The Trustees considered a broad set of potential restoration alternatives for this RP/EA, including a "no action" or "natural recovery" alternative. The proposed alternative identified by the Trustees is a suite of restoration projects that cumulatively aim to compensate for injuries to surface water, groundwater, aquatic resources, and terrestrial resources at the Site. The projects were identified by the Trustee agencies, based on their knowledge of restoration opportunities in the area, and also through outreach to a broad range of local, state, and federal agencies; organizations; and stakeholder groups (see Chapter 7 for contacts). This chapter describes the criteria for identifying and selecting alternatives (Section 3.1), describes the no-action alternative (Section 3.2), presents detailed descriptions of each of the projects included in the proposed alternative (Section 3.3), and describes restoration alternatives that were considered but eliminated from detailed analysis (Section 3.4). Descriptions of the restoration projects included in the proposed alternative include an overview of the environmental and socioeconomic consequences associated with individual projects. A broader discussion of impacts, including cumulative impacts from implementing the full suite of restoration projects, can be found in Chapter 5.

The Trustees have grouped preferred projects into three tiers. Projects in the first tier will have top priority for funding and the Trustees expect to fund these projects in 2010 with the settlement funding available to the Trustees. Projects in the second tier will be funded by the Trustees with funding that remains after the first tier projects have been funded. The Trustees may choose to wait to fund second tier projects until they have greater certainty regarding costs for the first tier projects.

The Trustees have determined that projects in the third tier meet Trustee criteria. At the present moment, sufficient information is unavailable about projects in the third tier to complete the required NEPA analysis or to make a final determination of Trustee preference. Therefore, these projects may be reconsidered by the Trustees at a later date, with appropriate NEPA analysis occurring at that time. The Trustees may choose to conduct a second round of project solicitation in the future to identify any new restoration project ideas. The Trustees would then issue a supplemental RP/EA at the time when they decide to fund third tier projects or newly identified projects.

3.1 Criteria for Identifying and Selecting the Proposed Restoration Projects

The Trustees prefer a mix of natural resource restoration projects to provide a broad array of natural resource services throughout the upper Arkansas River Basin. Thus, a variety of goals are supported, rather than a single objective. The categories of restoration projects that the Trustees prefer include improvement of aquatic habitat, terrestrial habitat protection and enhancement (including uplands, wetlands, and riparian), water quality protection or improvement, and increased access to natural resources (where appropriate). The Trustees also support monitoring projects that provide key data needed to attain restoration goals.

The Trustees prefer projects that are located in the environments of the mainstem Arkansas River or its tributaries. The Trustees also prefer projects with a closer proximity to injured locations (e.g., all things being equal, a project in Lake County would generally be preferred to an equivalent

project in Chaffee County). The Trustees expect to balance geographic preferences with the project evaluation criteria listed in Table 3.1. These criteria also were used in the Tiger and Dinero tunnels RP/EA previously published by the Trustees (Stratus Consulting, 2009). The Trustees evaluated each proposed project against the threshold acceptance criteria to determine if the project met minimum standards for acceptability. Projects that did not meet these standards were designated as "non-preferred." Projects that met the threshold acceptance criteria then were evaluated against the project evaluation criteria, using a qualitative assessment of project strengths and weaknesses. This qualitative assessment of project strength and weakness versus the criteria is described in the project descriptions provided below and was the basis for grouping projects into three tiers. Projects that best met the criteria were placed into the first tier for funding.

Table 3.1. Summary of Trustee criteria for evaluating restoration projects

Threshold acceptance criteria	1. Project must restore, replace, or acquire natural resources, not merely human services. 2. Restoration projects must be subject to a reasonable degree of Trustee management, control, and monitoring. 3. Project must have a reasonable likelihood of success. The project should be technically feasible and viable. 4. Project must comply with laws and be protective of health and safety. 5. Project must be generally acceptable to the public.
Project evaluation criteria	1. Projects that are consistent with existing state, regional, and local resource management and development plans will be strongly preferred. 2. Projects that provide higher flows of services throughout the project lifetime will be preferred. It is preferable and more cost-effective for projects to provide higher levels of near-term benefits as compared to projects that require protracted periods to realize benefits. Projects that provide long-term sustainable service flows are also preferred. 3. Projects with less long-term operation and maintenance (O&M) will be preferred. Projects with significant long-term O&M will only be considered if the costs are assumed by other parties and the Trustees are assured that O&M will be adequately carried out for as long as necessary. 4. Projects that are likely to benefit more than one resource and more services will be preferred. 5. Projects that can be reasonably monitored and have benefits that can be measured and verified will be preferred. 6. Projects that provide actual resource improvements will be preferred over projects that entail only conservation of open space, unless development threats are imminent or the conservation opportunity is of an advantageous scale or timing. 7. Projects that provide a high ratio of expected benefits compared to expected long-term costs for planning, implementation, and O&M will be preferred. Cost-effectiveness may be assessed relative to other projects that benefit the same resources; more cost-effective projects will be preferred. 8. Projects will be preferred if they are not likely to be funded through other mechanisms, or if implementation of the project would free restoration funding sources to finance other restoration projects. 9. Projects will be preferred if they leverage damage recoveries to match other funding sources and thereby enable projects to be larger or more comprehensive in scope.

3.2 No-Action/Natural Recovery Alternative

A no-action alternative is required to be considered under NEPA [40 CFR § 1502.14(d)]. The selection of this alternative by the Trustees would mean that no actions would be taken by the Trustees to restore injured natural resources, that existing natural resource losses would continue to occur, and that the public would not receive compensation for losses that occurred in the past or are ongoing. Natural recovery of contaminated surface water and groundwater in California Gulch and of terrestrial resources injured from mine wastes at the Site is not expected to occur within the foreseeable future (i.e., the next 100 years). Recovery of injured surface water and aquatic resources in the Arkansas River has already started as remedial actions help to reduce the concentration of heavy metals. These resources are expected to recover fully within the next two decades in areas where remedial actions have taken place; however, the no-action alternative would not result in any compensation for past and current injuries. Additionally, habitat in areas still impacted by mine waste will not recover without treatment. This alternative may be used as a benchmark to evaluate the comparative benefit of other actions. Because no action is taken, this alternative also has no cost. This alternative also provides no economic benefits to the population in Leadville and surrounding areas (Archuleta et al., 2003).

3.3 Proposed Alternative

The proposed alternative[5] is the alternative that the Trustees believe would best compensate the public for injuries to natural resources resulting from releases of hazardous substances at the Site. This alternative consists of a suite of projects that benefit each of the major categories of injured natural resources (Table 3.2). Tier one projects are described first, followed by tier two and tier three projects. As described above, tier one projects are the projects that best meet the restoration criteria and will be funded immediately in 2010. Tier two projects meet the restoration criteria and will be funded by the Trustees with funding that remains after the first tier projects have been funded. Tier three projects appear to meet Trustee criteria but more information is necessary before the Trustees can make a final determination of preference.

Table 3.2 provides information on the type of project, its location, the proposed sponsoring entity, the total project cost, and the proposed allocation from the NRDA settlement. As part of the proposed alternative, the Trustees will engage in appropriate public outreach activities, including public information meetings, publishing public informational documents online and in hard copy, and developing press releases and articles that will be provided to local media outlets. The Trustees may also develop educational signage at the sites of restoration activities to educate the public about the restoration actions and the role of the NRDA settlement in providing funding. Figure 3.1 provides a map that identifies geographic features mentioned in the restoration project descriptions (e.g., Hayden Ranch, Canterbury Tunnel) to help the reader understand where projects might occur. The Trustees are not restricting restoration project implementation to the area on the map.

[5] *Under NEPA, the proposed alternative is equivalent to the proposed action.*

For each project, a "logic model" is provided that briefly describes the key restoration action of a project, the expected short-term result from the proposed restoration action, and the pathway or process that will lead to the desired long-term results. In addition, each project description provides a brief overview of expected maintenance and monitoring requirements for the project so that the Trustees can determine if the desired benefits are being achieved and take remedial actions if necessary. The Trustees intend to develop a separate maintenance and monitoring document that will provide further detail on monitoring plans for all of the projects in the proposed alternative.

Table 3.2. Proposed restoration projects for the proposed alternative divided by funding tier

Project title	Type of project	Location(s)	Sponsoring entity	Total cost estimate	Proposed natural resource damage allocation
TIER 1					
Arkansas River in-stream habitat restoration	Improve aquatic resources	11-mile reach	Colorado DOW, NRCS, LCCD	$5,400,000	$4,600,000
Weed control in Lake and Chaffee counties	Habitat enhancement (riparian and uplands)	Lake and Chaffee counties	Lake/Chaffee Weed Board	$230,000	$230,000
Dinero Tunnel water quality monitoring	Water quality improvement	Dinero Tunnel and surrounding areas	USGS/CMC	$634,000	$165,000
Erosion control on roads	Habitat enhancement (uplands)	Paddock State Wildlife Area, Lake Fork watershed	USFS–Leadville Ranger District, BLM	$200,000	$200,000
Habitat protection (easements, acquisition, or land exchange)	Habitat protection	Upper Arkansas River watershed	AHRA/Colorado DOW/BLM/LCOSI	To be determined by market study	$650,000
			Total cost for Tier 1 projects:	**$6,464,000**	**$5,845,000**
TIER 2					
Habitat protection (easements, acquisition, or land exchange)	Habitat protection	Upper Arkansas River	AHRA/Colorado DOW/BLM/LCOSI	To be determined by market study	$1,150,000
Native plant propagation at Hayden Ranch	Habitat enhancement	Hayden Ranch on the Arkansas River	CMC/LCOSI	$100,000	$200,000
Development of an Engineering Evaluation and Cost Analysis (EE/CA) for the Venture Mine and Sugarloaf Mine dumps	Water quality improvement	Sugarloaf district	CMC/BLM	$400,000	$200,000
Hayden Ranch revegetation	Habitat enhancement (riparian)	Hayden Ranch	BLM	$25,000	$20,000
Canterbury Tunnel rehabilitation	Groundwater beneficial use	Canterbury Tunnel	Parkville Water District	$2,000,000	$200,000 (10% of total project cost)
Habitat management for land protected by Trustees	Habitat enhancement (riparian and uplands)	Lake and/or Chaffee County	Colorado State Forest Service	$100,000	$100,000
			Total cost for Tier 2 projects:	**$2,625,000**	**$1,870,000**
TIER 3					
Colorado Gulch wetland and upland restoration	Improve aquatic habitat/fishery	Colorado Gulch wetlands site	Lake Fork Watershed Group	$252,000	$125,000
Remediation of acid mine drainage in tributaries to the Arkansas River	Water quality improvement	Chalk Creek and St. Kevin's Gulch	USFS	$1,450,000	$400,000
Erosion Control on the Arkansas Headwaters Recreation Area	Habitat enhancement	Arkansas River Headwaters Recreation Area	Colorado State Parks	To be determined by watershed plan	$100,000
			Total cost for Tier 3 projects:	**$1,702,000**	**$625,000**
			Total cost of preferred action alternatives:	**$10,791,000**	**$8,340,000**
Considered but eliminated from further analysis					
Iowa Gulch wetland enhancement	Habitat enhancement	Sherman Mine (downstream)	BLM	$200,000	---
Lake Fork watershed-wide monitoring	Monitoring	Lake Fork	CMC/USGS/ BLM	$252,000	---
California Gulch remedial projects	Water quality improvement	California Gulch	Lake County Commissioners	$4,100,000	---

CMC = Colorado Mountain College, AHRA = Arkansas Headwaters Recreation Area

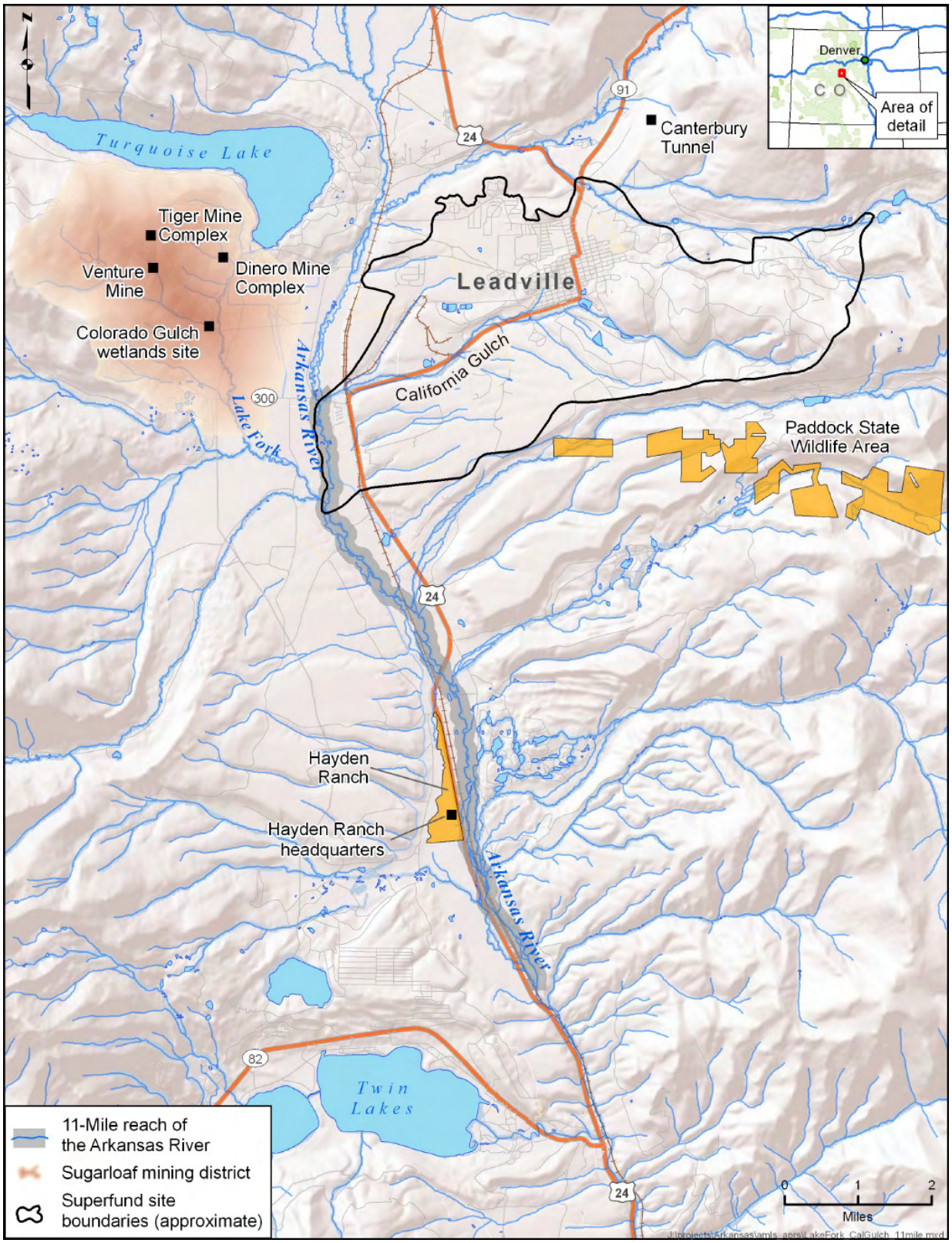

Figure 3.1. Overview map of the upper Arkansas River watershed which identifies geographic features mentioned in the restoration project descriptions.

3.3.1 ARKANSAS RIVER IN-STREAM HABITAT RESTORATION

TIER 1

Restoration objective

Improve in-stream aquatic habitat and increase brown trout populations by providing feeding areas, overhead cover, spawning areas, and overwintering refuge habitat along the 11-mile reach of the Arkansas River below the confluence with California Gulch and potentially in tributaries to this reach that provide important spawning or overwintering habitat. In targeted areas, improve riparian habitat and reduce bank erosion. See Figure 3.2 for the project logic model.

Project description

Trout habitat in the 11-mile reach of the Arkansas River is degraded, in part because of historic land-use practices that have altered the morphology of the river channel – resulting in a channel that is too wide and shallow and lacks important habitat features for trout such as deep-water pools. In-stream habitat restoration projects will address three major issues including (1) bank erosion, (2) altered river channel morphology, and (3) degraded in-stream trout habitat. This work will take place on both public and private land in the 11-mile reach and potentially in appropriate tributaries such as the Lake Fork.

A detailed description of the proposed habitat treatments for the Arkansas River is provided in Appendix A. These treatments are based on an initial restoration plan developed by the Colorado DOW after a field inventory and survey of river conditions that included qualitative assessments of bank stability and riparian vegetation, counts of the ratio of riffle habitat to pool habitat, calculation of the width to depth ratio of the river, aerial imagery, investigation of stream flow data from gauges, and determination of access logistics. These treatments will be further evaluated and adjusted during the development of final engineering plans for each reach of the river. General descriptions of the proposed habitat treatments are discussed below; further detail is provided in Appendix A.

FIGURE 3.2. ARKANSAS RIVER IN-STREAM HABITAT RESTORATION– LOGIC MODEL

Restoration action	Stabilize stream banks and create diverse stream morphology.
Expected short-term result	Reduction in erosion and downstream sedimentation; decrease in water temperatures during low-flow summer months; creation of diverse in-stream habitat including deep-water pools, riffles, and bars.
Pathway/process	Increase spawning and winter refuge habitat for brown trout and other fish.
Desired long-term results	Increase fish populations, especially brown trout in the 11-mile reach of the Arkansas River below the confluence of California Gulch.

Specific treatments proposed to restore natural river processes through modification of river channel morphology include (1) reducing channel width, (2) excavating pools, (3) elevating the river-bottom substrate that creates riffles, (4) excavating streambeds under overhanging woody

3.3.1 ARKANSAS RIVER IN-STREAM HABITAT RESTORATION *(continued)* TIER 1

vegetation, (5) construction of riparian benches to extend the width of the riparian zone, and (6) planting and reseeding riparian vegetation along stream banks. Treatments proposed to stabilize stream banks and prevent erosion include (1) adding woody debris such as logs or root wads to stream banks to divert and slow water flow at the water-bank interface, and (2) installing single boulders or groups of boulders along stream banks and into the stream channel to deflect water away from the stream bank and to aid in forming downstream pools. Treatments proposed to improve in-stream trout habitat include the placement of boulders and root wads in the channel to provide cover, slow-water refuge areas, and spawning habitat.

Riparian habitat improvements will be made as needed throughout the 11-mile reach and may include installation of livestock exclusion fencing, planting or seeding riparian vegetation, and development of grazing management plans. In some cases, upland treatments may be included to improve upland grazing conditions and protect the restored riparian habitat.

Implementation of this project will be closely coordinated by a group of agencies and stakeholders. The Colorado DOW will design and implement restoration actions on public land and on land where a conservation easement is held by a public agency. For work on private land, the Lake County Conservation District and the NRCS will work in partnership with willing private landowners to plan and facilitate the implementation of restoration work that is consistent with the work being carried out by the Colorado DOW. The NRCS will develop grazing management plans and upland grazing plans where they are needed. Overall, the Trustees are committed to ensuring close coordination by all parties to ensure that restoration work in one segment of the river will complement work done in adjacent segments.

Project location

Public and private land along the reach of the Arkansas River known as the "11-mile reach" (Industrial Economics, 2006), which extends from the confluence of California Gulch with the Arkansas River downstream to the confluence of the Arkansas River and Twobit Gulch in Lake County, Colorado (Appendix A). Additional locations may include land along tributaries such as the Lake Fork that provide important habitat.

Expected benefits and timeframe of benefits

In-stream habitat restoration treatments in the Arkansas River are expected to perform the following functions: (1) improve natural river processes and enhance the connection between the river and the floodplain and riparian zone, (2) stabilize banks in a manner that also creates winter habitat and cover for trout, and (3) enhance mid-stream habitats for trout and their prey base (forage fish or invertebrates). These in-stream habitat improvements are expected to provide an immediate benefit to resident and transient trout populations by improving feeding habitat, overhead cover, flow refugia, spawning habitat, and overwinter refuge areas. The habitat improvements also are expected to provide benefits to birds and mammals that feed on fish and aquatic invertebrates. Long-term

3.3.1 ARKANSAS RIVER IN-STREAM HABITAT RESTORATION *(continued)* TIER 1

benefits such as increased trout biomass, increased trout density, and improved trout body condition may not be realized until four to six years after project completion, given that brown trout in the Rocky Mountain region reach sexual maturity at two to three years of age (Adams et al., 2008). Similar habitat restoration projects in other locations observed a peak in trout populations more than six years (two to three generations) after project completion (Hunt, 1976; Binns, 1994). The Trustees expect to quantify improvements to the fishery based on changes over time in trout density and biomass, the availability and quality of spawning grounds, improvements to the forage base, and the number of large adult fish. The Trustees expect to quantify overall benefits to birds dependent on aquatic resources (integrating habitat improvements from the in-stream restoration work and reductions in metals exposure from the remediation work) by comparing the current health of tree swallows to those studied in 1997 and 1998, prior to the remediation and restoration activities.

Brief overview of maintenance and monitoring

Monitoring of the restoration project will take place in the following phases: baseline monitoring before project initiation, implementation monitoring, short-term monitoring, and long-term monitoring. Full details about the monitoring actions and budget will be described in the Monitoring Plan that will be released by the Trustees. This section provides a description of maintenance actions and a brief overview of each monitoring phase.

Maintenance of the project will be coordinated by pre-designated, participating agencies who will be responsible for identifying and documenting any treatment failures during the first 10 years of the project. A project maintenance fund and contingency fund will allow reconstruction and revegetation, if necessary, to ensure that the project continues to provide habitat benefits. For example, plantings that fail within the first two years will be replaced with new vegetation. Because the river is constantly moving and changing, the Trustees do not expect habitat conditions to remain frozen in time. Therefore, natural changes in river morphology that affect some of the treatments will not necessarily trigger corrective action. The need for corrective action will be determined by a review committee, including Colorado DOW personnel and Trustee representatives who will examine changes and determine if corrective actions are necessary to maintain habitat benefits.

Baseline monitoring is important because an understanding of the current ecological condition of the 11-mile reach is essential for evaluating the success of any proposed in-stream treatments. The Colorado DOW has already been undertaking the baseline quantification of the benthic invertebrate and fish communities along the 11-mile reach in anticipation of project approval.

Implementation monitoring will take place as the construction and revegetation work take place and will be focused on ensuring that project implementation is consistent with engineering and revegetation plans. Short-term monitoring (e.g., years 1–2) will focus on evaluating the initial engineering success associated with bank stabilization and in-stream structures as well as evaluating the initial biological response to the treatments. Long-term monitoring will focus on quantifying

3.3.1 ARKANSAS RIVER IN-STREAM HABITAT RESTORATION *(continued)* TIER 1

biological responses to the treatments (such as changes in fish populations). During short-term and long-term monitoring, water quality will be monitored to determine if water quality problems could be limiting the ecological response to the physical habitat improvements.

Additional long-term monitoring will examine tree swallow populations along the upper Arkansas River. Tree swallows have been chosen for monitoring for several reasons. First, they feed on aquatic invertebrates and should show a positive population response to improved in-stream habitat that benefits invertebrates. Second, tree swallows along the upper Arkansas River were assessed for lead exposure and injury as part of the initial NRDA activities in 1997 and 1998 (Custer et al., 2003). A repeated assessment 10–15 years later, after the extensive remediation and restoration have occurred, would provide regulatory and management agencies an assessment of the overall efficacy of those efforts for the upper Arkansas River.

Probability of success

Aquatic habitat restoration utilizing the physical improvements described in Appendix A has been practiced since the 1950s with documented improvements in trout population densities as high as 116% (Binns, 1999). These methods are widely known and accepted in the fisheries community (e.g., Hunt, 1976; Wesche, 1985; Binns, 1994, 1999; Orth and White, 1999; Roni et al., 2002; and Avery, 2004). Thus, the Trustees believe that there is a high likelihood that this project will successfully improve brown trout habitat and increase brown trout populations in the upper Arkansas River. Given the current condition of the habitat along the 11-mile reach and the expected future improvements, the Trustees have previously contended that they expect to observe up to a 40% improvement in fish population metrics compared to current conditions (Lipton, 2007).

Risks to project success result from several issues. There is an ongoing possibility that the concentration of heavy metals, such as zinc and cadmium, in the upper Arkansas River could exceed toxicity thresholds for brown trout fry or trigger avoidance behavior by adult trout under certain weather conditions and during certain times of the year. Ongoing monitoring of water quality will help the Trustees determine if this is posing a problem to the project. Another risk results from the need for treatments to be integrated across both public and private lands. A successful outcome for this project depends on successful integration and coordination across the project area.

Estimated costs

The estimated costs for all in-stream restoration in the 11-mile reach (including public and private land work) is $5.4 million. These costs include funding for all in-stream treatments, contingency costs, maintenance, and monitoring. The Colorado DOW expects to contribute $0.8 million to this project. NRCS also will make substantial in-kind contributions to the project for engineering review and oversight of restoration work on private land; the dollar value of these contributions has not been added to the total cost of the project. The LCCD will work with NRCS, CDOW, the Trustees, and private landowners to coordinate funding for the work done on private land.

3.3.1 ARKANSAS RIVER IN-STREAM HABITAT RESTORATION *(continued)* TIER 1

Environmental and socioeconomic consequences

Improving in-stream habitat in the 11-mile reach will improve the ecological functioning of the upper Arkansas River that is essential for brown trout populations and for other fish and wildlife species. The project also will have a positive socioeconomic impact on the community.

Specific biological impacts resulting from this project would include improved water quality (through decreased erosion), improved habitat for fish and wildlife species, and increased aquatic productivity. Improving water quality and habitat in the 11-mile reach provides a direct benefit to resources that were injured by releases of hazardous substances at the Site. Remedial actions taken by EPA to reduce metals loading to the upper Arkansas River and to remediate contaminated meadows and fluvial deposits along the 11-mile reach have created the necessary preconditions for success for this in-stream restoration project. There will be some short-term impacts to aquatic habitat due to construction activities, which will likely result in increased sediment suspension and turbidity. Previous projects completed by the Colorado DOW have shown that these impacts, as measured by trout populations, are short-lived (Nicole Vieira, Colorado Division of Wildlife, personal communication, October 13, 2009). The long-term benefits to the aquatic community outweigh any short-term adverse impacts associated with construction. In addition, impacts will be mitigated by halting construction before spawning season for brown trout (beginning in mid-October each year).

Public use and enjoyment of these resources will be improved by this project through improved fishing conditions, based on an expected increase in the size, condition, and population density of brown trout, as well as public enjoyment of enhanced wildlife populations that depend on aquatic resources. The construction activities also may have a positive short-term impact on the local economy through the need to fill construction jobs or obtain materials from local suppliers. During the construction period, there will be short-term negative impacts to fishing access and public enjoyment of the river. This impact will be minimized through the phased implementation schedule, so the entire 11-mile reach will not be disrupted simultaneously. There also may be short-term air pollution impacts associated with the use of heavy equipment with diesel motors. The construction zone is not located adjacent to populated areas, so this impact is considered to be minimal. The long-term benefits for public use and enjoyment of an enhanced resource and improved fishery outweigh any short-term adverse impacts associated with the construction.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 1 project. The project has a strong nexus to the NRDA injury because it will benefit aquatic resources in the 11-mile reach of the Arkansas River, where documented injury to surface water, brown trout, and tree swallows occurred. The in-stream restoration project served as one of the example restoration projects used by the Trustees to quantify natural resource damages in the Arkansas River, as described in the Preliminary Evaluation of Damages (Industrial Economics, 2006). The need for in-stream habitat improvement has been identified in a variety of regional and local resource management and development plans, including

3.3.1 ARKANSAS RIVER IN-STREAM HABITAT RESTORATION *(continued)* TIER 1

the "Restoration Alternatives Report" developed for the upper Arkansas River NRDA case (Archuleta et al., 2003). This project is expected to provide a high flow of ecological services through the project lifetime, because the restoration work will improve aquatic habitat and the natural functioning of the river. The project benefits more than one resource and has benefits that can be measured and verified. The project also provides actual resource improvements with a high ratio of expected benefits to expected long-term costs. The project has a high likelihood of success because the Colorado DOW has demonstrated expertise and a track record of success for implementing in-stream restoration projects. The project has leveraged in-kind and cash funding from the Colorado DOW, NRCS, and the LCCD, but requires natural resource damage funding for successful implementation. The Trustees propose to allocate $4.6 million in settlement funding for this project.

3.3.2 WEED CONTROL IN LAKE AND CHAFFEE COUNTIES

TIER 1

Restoration objective

Provide support to the Lake/Chaffee Weed Board to create an early detection/rapid response (EDRR) program for control of emerging weed threats and to purchase new equipment to better target their weed control efforts. See Figure 3.3 for the project logic model.

Project description

Invasive plants threaten the habitat value of riparian areas along the upper Arkansas River and its tributaries and in upland areas in Lake and Chaffee counties. New weed threats can emerge quickly as species are transported by vehicles, livestock, and through transport of contaminated hay or manure. Some recent threats that have been observed in Lake and Chaffee counties include elongated mustard (*Brassica elongate*), orange hawkweed (*Hieracium aurantiacum*), diffuse and spotted knapweed (*Centaurea diffusa* and *Centaurea stoebe*), and plumeless thistle (*Carduus acanthoides*). When new weed threats emerge, there can be a delay until the weed is classified officially as a noxious weed and subject to weed enforcement rules.

This project involves support for developing an EDRR program that can respond quickly and effectively to emerging weed threats to prevent the spread of weeds to additional locations. The program would be managed by the Lake/Chaffee Weed Board. The National Invasive Species Council has identified EDRR programs as high priorities for invasive species control efforts. This program would follow established national guidelines for developing an effective EDRR program that includes coordinated and sustained actions for early detection, rapid assessment, and rapid response (National Invasive Species Council, 2003).

Dedicated funding for an EDRR program in Lake and Chaffee counties would allow weed threats to be treated as soon as they are identified. The program would fund mapping and control efforts and would target invasive species that are newly identified in Lake and/or Chaffee counties or are not yet classified as noxious weeds. Control methods could include targeted herbicide spraying, using a boomless sprayer as appropriate, mechanical control, or other methods as appropriate. All regulations regarding pesticide applications would be followed.

FIGURE 3.3. WEED CONTROL IN LAKE AND CHAFFEE COUNTIES

Restoration actions	Implement an EDRR program in Lake and Chaffee counties to prevent the spread of novel weeds and purchase improved equipment for weed control.
Expected short-term result	Identification, mapping, and control of novel invasions.
Pathway/process	Improved control of novel invasive species benefits native vegetation; decreased herbicide use over the long-term reduces risk to water quality.
Desired long-term results	Native vegetation maintained with minimal impacts from novel invasive species. Water quality preserved with minimal herbicide residues.

3.3.2 WEED CONTROL IN LAKE AND CHAFFEE COUNTIES *(continued)* TIER 1

Part of the funding for this project will be used to purchase a new boomless sprayer for the Lake/Chaffee Weed Board. This equipment provides better control of herbicide application with more targeted spraying capabilities that allows more herbicide to remain on leaves and less to reach the ground surface and, ultimately, surface water and groundwater. The sprayer reduces the total volume of herbicide used and includes a GPS (global positioning system) unit allowing automatic mapping of new or established infestations. In addition to likely use in the newly established EDRR program, this equipment will be used to support other restoration and remedial projects in the Arkansas River watershed, enhancing the effectiveness of all Trustee actions.

Project location

The project location includes any location in Lake and Chaffee counties where newly emergent weed threats have been identified and the property owner provides consent for the weed treatment. Where a species has become well-established in a single location and is difficult to eradicate, the EDRR program might use a strategy of containment to prevent further spread.

In addition to newly emerging threats, the boomless sprayer may be used in any location identified by the Lake/Chaffee Weed Board that requires spraying. Likely locations include the irrigated meadows and fluvial deposits remediated by EPA in 2008–2009 and other lands disturbed by remedial work, including borrow areas, staging areas, and roads that were constructed to support remedial work.

Expected benefits and timeframe of benefits

This project would decrease the risk of new invasive species spreading into additional locations as soon as the program becomes operational. The Trustees plan to fund the EDRR program for an initial period of four years with the hope that new sources of funding would take over and continue the program at that time. There would be long-term benefits to habitat quality from the effective control of new invasive species. Benefits realized by purchase of the boomless sprayer will be realized immediately, as weed control improves, and long-term, as long as the equipment remains in-use. Annual reporting would document the number of acres treated and the species targeted with the EDRR funding.

Brief overview of maintenance and monitoring

During the time of the project, weed control requires a commitment to ongoing maintenance and monitoring. The Trustees expect that the program would be structured so that areas where control efforts take place would be mapped and surveys made in subsequent years to detect if regrowth or spread of the species had occurred. Maintenance actions involve repeating weed control efforts where the weed is found to be present again.

3.3.2 WEED CONTROL IN LAKE AND CHAFFEE COUNTIES *(continued)* TIER 1

Probability of success

The likelihood of success is very high if established guidelines for developing an EDRR program is followed (National Invasive Species Council, 2003). The Lake/Chaffee Weed Board has worked successfully to control weeds in their jurisdiction.

Estimated costs

The estimated cost is $230,000 for four years of EDRR funding and purchase of the boomless sprayer.

Environmental and socioeconomic consequences

Implementing effective weed control will improve riparian and upland habitats. Attacking weeds when populations are still small and easily controlled also minimizes herbicide use and decreases risks to water quality.

Specific biological impacts resulting from this project would include increased cover of native vegetation and decreased cover of novel invasive plants. Targeting weeds during the early stage of invasion will decrease herbicide use and prevent risks to habitat value. This project is expected to have a positive socioeconomic impact on the surrounding community because control of invasive species helps to maintain property values through maintaining the forage quality of ranchland.

In areas with more established weeds, the boomless sprayer will minimize herbicide use, map weed-infested areas and thus help streamline future weed control efforts, and reduce the amount of herbicide reaching the soil, surface water, and groundwater.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 1 project. The project has a strong nexus to the NRDA injury because it will benefit riparian habitat along the Arkansas River and upland habitat, through decreasing the risk of spread of novel invasive species. Additionally, improved weed control in remediated areas will benefit all restoration and remedial actions conducted in Operable Unit 11. The elimination of each novel weed threat through an EDRR program provides significant long-term benefits compared to an alternative scenario where the weeds spread and cause widespread environmental or economic damages. The project has a high likelihood of success because the Lake/Chaffee Weed Board has the capacity to develop and implement this type of program. The Trustees propose to allocate $230,000 in settlement funding for this project.

3.3.3 DINERO TUNNEL WATER QUALITY MONITORING

TIER 1

Restoration objective

Conduct necessary hydrologic and biologic monitoring of the Sugarloaf Mountain area in the Lake Fork watershed to assess changes in water quality and flow conditions attributable to the plugging of the Dinero Tunnel. See Figure 3.4 for the project logic model.

Project description

This project involves providing partial support for hydrologic monitoring of the Sugarloaf Mountain area in the Lake Fork watershed through 2020. The goal of the monitoring is to determine if the installation of the bulkhead in August 2009 to plug the Dinero Tunnel has changed water quality and flow conditions in areas that could be hydrologically connected to the tunnel. Water samples will be analyzed for a range of water quality parameters, likely including pH, specific conductance, acid neutralizing capacity, dissolved metals and major ions, chloride, and sulfate. In addition, measurements of deuterium and oxygen isotopes in water from seeps or springs can be used to help detect the source of that water. New monitoring data will be compared to baseline data to assess what major changes, if any, could be attributed to the Dinero Tunnel bulkhead installation. Biological monitoring of fish populations and fish conditions also will be conducted in conjunction with the hydrologic monitoring to determine if water quality improvements are resulting in improvements to fish populations in the Lake Fork watershed.

The need to conduct this monitoring work was already described in the previous restoration planning document developed by the Trustees, entitled "Draft Restoration Plan and Environmental Assessment for the Tiger and Dinero Tunnels Restoration" (Stratus Consulting, 2009). For this project, the Trustees will provide partial support for a sampling program developed by CMC and USGS, in conjunction with the Lake Fork Watershed Working Group. The sampling program (referred to as the "Sugarloaf BMP monitoring") has received partial funding from the 2009 Colorado nonpoint source program and matching support from USGS, BLM, the Colorado Division of Reclamation Mining Safety, the Colorado DOW, the Lake Fork Watershed Working Group, CMC, and Trout Unlimited – Collegiate Peaks Chapter. The contribution from the Trustees will help provide the remaining amount of funding necessary to implement the full hydrologic monitoring

FIGURE 3.4. DINERO TUNNEL WATER QUALITY MONITORING – LOGIC MODEL

Restoration actions	Conduct hydrologic monitoring of the Sugarloaf Mountain area in the Lake Fork watershed.
Expected short-term result	Assess whether installation of the bulkhead in the Dinero Tunnel has altered water quality or flow conditions.
Pathway/process	Monitoring result will lead to management changes if necessary (e.g., releasing water through the bulkhead valve).
Desired long-term results	Water quality is protected; wildlife and human health is not put at risk from contaminated seeps or springs.

3.3.3 DINERO TUNNEL WATER QUALITY MONITORING *(continued)* TIER 1

plan during low-flow and high-flow conditions and additional funding to continue a subset of this monitoring through 2020.

Project location

Forty-five sample sites will be included in the project from 2010 to 2013 (Figure 3.5); these sites were monitored for baseline conditions by USGS before the bulkhead installation. The sample sites include surface water sites such as springs, geologic features (faults/veins), abandoned draining features associated with historic mining, and some existing groundwater wells in the area. From 2014 to 2020, the project will focus on eight long-term monitoring sites in the Lake Fork and an additional eight sites in the vicinity of the Dinero Tunnel that will be selected based on the results of the 2010–2013 monitoring.

Expected benefits and timeframe of benefits

This project would allow scientists to determine whether water quality is deteriorating upgradient of the tunnel, which could happen if rising water in the mine is discharged through springs or seeps. Sampling also will allow a determination of whether water quality is improving down-gradient of the Dinero Tunnel, as expected. This monitoring is an important part of determining the long-term success of the Dinero Tunnel project, previously supported in

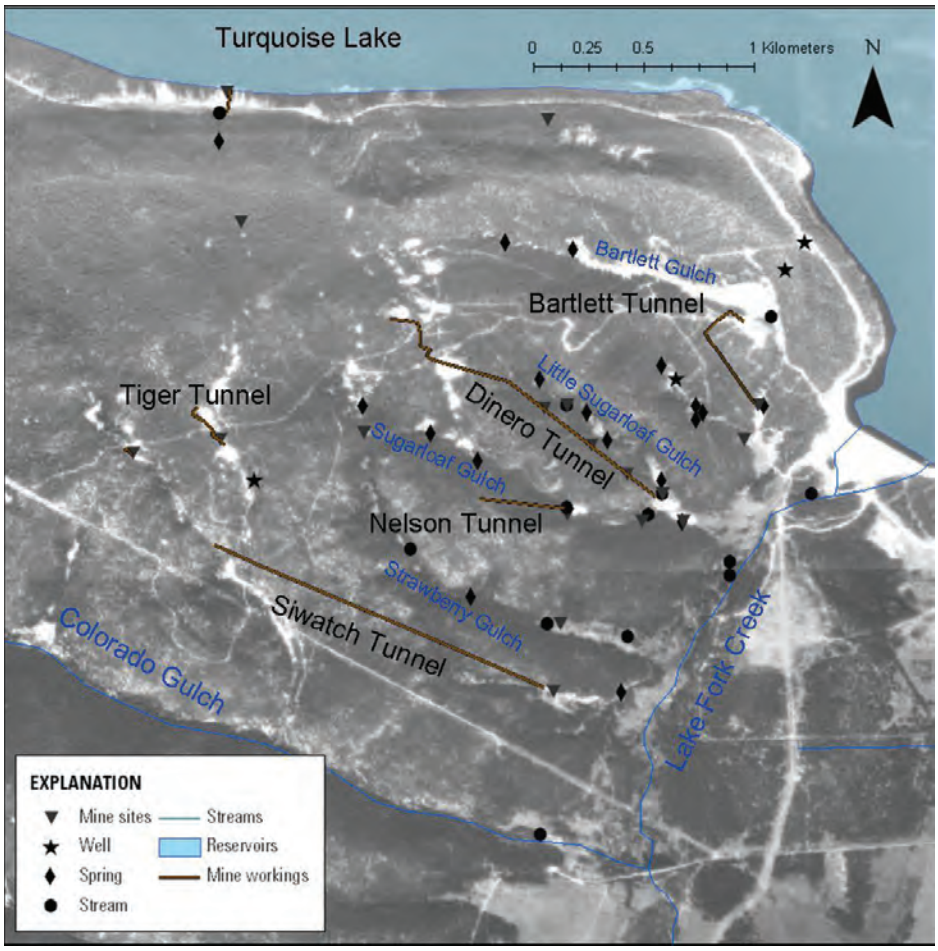

Figure 3.5. Map of Dinero Tunnel area showing 45 sampling sites for the years 2010–2013 study, plus eight additional sites that were monitored during the baseline water quality assessment. *Source: CMC, 2009, Figure 3.*

3.3.3 DINERO TUNNEL WATER QUALITY MONITORING *(continued)* TIER 1

part by Trustee funding. The monitoring also will allow adaptive management of the Dinero Tunnel bulkhead to occur (such as releasing water through the valve, if necessary, to decrease water levels and eliminate upgradient seeps or springs). Sampling would take place from 2010 to 2020.

Brief overview of maintenance and monitoring

This project provides part of the necessary monitoring for the Dinero Tunnel project previously funded in part by the Trustees. These sampling activities do not require separate maintenance and monitoring.

Probability of success

The likelihood of success for this project is very high. The project proponents (CMC and USGS) are highly experienced with this type of sampling and analysis and have already conducted the necessary baseline monitoring.

Estimated costs

The total estimated cost for this project is $509,000 from 2010 to 2013, plus $125,000 for monitoring the 16 Lake Fork and Dinero Tunnel sites from 2014 to 2020. The total estimated cost is based on the approximate cost for three years of BMP monitoring in the Lake Fork and 10 years of monitoring for the Lake Fork and Dinero Tunnel.

Environmental and socioeconomic consequences

Conducting a comprehensive monitoring program for the Sugarloaf Mountain area will reduce the risk of unintended discharges (seeps or springs) threatening water quality or harming wildlife. Specific biological impacts resulting from this project includes a decreased risk of wildlife exposure to contaminants, if rising water levels in the Dinero Tunnel result in contaminated seeps or springs. This project is expected to have a positive socioeconomic impact on the surrounding community because it decreases the risk of threats to water quality and increases public confidence in the safety of the Dinero Tunnel bulkhead installation.

Expected benefits and timeframe of benefits

This project would allow scientists to determine whether water quality is deteriorating upgradient of the tunnel, which could happen if rising water in the mine is discharged through springs or seeps. Sampling also will allow a determination of whether water quality is improving down-gradient of the Dinero Tunnel, as expected. This monitoring is an important part of determining the long-term success of the Dinero Tunnel project, previously supported in part by Trustee funding. The monitoring also will allow adaptive management of the Dinero Tunnel bulkhead to occur (such as releasing water through the valve, if necessary, to decrease water levels and eliminate upgradient seeps or springs). Sampling would take place from 2010 to 2020.

3.3.3 DINERO TUNNEL WATER QUALITY MONITORING *(continued)* TIER 1

Trustee evaluation and proposed allocation

This project is proposed as a Tier 1 project because it is a necessary component of the Dinero Tunnel project previously funded by the Trustees. The project has a high likelihood of success because USGS and CMC have the capacity to implement this type of monitoring. The Trustees propose to allocate $165,000 in settlement funding for this project.

3.3.4 EROSION CONTROL ON ROADS

TIER 1

Restoration objective

Reduce erosion from roads to protect habitat and water quality. Where appropriate, create legal and safe transportation options on designated roads and eliminate "non-system" travel. Initial locations identified for this work are the Paddock State Wildlife Area and the Sugarloaf mining district in the Lake Fork watershed. Other locations in Lake County may be identified as well. See Figure 3.6 for the project logic model.

Project description

User-created motorized routes (i.e., "jeep trails") cause erosion and threaten aquatic and wildlife habitat(Figure 3.7). In addition, these informal roads lack drainage structures, so stream channels are sometimes diverted to run down wheel ruts. These problems are prevalent throughout the newly-created Paddock State Wildlife Area in the Leadville Ranger District, where there are numerous user-created motorized routes that are negatively affecting resource management objectives and creating confusion for visitors trying to access the wildlife area.

Similarly, many roads that were constructed in decades past to access mining claims are eroding badly. The Sugarloaf mining district of the Lake Fork watershed has many roads with significant erosion problems, especially those in higher altitude areas east of Lake Fork. Historic mining roads were not designed with consideration of erosion, water flow, or other environmental impacts and, therefore, contribute large amounts of sediment to the Lake Fork. An example of a problem road is the access road to Colorado Gulch above Lake Fork. Other locations in Lake County have similar problems.

This project would involve providing support for road improvement in the Paddock State Wildlife Area, the Sugarloaf mining district, and other areas with similar problems if identified. Specifically, in the Paddock State Wildlife Area, the USFS would work with Colorado DOW and BLM to designate official system routes for travel and to eliminate and rehabilitate non-system routes. The project would provide funding to

FIGURE 3.6. EROSION CONTROL ON ROADS – LOGIC MODEL

Restoration actions	Develop a planning process and implement actions to eliminate non-system travel and rehabilitate informal roads in the vicinity of the Paddock State Wildlife area. Implement erosion control actions on high-altitude roads in the Lake Fork watershed and in other areas if identified.
Expected short-term result	Travel consolidated on designated routes; non-system travel is minimized or eliminated. Road improvements occur.
Pathway/process	Closure of non-system routes and improvements to roads decrease erosion and sedimentation and minimize wildlife disturbance.
Desired long-term results	Water quality improved in streams and in the Arkansas River; sensitive aquatic species protected; wildlife populations increased.

3.3.4 EROSION CONTROL ON ROADS *(continued)* TIER 1

complete a planning process and EA that would address obvious non-system routes that need to be obliterated, as well as addressing access and travel issues throughout the area. The project also would provide partial funding for implementation of road closure and road improvements in the Paddock State Wildlife Area, with the remainder of the implementation expected to be provided by project partners. This project also would provide funding for road improvements in the Sugarloaf district of the Lake Fork watershed and other areas if identified. Implementation would include construction of appropriate drainage structures so that streams were no longer diverted onto roads. The project also would provide public education on the importance of remaining on system routes to minimize disruptions to wildlife and to reduce erosion and sedimentation into the Arkansas River.

Project location

The project locations would be (1) on the east side of the Leadville Ranger District including the Paddock State Wildlife Area, and (2) in the Sugarloaf mining district of the Lake Fork watershed. Additional locations may be identified with input from relevant agencies and stakeholders.

Expected benefits and timeframe of benefits

This project would provide environmental benefits as soon as the non-system road closure and rehabilitation occurs, which is expected on the Paddock State Wildlife Area to take place in 2013 after the conclusion of the planning and NEPA process. Improvements may occur sooner in the Sugarloaf mining district and would begin when road conditions were fixed. Expected benefits include improved public safety, reduced sedimentation, and improved water quality in the Arkansas River and in the Lake Fork (e.g., Dunnigan et al., 1998). Aquatic resources in small streams would benefit from no longer being diverted onto jeep tracks. Wildlife resources would benefit as well from decreased habitat fragmentation and disturbance. There would be long-term benefits to habitat quality from decreased erosion and wildlife disturbance.

Figure 3.7. Example of user-created "non-system" route on the Leadville Ranger District. Closure and rehabilitation of these non-system routes would enhance habitat for threatened, endangered, and sensitive species; improve water quality in the headwaters of the Arkansas River; provide for the safety of recreational users; and eliminate trespass issues on surrounding private land.

3.3.4 EROSION CONTROL ON ROADS *(continued)*

TIER 1

Brief overview of maintenance and monitoring

Maintenance of the newly designated system routes will be the responsibility of USFS and will be incorporated into their normal road maintenance programs. Maintenance of road closures will be done by rangers who will post signs, monitor public use, and conduct additional closure actions if necessary. Monitoring will take place in phases and will include monitoring of travel on system and non-system routes and qualitative monitoring of water quality and wildlife presence.

Probability of success

The likelihood of success is very high. The USFS has had success in the Salida Ranger District obtaining public support for closure of non-system routes because of the improved hunting opportunities that result from a decrease in disturbance from motorized vehicles. The techniques for rehabilitating closed roads are well established and can result in the successful recovery of forested habitat. The techniques for improving highly eroding historic mine roads are well established as well. The USFS Leadville Ranger District has the personnel and capacity necessary to implement this project.

Estimated costs

The estimated total cost for this project is $200,000 for planning and contributions to implementation partnerships.

Environmental and socioeconomic consequences

Closing and rehabilitating non-system roads will improve aquatic and upland habitats and benefit water quality and wildlife.

Multiple radiotelemetry and satellite locations suggest that the federally threatened Canada lynx moves through the proposed project area. Potential habitat for the federally endangered Uncompahgre fritillary butterfly exist at higher elevations in the project area. There are two known breeding boreal toad populations in the project area and there was a leopard frog sighting documented in 2009. Specific biological impacts resulting from this project would include decreased disturbance to the Canada lynx and Uncompahgre fritillary butterfly. Other wildlife that would benefit include bighorn sheep, northern leopard frog, and boreal toad, which are classified as sensitive species in Region 2 of the USFS. Big game species in the area include mule deer, elk, and black bear – these species all would benefit from decreased disturbance by motorized vehicles on non-system roads and from decreased habitat fragmentation. Aquatic species, including boreal toads, northern leopard frogs, and other aquatic species would benefit from reduced sedimentation, reduced direct impact from being run over, and increased aquatic connectivity (proper planning of system roads would include culverts or other adequate structures to facilitate passage). Many aquatic species would benefit from decreased erosion into headwater streams, the Lake Fork, and the Arkansas River.

This project would have positive socioeconomic consequences because it would decrease sediment into the Lake Fork and Arkansas River, thereby benefiting the trout fishery and helping to maintain

3.3.4 EROSION CONTROL ON ROADS *(continued)* TIER 1

good quality surface water that is used as a drinking water supply. The current non-system routes also pose a threat to community safety because the trails are extremely rutted or washed out and exceed safe grades for ascent and descent. Many of these routes also facilitate trespass onto adjacent private property. Closure and rehabilitation of these routes would improve safety and decrease trespass.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 1 project. The project has a strong nexus to the NRDA injury because it will benefit aquatic habitat in the Lake Fork and Arkansas River and upland habitat for a large variety of wildlife species. The project improves habitat at the Paddock State Wildlife Area, which was created as a result of an easement obtained on the Moyer Ranch. The Trustees had identified obtaining an easement on the Moyer Ranch as an important restoration project to benefit terrestrial resources in their Preliminary Estimates of Damages (Industrial Economics, 2006). Although the easement was put into place without Trustee funding, this project will provide a long-term improvement for aquatic and terrestrial habitats associated with the easement. This project also benefits aquatic habitat in the Lake Fork River and complements the previous work conducted by the Trustees in the Sugarloaf mining district at the Tiger and Dinero tunnels to improve water quality in the Lake Fork River by reducing metals loading. This project provides significant long-term benefits for a low cost. The project has a high likelihood of success because the USFS Leadville Ranger District has experience in developing and implementing this type of project. The Trustees propose to allocate $200,000 in settlement funding for this project.

3.3.5 HABITAT PROTECTION (EASEMENTS, ACQUISITION, OR LAND EXCHANGE) TIER 1 & 2

Restoration objective

To protect land in high-priority locations in the upper Arkansas River watershed to preserve natural resource benefits and avoid the risk of development. See Figure 3.8 for the logic model.

Project description

Wildlife habitat in riparian and upland areas in Lake County is threatened by development, mining, and other land uses that can have negative impacts on habitat value. The goal of this project is to preserve lands and habitats that provide important benefits to natural resources or increase opportunities for natural resource-based recreation. Preservation may be accomplished through land acquisition, obtaining a conservation easement in perpetuity, or a land exchange that would deed land to an appropriate agency.

The Trustees are undertaking a systematic feasibility analysis to identify high priority parcels for land tenure adjustment. This process will be undertaken with opportunities for public review and comment on the resource benefits and risks associated with different parcels. Final selection of parcels will be based on an analysis that considers a variety of factors, including:

- Context of surrounding land use and land protection status (e.g., Does the parcel provide important connectivity to other protected land or habitat?)
- Whether the parcel has already been identified as a high priority for protection in existing local or regional land-use planning documents (e.g., the Lake County Open Space Initiative Ecosystem Management Plan, Colorado State Parks planning documents)
- Type and condition of natural resource benefits provided by the parcel
- Nature and likelihood of development threats
- Cost of protection, based on the best mechanism for land protection for that parcel (acquisition, easement, or land transfer).

After completing this analysis, the Trustees expect to identify high priority parcels for

FIGURE 3.8. HABITAT PROTECTION – LOGIC MODEL

Restoration actions	Protect habitat at risk of development in the upper Arkansas River watershed, using conservation easement, fee-title acquisitions, or land exchange.
Expected short-term result	Increase the amount of protected land held in the public trust.
Pathway/process	More land available for wildlife use and potentially public use for natural resource-based activities.
Desired long-term results	Increase the area of protected habitat with subsequent improvements in wildlife populations, riparian habitat quality, and opportunities for natural resource-based public uses.

3.3.5 HABITAT PROTECTION *(continued)*

TIER 1 & 2

protection and will provide funding or partial funding (where matching funds exist) to complete land transactions. The Trustees will conduct transactions only with willing participants.

The Trustees will ensure that all land transactions conform with their land transaction policy (Appendix B). Land acquired will be deeded to the appropriate entity (local, state, or federal government; land trust; or conservation nongovernmental organizations) after following the specific procedures and standards required by each entity. Payment in lieu of taxes (also called Impact Assistance Grant payments) will be made on land deeded to government parties.

Because the primary purpose of land preservation is to protect natural resource values, public access may not necessarily be permitted in all portions of acquired properties. The Trustees expect that some parcels may be managed for public access, through an entity such as Colorado State Parks (if the land is acquired) or through a recreational easement with a willing landowner. The nature of public access will be determined on a case-by-case basis.

The Trustees expect to identify opportunities for improved natural resource management on land parcels that have been protected with NRDA funding. The Trustees have designated funding that can be used to enhance resource values, as appropriate. For private land protected with conservation easements, the Trustees will provide funding for habitat management planning to ensure that the habitat values of the protected land are maintained (see the project in Section 3.3.10 – Habitat management for land protected by Trustees).

Project location

Various locations throughout the upper Arkansas River Basin, including properties along the upper Arkansas River and tributaries, will be considered. Riparian habitats and upland habitats that are similar to those impacted by mine waste and mining activities will be given highest priority.

Expected benefits and timeframe of benefits

Land protection arrangements, such as conservation easements or land acquisitions, are important tools for preserving habitat used by wildlife and for improving the quality of natural resource-based recreational activities. For example, protection of parcels that are contiguous with other areas of protected land can protect movement corridors that wildlife use for food, travel, mating, and rearing their young. Increasing the amount of protected land will improve wildlife habitat and benefit wildlife populations throughout the upper Arkansas River Basin.

Parcel acquisition can occur as soon as all the necessary planning documents are in place, a process that is likely to take three to six months after the Trustees have identified preferred targets for acquisition and authorized funding. The benefits of land acquisition accrue over the time period when the land would have been threatened by development.

3.3.5 HABITAT PROTECTION *(continued)* TIER 1 & 2

Brief overview of maintenance and monitoring

Maintenance and monitoring will be the responsibility of the future holding agency responsible for that parcel. Lands protected by conservation easements will be inspected on a yearly basis at a minimum to ensure that the terms of the easement are being upheld. For acquired land, land management activities will take place consistent with the procedures of the acquiring entity, such as Colorado State Parks.

Probability of success

The likelihood of success for this project is very high. Organizations like the LCOSI and Colorado State Parks have already identified parcels that they consider high priorities for acquisition, suggesting that there are appropriate opportunities which are expected to meet Trustee needs. Agencies and nonprofit organizations that are likely to partner with the Trustees for this effort have experience and expertise in developing land protection arrangements, with appropriate legal protections.

Estimated costs

The estimated costs for protection of specific parcels will not be known until the Trustees complete their feasibility analysis.

Environmental and socioeconomic consequences

Land protection will contribute to the protection of important habitat for wildlife, likely including sensitive species. Land protection also is likely to enhance habitat connectivity, thus preserving movement corridors. In some cases, land acquisition may have beneficial impacts on surface water or groundwater, through protecting water quality. No adverse environmental impacts are expected from land protection.

Land protection is likely to have a positive socioeconomic impact on the local community. Tourism and recreation are important industries in Leadville, and the protection of important land parcels contributes to the natural resource values that attract tourism and recreation to the mountain environment. In addition, it is likely that some of the acquisitions will have public access, which will increase recreational opportunities.

Trustee evaluation and proposed allocation

This project is proposed as both a Tier 1 and a Tier 2 project. The project has a strong nexus to the NRDA injury because it provides the opportunity to protect parcels that provide resource benefits for the same type of resources as those that were injured. Existing planning processes have identified land acquisition as a high priority in the Arkansas River Valley and in the watershed. The Trustees expect to allocate approximately $500,000 for land protection as part of the first tier of project funding. The Trustees estimate allocating $1,000,000 for land protection as part of the second tier of project funding. In addition, the Trustees have designated $150,000 for habitat enhancements on protected land where required. Additional funding may be allocated as part of the second tier of project funding, depending on funding availability and the opportunities identified during the feasibility analysis.

3.3.6 NATIVE PLANT PROPAGATION AT HAYDEN RANCH

TIER 2

Restoration objective

To develop a facility at the Hayden Ranch Headquarters property for propagation of native plants for use in forestry and wetland remediation and restoration activities. See Figure 3.9 for the project logic model.

Project description

CMC – Timberline Campus and the Lake County Open Space Initiative have completed a preliminary feasibility analysis for the development of a "Center for Sustainable Agronomy Research" at the Hayden Ranch Headquarters property, which is owned by the college (Conlin Associates, 2009). The center would include a greenhouse for initial plant propagation and outdoor nursery plots where plants would be adapted ("hardened") to the local environmental conditions and grown to a size where they can be used in reforestation and remediation projects in the upper Arkansas River Valley. This project would provide partial funding for the study, design, and construction of the greenhouse and nursery facilities. The center would also include a community garden, but that part of the project is not included in the request for natural resource damage funding.

Currently, there is no local source of root stock and nursery seedlings for species that are adapted to the local conditions of the upper Arkansas River Valley. There is a current need for wetland species for remedial projects in areas impacted by historic mining activities. For example, the construction of sulfate reducing bioreactors for final treatment of any residual contaminated water is anticipated at the Tiger and Dinero tunnel remediation sites (previously supported by natural resource damage funding) (Stratus Consulting, 2009). These bioreactors require wetland vegetation to be established and then replaced at regular intervals as part of the maintenance of the bioreactors. Currently, wetland vegetation either needs to be harvested from existing wetlands, which damages current wetlands and poses environmental and regulatory problems, or they have to be purchased from nurseries along the Front Range, which is cost prohibitive. A local source of wetland plants would increase the likelihood of success for the Tiger and Dinero tunnels projects and other similar remediation projects. There also is an anticipated future need for root stock and saplings of coniferous and deciduous forest species to revegetate areas that are likely to be impacted by mountain pine beetle.

FIGURE 3.9. NATIVE PLANT PROPAGATION AT HAYDEN RANCH – LOGIC MODEL

Restoration actions	Develop a greenhouse and nursery facility to propagate locally-adapted forestry and wetland plants.
Expected short-term result	Forest and wetland species are available for remediation and restoration activities.
Pathway/process	Using inexpensive, locally-adapted species increases the success of reforestation and remediation projects.
Desired long-term results	Water quality is protected; wildlife and human health is not put at risk from contaminated seeps or springs.

3.3.6 NATIVE PLANT PROPAGATION AT HAYDEN RANCH *(continued)* TIER 2

A preliminary feasibility analysis for the project has been completed and detected no major impediments to the project (Conlin Associates, 2009). CMC has committed to providing the land to construct the infrastructure for this project and to maintain and operate the facility as an off-campus program. The greenhouse would be constructed in a manner that would be consistent with the historic conservation easement on the site. Surface water from Box Creek is the planned source of irrigation water for the greenhouse, saturated wetland plots, and the tree nursery. The project has received initial letters of support from the Lake County Board of County Commissioners, the Board of Water Works of the City of Pueblo, and the City of Aurora Water Department to work cooperatively to identify and secure water rights and/or storage capacity that would be needed for the project. The wetland plot is planned for a ½ acre pasture adjacent to Box Creek, where surface water flowing from Box Creek would then re-enter the Box Creek drainage through a pond at the lower end of the pasture.

The project proponents require funding for the study design phase of project planning, which would develop the final scope for project elements, submit permit applications, and complete architectural design and engineering. Funding for construction is also necessary.

Project location

The project is located on the Hayden Ranch Headquarters, along the Arkansas River within the 11-mile reach of the Arkansas River.

Expected benefits and timeframe of benefits

This project would increase the likelihood of success of restoration activities in the upper Arkansas River Valley by providing nursery stock that is adapted to local conditions. Currently, vegetation is transported from the Front Range at greater cost and without the benefit of local adaptation. Benefits will be realized when the facility is constructed, which is likely to be 3–5 years into the future.

Maintenance and monitoring

Successful management of the greenhouse and nursery complex would require ongoing O&M activities, which CMC has committed to provide. CMC intends to use these facilities as off-campus classrooms and would operate these facilities to provide their students with experiential learning and research opportunities.

Probability of success

The likelihood of success for this project is moderate. Development of the project plan has a high likelihood of success but the likelihood of obtaining funding for full implementation of the project is not known at this time. CMC has successfully obtained funding for other campus initiatives, so there is a reasonable likelihood that they will be able to arrange implementation funding for this project as well, if additional sources of funding beyond the natural resource damage contribution are required. Initial commitments of support for obtaining the water necessary for this project suggest that there is a good likelihood of success for obtaining the year-round water rights necessary to support the project; however, some risk remains with respect to water rights.

3.3.6 NATIVE PLANT PROPAGATION AT HAYDEN RANCH *(continued)* TIER 2

Estimated costs

An initial cost estimate of $100,000 has been developed for the Phase 1 planning effort, through an analysis by Conlin Associates, in conjunction with CMC. The total cost for implementation will be developed during the Phase 1 planning effort.

Environmental and socioeconomic consequences

This project will have positive environmental benefits by increasing the likelihood of success of revegetation efforts in the upper Arkansas Valley. "Bioreactors" and other constructed wetlands for treating acid mine drainage will have a greater likelihood of success if they are planted with native plants adapted to local conditions. Local nursery stock will also be of great importance for revegetation efforts that are expected to be necessary in the next five years as mountain pine beetle has a greater impact on the Leadville area. In addition, improving revegetation efforts on mine spoils in forested habitat will protect the forest ecosystem and further protect aquatic habitat and water quality by reducing erosion. The project may have a negative impact on water levels in Box Creek due to consumptive uses involved with greenhouse operations (this impact has not yet been fully quantified).

This project also will have positive socioeconomic consequences. The facilities would help train students in important agronomy and forestry skills that would help improve their likelihood of gaining employment. A local source of seedlings would help revegetate forests that are impacted by mountain pine beetle, which would have a positive impact on tourism and quality of life in the region. The sale of plants from the nursery also would have a positive impact on the budget of CMC. The project would be conducted in a manner that is consistent with the historic conservation easement on the property and with the scenic conservation overlay zone in the Lake County Land Development Code. Thus, the project is not expected to have a negative impact on cultural values. Finally, the greenhouse is intended to function on renewable energy, so it would not increase the carbon footprint of the college.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 2 project. The project has a nexus to the NRDA injury because it would provide the wetland vegetation to treat contaminated surface water and groundwater and would provide forest seedlings to benefit upland resources. CMC has the forestry and agronomic expertise to successfully manage the greenhouse and nursery complex. The greatest risks to the project are that full funding may not be obtained to complete the project according to its full project plan or that water rights may not be available. The project has received letters of support from the Colorado State Forest Service and the USFS, who have indicated their willingness to serve as project partners. The Trustees propose to allocate $200,000 in settlement funding for planning ($100,000) and future implementation ($100,000) of this project, if that level of funding is available after Tier 1 projects are funded.

3.3.7 DEVELOPMENT OF AN EE/CA FOR THE VENTURE MINE AND SUGARLOAF MINE DUMPS

TIER 2

Restoration objective

Develop an EE/CA for the Venture Mine and Sugarloaf Mine dumps. See Figure 3.10 for the project logic model.

Project description

The Venture Mine complex is directly downstream of the Tiger Mine complex, between the Tiger Mine and the Arkansas River. It is the only remaining area in the Lake Fork watershed where waste rock has not been cleaned up and is a major contributor of heavy metals contamination into the Little Frying Pan Gulch tributary. A key step in the cleanup process is the development of the EE/CA. In the past, BLM has had a difficult time securing funding to develop the EE/CA, but once it is completed, they have been successful in acquiring the funding needed to implement the preferred restoration actions.

Restoration work completed at the Venture Mine and in the Sugarloaf Mine dumps would be similar to that completed at the Tiger and Dinero tunnels (see BLM, 2006a, 2006b; Stratus Consulting, 2009). The restoration actions would be designed to break hazardous substance pathways to natural resources at the Venture Mine and Sugarloaf Mine dumps.

Restoration actions (based on the work completed at the Tiger and Dinero mines) likely would include elimination of waste rock dumps and acid-mine drainage pathways by construction of control structures to divert clean surface water and clean shallow groundwater away from waste rock piles, and relocation and capping of waste piles in an on-site repository. The steps involved in designing and implementing the restoration work include identifying and designing a repository site for mine waste piles, preparation of the repository site, relocation of mine waste piles to the repository, reclamation of the mine waste sites including revegetation and stream restoration, and long-term O&M of the site.

FIGURE 3.10. DEVELOPMENT OF AN EE/CA FOR THE VENTURE MINE AND SUGARLOAF MINE DUMPS – LOGIC MODEL

Restoration actions	Development of an EE/CA that describes actions to contain mine waste in a repository and eliminate sources of contamination to surface water and groundwater.
Expected short-term result	Development of an EE/CA allows funding to be obtained for implementation of the preferred actions.
Pathway/process	Restoration actions isolate contaminant sources.
Desired long-term results	Aquatic habitat and associated terrestrial habitat quality are improved; metals loading to the Lake Fork and the Arkansas River are reduced.

Project location

Venture Mine and Sugarloaf Mine dumps, Lake Fork watershed.

3.3.7 DEVELOPMENT OF AN EE/CA FOR THE VENTURE MINE AND SUGARLOAF MINE DUMPS *(continued)* TIER 2

Expected benefits and timeframe of benefits

This project will benefit natural resources in the Lake Fork watershed and the Arkansas River. Aquatic habitat will benefit, leading to increases in fish populations. Aquatic resources other than fish and terrestrial resources and wildlife that depend on the aquatic environment will also benefit from these restoration actions.

Benefits will be realized starting immediately after restoration actions are completed. Diverting clean water away from the mine waste will have an immediate effect on the downstream environment by reducing or eliminating the last remaining source of contaminated surface and shallow groundwater in the Lake Fork watershed. Containing mine waste contamination will remove the ongoing source of contamination from the watershed, leading to an immediate reduction in contaminant concentrations found in the environment and a longer-term, gradual reduction as already-contaminated resources move through the environment.

Maintenance and monitoring

Maintenance and monitoring will be conducted to ensure that restoration actions are effective and remain in place. Long-term activities will include monitoring the repository, monitoring the restored site, and monitoring water quality in Little Frying Pan Gulch.

Probability of success

The types of reclamation and restoration proposed at the Venture Mine and Sugarloaf Mine dump sites have been employed successfully at nearby mine waste sites in the Lake Fork watershed. The techniques proposed are well-established and are likely to be highly successful at reducing the contaminant load from these sites that reaches Little Frying Pan Gulch and, ultimately, the Arkansas River. The risk for this project is that development of the EE/CA will not lead to implementation of the restoration actions.

Estimated costs

The estimated total cost to develop the EE/CA for the Venture Mine and Sugarloaf Mine dumps is $400,000. BLM expects to obtain partial funding from the Colorado Section 319 nonpoint source program ($150,000) and from in-kind services ($50,000).

Environmental and socioeconomic consequences

Improving water quality in the Lake Fork watershed will improve habitat for fish and wildlife species, increase aquatic productivity, and provide a direct benefit to injured resources similar to those resources and injuries that occurred in the upper Arkansas River. Additionally, improving habitat in the Lake Fork watershed will lead to improved habitat quality in the upper Arkansas River. Construction activities will lead to some short-term impacts to the environment, resulting from the presence and use of construction equipment. Impacts may include short-term increases in erosion

and sedimentation, physical disturbance, and equipment-related impacts. The long-term benefits of improved water quality outweigh any short-term adverse impacts associated with construction.

Public use and enjoyment of these public resources will be improved as a result of these restoration actions by improving surface water and groundwater quality, improving aquatic habitat, improving fishing, and improving habitat in the Lake Fork watershed for all wildlife. Construction activities may have a short-term positive impact on the local economy by providing construction jobs and obtaining materials from local suppliers. However, construction activities also may have a short-term adverse impact on public use and enjoyment as a result of short-term air-pollution associated with heavy equipment use. The long-term benefits for public use and enjoyment outweigh any short-term adverse impacts associated with construction activities.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 2 project. The project has a strong nexus to the NRDA injury because it benefits aquatic resources in Little Frying Pan Gulch and the Lake Fork watershed, which are tributaries to the Arkansas River. The natural resources and associated injuries in the Lake Fork watershed are similar to those documented in the Arkansas River. This project has a high likelihood of success because BLM has experience and a positive track record of success for mine reclamation projects. The Trustees propose to allocate $200,000 in settlement funding for this project, funding will be used to develop the EE/CA and for on-the-ground work.

3.3.8 HAYDEN RANCH REVEGETATION

TIER 2

Restoration objective

To seed 222 acres of the Hayden Ranch with native vegetation. See Figure 3.11 for the project logic model.

Project description

BLM will seed 222 acres of the Hayden Ranch with native vegetation. The native vegetation in this area typically consists of a mountain sagebrush (*Artemesia tridentata*) community; common species associated with this community include forbs such as silvery lupine (*Lupinus argenteus*), Nuttall's larkspur (*Delphinium nuttallianum*), hairy goldenaster (*Heterotheca villosa*), and arrowleaf balsamroot (*Balsamorhiza sagittata*) and graminoids such as Sandberg bluegrass (*Poa secunda*), muttongrass (*Poa fendleriana*), Indian ricegrass (*Oryzopsis hymenoides*), onion grass (*Melica* spp.), and prairie junegrass (*Koeleria macrantha*) (Colorado Natural Areas Program et al., 1998). The goal for the seeding project is to return this land to a natural vegetative community. Planting will most likely be conducted using a drill-seeding method; a disc seeding method may also be used if needed. Seedlings will not be irrigated. A certified weed-free seed supplier will be identified. Ideally, BLM will use their preferred, high-standard seed supplier.

Project location

The project is located on 222 acres on the north side of the Hayden Ranch property, along the Arkansas River within the 11-mile reach of the Arkansas River (Figure 3.12).

Expected benefits and timeframe of benefits

Planting native seeds benefits upland habitat for wildlife and helps minimize the potential for non-native plant species to become established. Native habitat attracts desirable native wildlife such as elk and provides forage and protection for these species. Additionally, healthy native plant communities can help minimize erosion, improving in-stream water quality.

Benefits will be realized within the first year of planting, as plants become established. Benefits continue into the future as natural reproduction and succession further establish native species and improve habitat conditions.

FIGURE 3.11. HAYDEN RANCH REVEGETATION – LOGIC MODEL

Restoration actions	Seed 222 acres of the Hayden Ranch with native vegetation.
Expected short-term result	The cover of native vegetation increases.
Pathway/process	Increased cover of native vegetation restores native habitat, attracts wildlife species, and improves overall ecological function.
Desired long-term results	Restored habitat helps prevent erosion, minimizes the risk that invasive plant species will become established, and attracts a broad array of wildlife, including elk.

3.3.8 HAYDEN RANCH REVEGETATION *(continued)*

TIER 2

Maintenance and monitoring

The site will be monitored using photo documentation to evaluate growth and the need for weed control. A livestock exclusion fence will be erected for one to two years; after that, the site will be open to managed grazing.

Probability of success

Moderate to high. The seeded area may require weed control and will require livestock exclusion fencing for the first one to two years after planting. Once the native seedlings are established, the site will require little maintenance and provide high-quality native habitat.

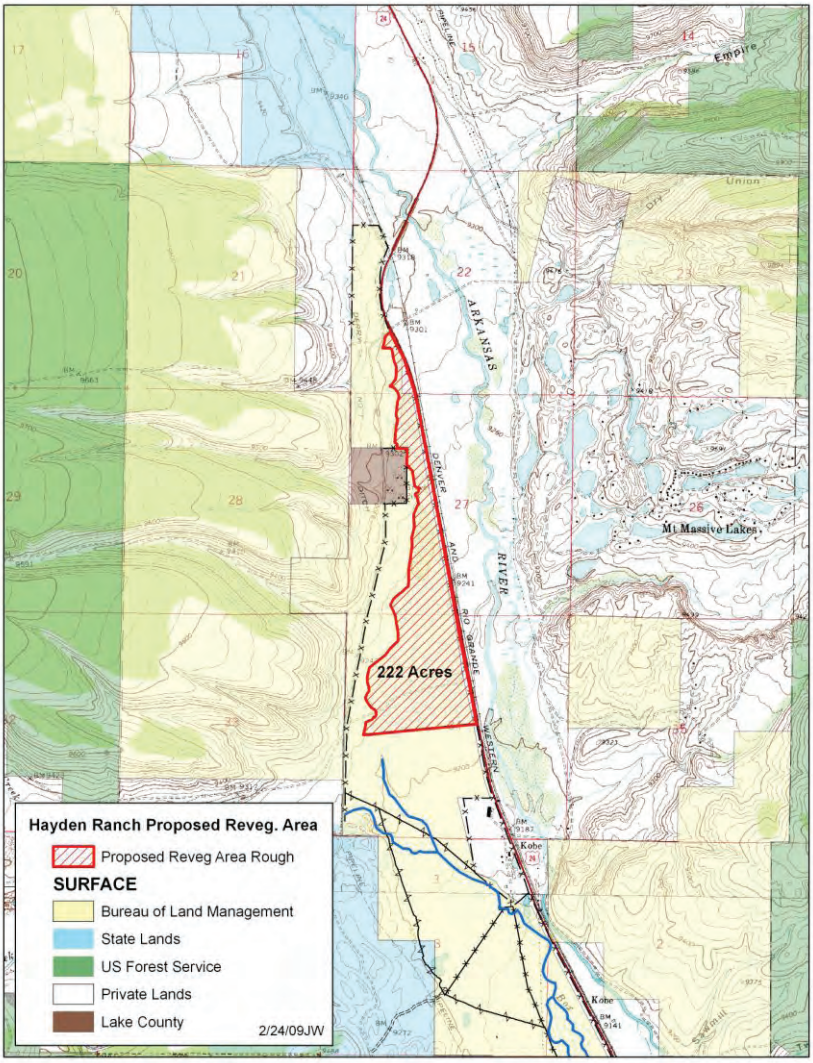

Figure 3.12. Map showing the location of the Hayden Ranch seeding project in relation to federal and private land holdings.
Source: John Smeins, BLM.

Estimated costs

$20,000 including ground preparation and seed application. The cost of livestock exclusion fencing will be comparable to the cost of fencing that will be part of the those costs for the Arkansas River in-stream habitat restoration project, approximately $2.20 per foot of fencing. The BLM will provide in-kind services at a value of approximately $5,000. Maintenance and monitoring costs will be minimal.

Environmental and socioeconomic consequences

This project would have positive environmental and socioeconomic consequences.

Specific biological impacts resulting from this project would include improved habitat for wildlife and improved water quality through decreased erosion. Maintaining good quality habitat for elk and other wildlife provides a positive socioeconomic benefit by providing good hunting conditions and wildlife viewing.

3.3.8 HAYDEN RANCH REVEGETATION *(continued)* TIER 2

Trustee evaluation and proposed allocation

This project is proposed as a Tier 2 project. The project has a nexus to the NRDA injury because it benefits upland resources in the 11-mile reach of the Arkansas River, where documented injury to upland natural resources was reported. This project has a high likelihood of success because BLM has experience and a positive track record of successfully planting and managing native vegetation in areas with degraded habitat. The Trustees propose to allocate $20,000 in settlement funding for this project, if that level of funding is available after Tier 1 projects are funded.

3.3.9 CANTERBURY TUNNEL REHABILITATION

TIER 2

Restoration objective

To restore the Canterbury Tunnel as a major water supply for the Parkville Water District. See Figure 3.13 for the project logic model.

Project description

The Canterbury Tunnel was constructed in 1924 with the intention that it would help drain several of the active mines in the Leadville area and improve mine operations. Although the tunnel was not successful for that purpose, beginning in the early 1960s, the Leadville Water Company (a predecessor to the current Parkville Water District) used groundwater from the tunnel as a clean source of water for the city of Leadville. The Canterbury Tunnel served as an important source of drinking water for Leadville because the district had a water right allowing it to use 600 gallons per minute (3.2 acre-feet per day), out of a total flow of 1,500 gallons per minute from the tunnel (Wibbenmeyer, 2007). The tunnel also has a constant temperature of approximately 54°F (Greg Teter, General Manager, Parkville Water District, personal communication, November 9, 2009). This water helped alleviate two difficult operational problems for the Parkville water system – low surface flow in Evans Creek in the winter (the major surface water supply for the system), and cold surface water temperatures that result in frozen water mains in the winter.

Beginning in 2000, support structures in the tunnel began to fail, causing intermittent cave-in events that reduced the flow from the tunnel portal and increased the turbidity of the water. The Parkville Water District stopped using water from the tunnel in 2002. Since losing this source of water, Parkville is again forced to cope with water shortages in the winter and frozen water lines, which result in a loss of service and high repair costs. For example, a block of frozen water mains in 2007 cost over $50,000 to restore service.

A study completed by USGS (Paschke et al., 2008) determined that the Canterbury Tunnel did not have a hydrologic connection to the Leadville Mine Drainage Tunnel and therefore the collapse in the Canterbury Tunnel was not increasing water levels in the Leadville Mine Drainage Tunnel. This study also provided an overview of four drilling options that could restore water supply from the Canterbury Tunnel. The Parkville Water District has determined that a vertical well drilled into the tunnel with a pipeline to the existing Evans Gulch Treatment Plant

FIGURE 3.13. CANTERBURY TUNNEL REHABILITATION – SIMPLIFIED LOGIC MODEL

Restoration actions	Construct a well and pipeline to pipe water from the Canterbury Tunnel to the Parkville Water District.
Expected short-term and long-term result	Restore a flow of groundwater to the water treatment plant that provides a clean, sustainable supply of drinking water to Leadville (Parkville Water District), which also reduces the risk of water main freezing.

3.3.9 CANTERBURY TUNNEL REHABILITATION *(continued)* TIER 2

would be the most practical solution for regaining access to drinking water from this source. This project would resolve the lack of adequate surface flow in the winter from Evans Creek and the cold surface water temperatures that result in frozen water mains. The district is actively seeking funding for this project because current water supplies are inadequate for the winter and would be unable to accommodate future growth and development in Leadville.

Project location

The project is located at the Canterbury Tunnel, which is approximately two miles to the northeast of the downtown area of Leadville, Colorado (Figure 3.1).

Expected benefits and timeframe of benefits

The benefit of this project is the development of an additional drinking water resource for the city of Leadville that also provides protection against water mains freezing. Benefits would occur as soon as the project came on-line and would be expected to last indefinitely. The project would likely take approximately one year to complete after funding is made available.

Maintenance and monitoring

Maintenance of the pump and groundwater well would be the responsibility of the Parkville Water District. The pump and well would be part of the routine maintenance activities of the district and can be accommodated within existing operations budgets.

Probability of success

The probability of success for this project is high. The technical feasibility of drilling through bedrock to reach the Canterbury Tunnel is high, if the appropriate contractor is selected. This option has the lowest risk, compared to other alternatives that involved drilling through the collapsed sections of the tunnel.

Estimated costs

Parkville Water District estimates that the cost of the project will be $2 million. They expect to receive $500,000 in funding from the Colorado Department of Local Affairs.

Environmental and socioeconomic consequences

This project is expected to have minimal environmental impacts on surface resources. The pipeline would need to be routed through areas that avoid sensitive habitats. The project results in beneficial use of a groundwater resource that is recharged through snowmelt (Paschke et al., 2008).

This project provides significant socioeconomic benefits to the city of Leadville. The Parkville Water District does not have the capital reserves to undertake this project without outside financial assistance. The most likely funding source for the project would be a loan from the State Revolving Fund, which would then require a substantial rate increase to cover the debt service. Natural resource

3.3.9 CANTERBURY TUNNEL REHABILITATION *(continued)* TIER 2

damage funding for this project would allow the project to be completed sooner, without a large financial impact on the citizens of Leadville that are customers of the Parkville Water District. Access to groundwater from the Canterbury Tunnel would allow future development to occur in Leadville without the worry of water shortages in the winter. The decrease in the risk of water mains freezing also would provide a significant benefit to Leadville citizens, who have had to cope with winter water outages in the past.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 2 project. The project has a strong nexus to the NRDA injury because it provides compensation to the public for the loss of groundwater resources caused by contamination in California Gulch. This project restores a groundwater resource that is currently not usable because of the tunnel collapse. This project has a high likelihood of success because the engineering is feasible. The Trustees propose to allocate 10% of the total project cost ($200,000) in settlement funding for this project, if that level of funding is available after Tier 1 projects are funded.

3.3.10 HABITAT MANAGEMENT FOR LAND PROTECTED BY TRUSTEES — TIER 2

Restoration objective

To improve forest and grazing management on private land protected with natural resource damage funding. See Figure 3.14 for the logic model.

Project description

The Trustees may choose to fund land protection on private land to preserve wildlife habitat from development [see project in Section 3.3.5: Habitat protection (easements, acquisition, or land exchange)]. In some cases, the long-term habitat value of the land protected with conservation easements would benefit from improved resource management. The LCCD and the Colorado State Forest Service are able to provide willing landowners with technical expertise to develop grazing and forestry management plans. Grazing management plans are important for maintaining habitat, especially riparian habitat, in good condition. Forestry management plans can help improve wildlife habitat and decrease the risk of mountain pine beetle damage by diversifying the species and age-structure of the forest.

This project would provide funding for management plans to be developed and implemented on private lands where conservation easements have been obtained with natural resource damage funding.

Project location

The project is located in the upper Arkansas River watershed. Specific locations will depend on the parcels protected with easements.

Expected benefits and timeframe of benefits

The expected benefits from this project are improved wildlife habitat for areas where grazing and forestry management would protect or enhance habitat. The timeframe of benefits would begin at the time when the management plan was put into place and would continue for as long as the plan is implemented. It would likely take approximately one to three years for plans to be developed and implemented, because implementation can proceed in phases.

FIGURE 3.14. HABITAT MANAGEMENT FOR LAND PROTECTED BY TRUSTEES– LOGIC MODEL

Restoration actions	Develop and implement grazing and forestry management plans for private land protected with natural resource damage funding.
Expected short-term result	Management plans are developed and implemented.
Pathway/process	Improved management protects habitat, diversifies species, and improves overall ecological function.
Desired long-term results	Support a broad array of native vegetation and wildlife. Reduce fire risk from mountain pine beetle damage.

3.3.10 HABITAT MANAGEMENT FOR LAND PROTECTED BY TRUSTEES *(continued)*

TIER 2

Maintenance and monitoring

Management plans require ongoing maintenance and monitoring to be successful. The agencies developing the management plans potentially can provide periodic reviews of implementation. The organization that holds the conservation easement also can monitor whether management actions have occurred.

Probability of success

Moderate to high. The benefits of a specific management plan depend on the actions required to be taken and the diligence of the landowner in implementing these actions. Because management actions can provide benefits to the landowner (such as reducing the risk of fire through improved forest management), landowners are likely to be motivated to implement the management plans.

Estimated costs

The total costs for developing and implementing management plans depend on the size and condition of the property. The Colorado State Forest Service charges $20 per acre to develop a plan for a property of 20–80 acres. Treatment costs can range anywhere from $500 to $5,000 per acre, depending on the treatments needed, the terrain, and the condition of the land.

Environmental and socioeconomic consequences

Improving land management will provide positive biological impacts for habitat and for wildlife. The project is expected to have a positive socioeconomic impact on the surrounding community because management actions are likely to maintain or improve property values by improving the grazing management of rangeland and/or decreasing fire risk.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 2 project. The project has a nexus to the NRDA injury because it will improve the natural resource condition for land that the Trustees protect through conservation easements. This project has a moderate to high likelihood of success because the LCCD and Colorado State Forest Service have experience working with landowners and providing technical expertise. The Trustees propose to allocate $100,000 in settlement funding for this project, if that level of funding is available after Tier 1 projects are funded. Funds will be used for both planning and implementation actions.

3.3.11 COLORADO GULCH WETLAND AND UPLAND RESTORATION

TIER 3

Restoration objective

Restore degraded stream habitat that has been adversely impacted by upstream erosion and contamination. See Figure 3.15 for the project logic model.

Project description

Wetland habitat near the downstream end of Colorado Gulch is degraded. Weathered bedrock outcrops, mine waste piles, and unimproved roads upstream of this property have eroded and transported both contaminated and uncontaminated sediments into the wetlands. Data indicate that water quality upstream of the impaired wetlands is better than water quality downstream of the wetlands. Therefore, restoring these wetlands is expected to improve water quality in Colorado Gulch downstream of the wetlands.

Approximately 3.5 acres of wetlands will be restored. Restoration actions will include dredging excess and contaminated sediments and placing them in a repository. Replacement soil will be obtained and placed in the dredged area. After dredging, new vegetation will be planted on-site and the slope will be stabilized.

Project location

This project is located on the McNichols property, in Western Lake County.

Expected benefits and timeframe of benefits

Benefits of this restoration project include improved water quality, reduced sediment toxicity, and improved wetland, riparian, and aquatic habitats.

This project will not start until upstream restoration at the former Venture and Tiger mines is completed. Benefits such as improved water quality will be realized immediately following dredging activities. Benefits resulting from revegetation and habitat improvements will be realized within the first year and will continue to improve as the vegetation matures. Long-term benefits are expected to be maintained because the property is encumbered with a conservation easement and the property owners support the project.

FIGURE 3.15. COLORADO GULCH WETLAND AND UPLAND RESTORATION – LOGIC MODEL

Restoration actions	Remove contaminated sediments, restore degraded wetland habitat, and create in-stream habitat.
Expected short-term result	Improve in-stream and wetland habitat quality and reduce erosion.
Pathway/process	Improved habitat will mitigate effects of sedimentation, contamination will be eliminated during restoration, and restoration will provide habitat to aquatic and riparian wildlife.
Desired long-term results	Improved water quality, improved habitat quality, and access for aquatic and riparian wildlife.

3.3.11 COLORADO GULCH WETLAND AND UPLAND RESTORATION *(continued)*

TIER 3

Maintenance and monitoring

New vegetation will be monitored and revegetation will take place as needed. Additional dredging may be needed in the future, particularly from catch basins that will be constructed to catch sediment migrating from upstream. The Lake Fork Watershed Working Group will oversee maintenance and monitoring activities.

Probability of success

The chance of success is moderate to high. The types of restoration proposed at the Colorado Gulch site have been employed successfully at nearby mine waste sites in the Lake Fork watershed. Restoration on the McNichols property will not begin until the major sources of upstream contamination – the Venture and Tiger mines – have been removed.

Estimated costs

The estimated total cost is $252,000, of which $125,000 would come from NRDA funding, $17,500 from BLM, $88,500 from Colorado 319 Non-point Source Program funding, and $21,000 through in-kind donations from CMC and Lake Fork Watershed Working Group volunteers.

Environmental and socioeconomic consequences

Specific biological impacts resulting from this project would include improved water quality (through decreased erosion), improved habitat for fish and wildlife species, and increased aquatic productivity. There would be some short-term impacts to aquatic habitat due to construction activities, which would likely result in increased sediment suspension and turbidity. The long-term benefits to the aquatic community outweigh any short-term adverse impacts associated with construction.

Improved fishing conditions are expected in the Lake Fork downstream of Colorado Gulch after this project is completed., which would have a positive socioeconomic benefit.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 3 project. The project is well planned but restoration actions would not take place until upstream removal actions are completed, which have an uncertain timeline. The project has a strong nexus to the NRDA injury because it benefits aquatic and wetland resources in the upper Arkansas River Basin, where documented injury to wetland, surface water, and aquatic resources occurred. This project has a high likelihood of success because the landowner is committed to restoration and the Lake Fork Watershed Working Group has experience and a positive track record of success for wetland restoration projects. The Trustees tentatively propose to allocate $125,000 in settlement funding for this project.

3.3.12 REMEDIATION OF ACID MINE DRAINAGE IN TRIBUTARIES TO THE ARKANSAS RIVER

TIER 3

Restoration objective

Reduce contamination from waste piles and flowing mine tunnels in tributaries to the Arkansas River. See Figure 3.16 for the project logic model.

Project description

Heavy metals and acid drainage associated with historic mining activity result in negative impacts to aquatic resources in tributaries to the Arkansas River. Funding for cleanup of these sites can be difficult to obtain when the sites are "abandoned" and there is no financially-viable responsible party. Two potential reclamation sites have been identified by the abandoned mine land program of the USFS in the Pike and San Isabel National Forests. At the Chalk Creek project area, drainage from the Golf Tunnel accounts for the largest point-source of heavy metals into Chalk Creek, which is a tributary to the Arkansas River near Buena Vista. The USFS has received funding to conduct a feasibility study of installing a bulkhead to control drainage from the tunnel and constructing a repository for waste rock that also contributes metals loadings to the creek. Another identified location is St. Kevin's Gulch, near the headwaters of the upper Arkansas River, where acid-mine drainage from the Griffin Mine waste rock pile results in loadings of metals and acid to the gulch, a downstream wetland, Tennessee Creek, and ultimately the Arkansas River. Construction of a repository at this site, as well as the potential installation of a bulkhead at another mine tunnel (the Rosse Tunnel) would reduce the impacts to aquatic resources caused by releases of contaminants.

For the location in Chalk Creek, this project would involve implementation of the preferred alternative that emerges from the study that is being initiated. For St. Kevin's Gulch, funding would be needed for a study to identify alternatives and then for implementation.

Project location

Chalk Creek and St. Kevin's Gulch.

Expected benefits and timeframe of benefits

Water quality in Chalk Creek, St. Kevin's Gulch, Tennessee Creek, and the Arkansas River would benefit from a decrease in metals loadings. Aquatic resources, including trout, would benefit from improved water quality. Benefits will begin to be realized as soon as the remedial actions are put into place, which is likely to be one to three years from now, to account for the need to study and plan implementation actions.

Maintenance and monitoring

Long-term maintenance and monitoring would be needed to ensure that the

FIGURE 3.16. REMEDIATION OF ACID MINE DRAINAGE IN TRIBUTARIES TO THE ARKANSAS RIVER – LOGIC MODEL

Restoration actions	Install bulkheads and construct mine waste repositories at abandoned mine land sites along tributaries to the Arkansas River.
Expected short-term result	Reduce metals loading to tributaries to the Arkansas River.
Pathway/process	Reduced metals loading will improve aquatic habitat quality.
Desired long-term results	Improved water quality will be maintained and aquatic populations will increase in tributaries to the Arkansas River.

3.3.12 REMEDIATION OF ACID MINE DRAINAGE IN TRIBUTARIES TO THE ARKANSAS RIVER *(continued)* TIER 3

bulkheads are not having a negative impact on upgradient water quality through the emergence of seeps or springs. The repositories also would need maintenance and monitoring to ensure that the waste rock was remaining contained and the repositories were kept in good shape without erosion. Specific details of maintenance and monitoring would be developed at a future date, when more information is known about the specific alternatives that would be implemented.

Probability of success

The probability of success is high. USFS has experience and expertise in reclaiming abandoned mine lands, including bulkhead installation and construction of repositories. The project also can benefit from the successful reclamation efforts at the Tiger and Dinero tunnels, because the proposed projects are similar to those efforts.

Estimated costs

The total cost is unknown. The Chalk Creek project has a general estimate of $750,000 for implementation. The St. Kevin's Gulch project has a general estimate of $300,000 for the repository alone and $600,000–$700,000 to include the bulkhead installation. The Trustees have estimated a total cost for both projects of $750,000 + $700,000 = $1,450,000.

Environmental and socioeconomic consequences

Improving water quality in tributaries to the Arkansas River will improve their ecological functioning for aquatic and other wildlife species. This project will also have a positive socioeconomic impact on the community.

Specific biological impacts resulting from this project will include improved water quality through reduced metals loading, leading to improved habitat for fish and wildlife and increased aquatic productivity. Improved water quality in tributaries benefits resources similar to those that were injured by the release of hazardous substances at the Site. Further improvements made to water quality in tributaries also will benefit fish in the Arkansas River that use these tributaries for spawning. Construction-related impacts may include temporarily increased erosion, dust, and exhaust from heavy equipment use. The long-term benefits to the aquatic community outweigh the short-term adverse impacts associated with restoration-related construction activities.

Public use and enjoyment of natural resources in the tributaries and in the Arkansas River will be improved through improved fishing and better water quality.

Trustee evaluation and proposed allocation

This project is proposed as a Tier 3 project. The project is contingent on remedial studies being completed and implementation actions being identified. The project has a strong nexus to the NRDA injury because it benefits aquatic and wetland resources in the upper Arkansas River Basin. This project has a high likelihood of success because the types of reclamation and restoration work likely required for these sites have been implemented successfully in other locations. The Trustees tentatively propose to allocate $400,000 in settlement funding for this project.

3.3.13 EROSION CONTROL IN THE ARKANSAS HEADWATERS RECREATION AREA

TIER 3

Restoration objective

Reduce erosion and increase habitat value for wildlife and recreational activities in the Arkansas Headwaters Recreation Area. See Figure 3.17 for the project logic model.

Project description

With participation from other local stakeholders such as the USFS and the BLM, Colorado State Parks is preparing to develop a watershed plan that will be used to manage and protect against nonpoint source pollution in the Arkansas River headwaters. The watershed plan will follow EPA guidance and include the nine key elements that are required by EPA for a plan to be eligible for CWA Section 319 funding (U.S. EPA, 2008).

This project involves providing funding to help implement appropriate and effective restoration actions or "management measures" in the Arkansas Headwaters Recreation Area that are identified in the watershed plan and do not have implementation funding from other sources. Examples of possible restoration actions include constructing sediment basins to collect and trap sediment before it reaches the river, seeding areas that have damaged vegetation to prevent erosion, or conducting vegetation management practices to reduce erosion potential on steep slopes (e.g., promoting cover of herbaceous grasses by controlling over-growth of shrubs).

FIGURE 3.17. EROSION CONTROL IN THE ARKANSAS HEADWATERS RECREATION AREA – LOGIC MODEL

Restoration actions	Implement erosion control actions in degraded areas identified through a watershed plan.
Expected short-term result	Erosion control measures will reduce sediment loading to the Arkansas River.
Pathway/process	Reduced erosion leads to healthier terrestrial vegetation, reduced sediment loading into the river, and improved aquatic habitat.
Desired long-term results	Improved water quality in the Arkansas River with a commensurate improvement in fish populations and associated aquatic and terrestrial wildlife populations. Upland terrestrial habitat, riparian habitat, and aquatic habitat will improve.

Project location

Arkansas Headwaters Recreation Area.

Expected benefits and time frame of benefits

Restoration projects that target erosion reduction have wide-ranging benefits across ecosystems. Upland projects may include vegetation management and planting; this type of action improves habitat for upland wildlife. Upland projects that reduce erosion also benefit riparian, wetland, and aquatic habitats by reducing sediment transport across these habitats, improving water quality and habitat quality. Riparian and wetland projects that reduce sedimentation improve habitat for riparian and aquatic wildlife, and also improve water quality by reducing sediment loading into the

aquatic environment. All erosion reduction projects will benefit water quality and improve aquatic habitat, thus helping to benefit fish populations and wildlife populations that depend on the aquatic ecosystem.

Benefits will begin to be realized after restoration actions are completed. The benefits will continue to increase as vegetation matures and other erosion control measures become established. Benefits will continue to be realized for as long as the project elements are properly maintained.

Brief overview of maintenance and monitoring

Monitoring actions will be developed to evaluate the success of erosion control projects. A monitoring plan likely will include evaluation of the effectiveness of upland source control measures, inspection of any engineered structures, and appropriate water quality measurements.

Probability of success

The probability of success is very high. Colorado State Parks will spend two years developing a comprehensive watershed plan that will identify the areas most in need of restoration. Following the watershed planning process, a restoration planning process will identify the most appropriate restoration actions in the targeted areas. The restoration actions will use established techniques that have been proven successful at other locations.

Estimated costs

Costs for implementing restoration actions have not yet been estimated; costs will vary depending on the type of project.

Environmental and socioeconomic consequences

Reducing erosion in the Arkansas Headwaters Recreation Area will improve water quality in the Arkansas River, improve aquatic and terrestrial habitats, and likely will enhance recreation opportunities. Restoration actions will occur in targeted areas that are most vulnerable to erosion, maximizing the improvements to the ecosystem.

Some potential restoration actions may have short-term negative impacts on the environment if they involve construction. There may be short-term increases in sediment loading to the river and short-term habitat disturbance in upland and riparian habitats. This project would have positive socioeconomic consequences because it would decrease sediment into the Arkansas River, thereby benefiting the trout fishery and helping to maintain good quality surface water that is used as a drinking water supply. The long-term benefits of improved habitat, improved water quality, and thus improved recreation opportunities outweigh the temporary adverse impacts associated with construction.

3.3.13 EROSION CONTROL IN THE ARKANSAS HEADWATERS RECREATION AREA *(continued)*

TIER 3

Trustee evaluation and proposed allocation

This project is proposed as a Tier 3 project; it will take place after the Colorado State Parks watershed planning phase is completed and targeted restoration actions have been identified. The project has a strong nexus to the NRDA injury because it benefits aquatic and upland resources in the upper Arkansas River, where documented injury to surface water, aquatic resources, and upland resources occurred. This project has a high likelihood of success because Colorado State Parks has experience and a positive track record of success in identifying and implementing erosion control projects. The Trustees propose to allocate $100,000 in settlement funding for this project.

3.4 Alternatives Considered but Eliminated from Detailed Analysis

The Trustees investigated additional potential restoration projects to benefit aquatic, terrestrial, and groundwater resources. These alternatives were eliminated from detailed analysis because (1) they either failed the screening criteria, or (2) a preliminary evaluation determined that projects passed the screening criteria but scored lower against the evaluation criteria compared to the projects included in the proposed alternative.

3.4.1 Iowa Gulch Wetland Enhancement

This project involves enhancing wetland habitat in Iowa Gulch that had been degraded from sediment and contaminated mine waste released from the Sherman Mine, near the Leadville area. The Trustees investigated the feasibility of providing funding for this wetland enhancement work. This project was eliminated from detailed analysis because the Trustees learned that BLM has already completed the project using other sources of funding.

3.4.2 Lake Fork Watershed-wide Monitoring

This project involves providing partial funding to monitor stream water quality in Lake Fork from 2013 to 2020, following completion of the Sugarloaf best management practice (BMP) monitoring program that is being funded by a grant from the Colorado nonpoint source pollution control program ("319 funding"). Beginning in 2013, a watershed-wide monitoring program will be in place to continue monthly monitoring and sampling at 16 established monitoring sites; baseline data were collected from these sites in 2001. This monitoring effort is designed to take over when the Sugarloaf BMP monitoring concludes. Samples will be collected monthly from April to September each year, beginning in 2013 and continuing through 2020. Data collected will include stream discharge, total dissolved solids, pH, conductivity, total dissolved oxygen, total sulfate, and turbidity. Water samples will be analyzed either at the Timberline Analytical Laboratory or at the Colorado School of Mines.

This project was eliminated from detailed analysis because the Trustees are planning to fund water-quality sampling in the vicinity of the Dinero Tunnel through the project in Section 3.3.5. Monitoring across the entire Lake Fork that is not specifically in conjunction with natural resource damage funded restoration actions does not meet the threshold acceptance criteria of "restoring, replacing, or acquiring natural resources."

3.4.3 California Gulch Remedial Projects

This project involves implementing several remedial projects proposed by the Lake County Commissioners for the California Gulch Superfund Site. One project involves constructing a site-wide repository to receive contaminated soil. Another project involves establishing a seasonal spring bypass for California Gulch by routing California Gulch through a constructed treatment wetland to reduce metals loadings from California Gulch into the Arkansas River. A third project involves constructing and operating a pump station to isolate specific springs below the Yak Treatment Plant impoundment and pumping that water to the Yak Treatment Plant for processing.

These project ideas were eliminated from detailed analysis because the Trustees believe that these are remedial projects that should be considered by EPA in developing a Record of Decision for Operable Unit 12 at the Site (site-wide groundwater). Furthermore, the Trustees will not fund projects that could conflict with remedial actions.