the land, the more damage they will cause in future storms – damage that can cost hundreds of millions of dollars. But we cannot build a restoration economy unless public agencies and private industry invest in such work and create the infrastructure to support such work. While road reclamation funding has been scarce for years, there is growing interest in this effort. In December 2007, Congress appropriated $39.4 million to decommission roads and address critical maintenance needs to protect clean water and fisheries, mostly in storm-damaged national forests.

When lands and watersheds are restored, their economic value is also increased for the commensurate amenities-based economy. Growing numbers of people are moving to western landscapes to take advantage of recreational opportunities like fishing, hiking, hunting and bird-watching. The restoration economy is just one piece of a much broader and greener national economic vision for the United States. It deserves our attention and our investment.

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