

## SECTION 4.0 PREFERRED WATERSHED RESTORATION PLAN

### 4.1 Development of Watershed Restoration Alternatives

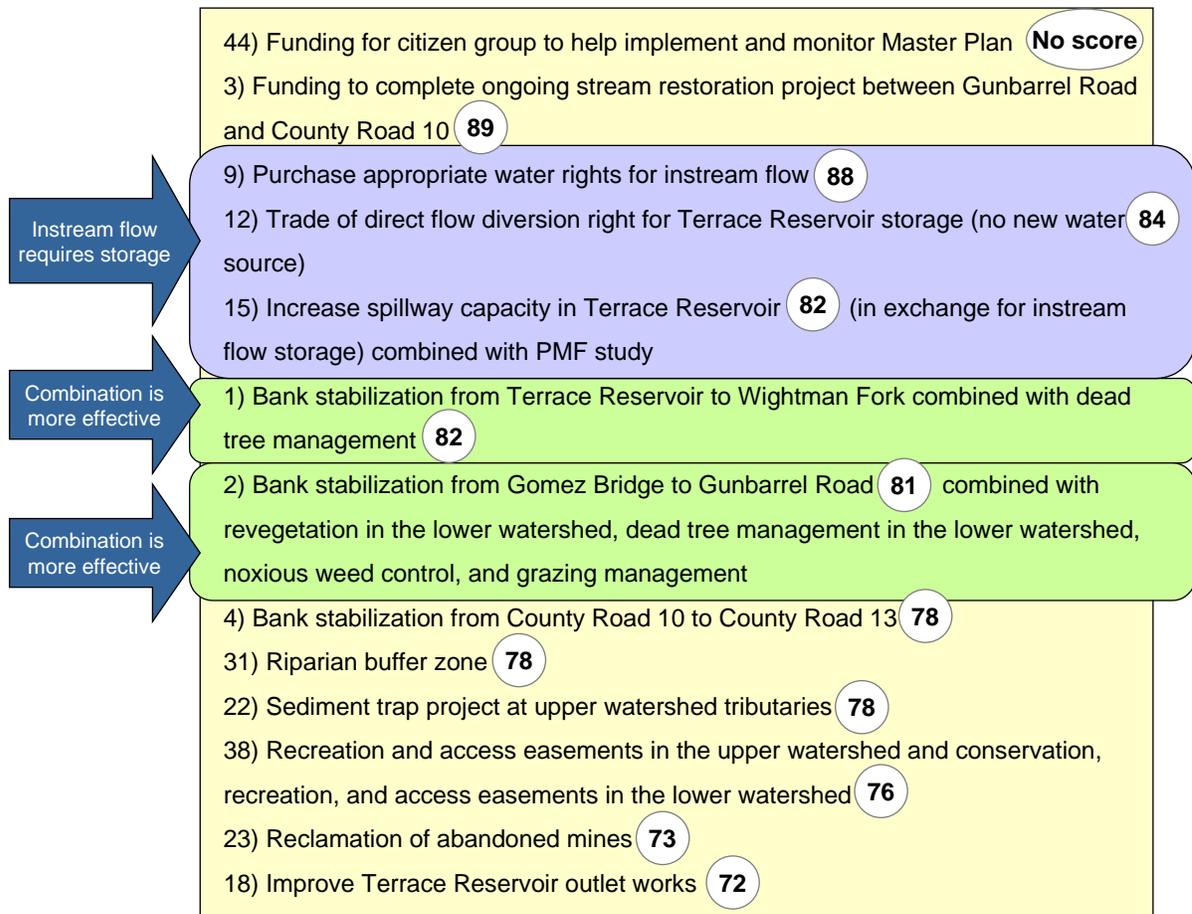
The following three approaches were used to develop watershed restoration alternatives:

- Project rank alternative
- Watershed objectives alternative
- Trustee priorities

The approach for formulating each alternative, or comprehensive package of projects, and the individual projects that best fit the approach are described below.

#### 4.1.1 Project Rank Alternative

The first alternative was assembled based on the project ranking established in **Section 3.15**. Project ranking was determined by ordering projects according to their total project score from highest to lowest. The highest ranked projects are shown in **Figure 4-1** along with the overall project scores. Project numbers are also included to assist with correlation to project descriptions in **Section 3**. Some projects were included out of rank order because they are either prerequisites for other highly ranked projects (shown in purple) or because they are logical combinations with other highly ranked alternatives (shown in green).



**Figure 4-1. Project Rank Alternative**

Funding for a citizen group to help implement and monitor the Master Plan, Project 44, was included in all three alternatives. Funding the Alamosa River Foundation will facilitate implementation of the preferred alternative. This project does not have a score because studies and administrative activities were not ranked on the same scale as physical projects.

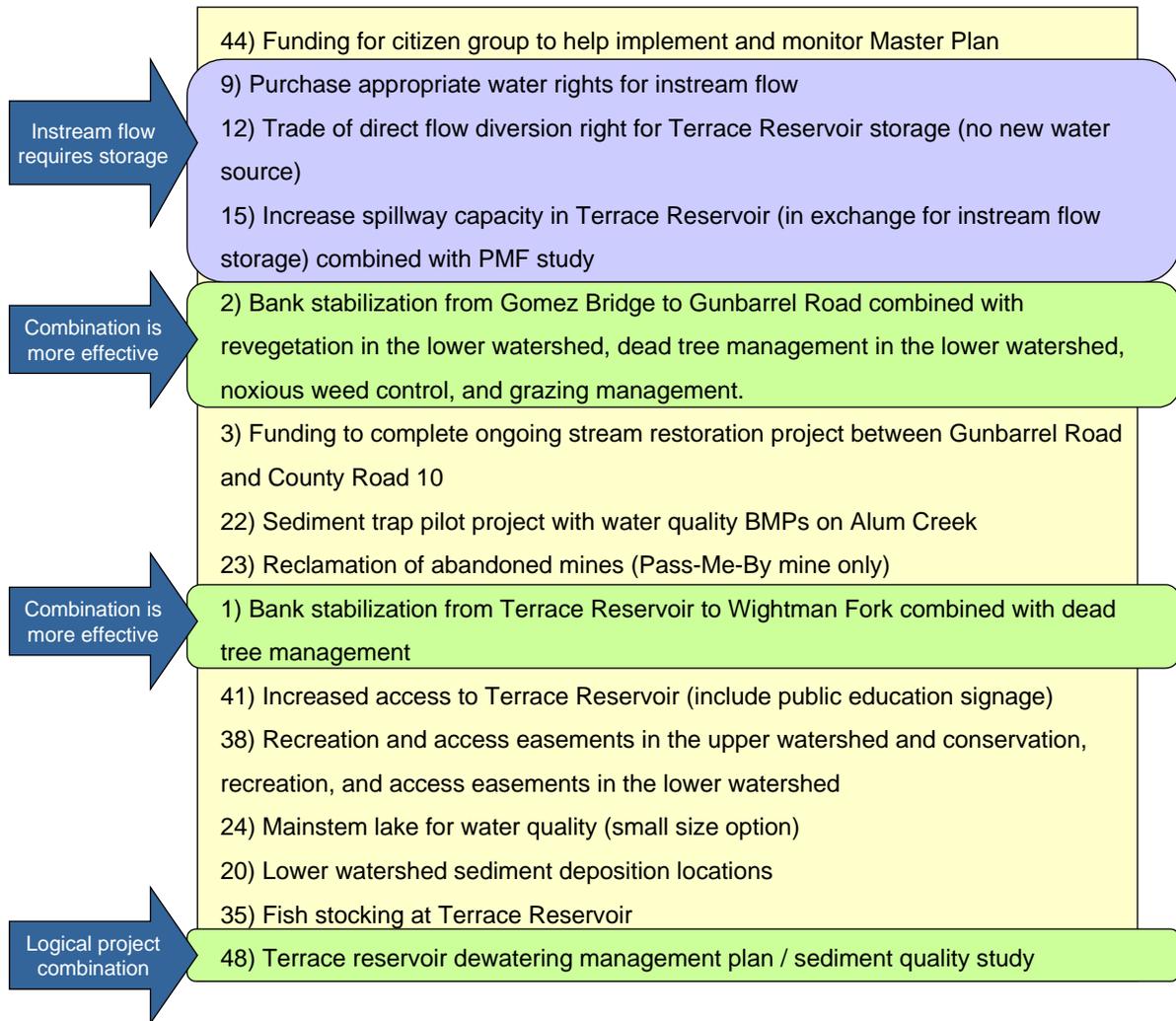
Purchase instream flow water rights, Project 9, was the second highest ranked project with a total score of 88. The instream flow water rights project requires a storage project. Project 12, trade of direct flow diversion right for storage in Terrace Reservoir, was the highest ranked storage project and is included as a prerequisite. In most years, Project 12 is not expected to provide enough storage for the entire instream flow water right. Therefore, the second highest ranked storage project, increase spillway capacity, Project 15, is also included.

The stream restoration projects are combined with related projects such as revegetation, dead tree management, weed management, and grazing management. The combination of projects will improve the performance of stream restoration and will reduce the total project cost compared to implementation of each project independently.

This alternative includes the reclamation of abandoned mines, Project 23, at a funding level that would facilitate water quality treatment at both the Pass-Me-By and Miser Mines as well as provide funds for some other cleanup activities.

### 4.1.2 Watershed Objectives Alternative

The Watershed Objectives Alternative was assembled by the consultant team (see **Figure 4-2**). This alternative is focused on the technical ability of projects to meet watershed objectives and the vision statements discussed in **Section 3.1.1**. At least one project was included to address each of the watershed problem categories identified at the outset of the restoration planning effort. In this alternative, additional projects are combined with the underlying base projects, either as prerequisites or as beneficial combinations to improve project effectiveness.



**Figure 4-2. Watershed Objectives Alternative**

The Watershed Objectives Alternative includes more water quality projects than the Project Rank Alternative because improving water quality is necessary to meet many of the restoration objectives. Improved water quality will benefit riparian and aquatic habitat. The water quality projects include a small lake on the Alamosa River mainstem near Wightman Fork, a sediment trap project on Alum Creek, and reclamation of the Pass-Me-By mine.

Treatment of Alum Creek is included because it is the tributary that contributes the highest load of iron and aluminum to the Alamosa River and significant amounts of sediments and low pH. Improving the water quality from this tributary may help offset the potential injury caused by

hazardous substance release from the Summitville Mine. The project is proposed as a pilot because there are many challenges associated with capturing the sediment and treating the water quality in the small space available. It may be necessary to try more than one design to find the best approach.

Abandoned mines contribute to water quality problems, but to a much smaller degree than Wightman Fork and other altered tributaries. The abandoned mines contribute less than 5 percent of the watershed load for each metal of concern (as discussed in Section 2.4.9). Therefore, only the largest mine, the Pass-Me-By mine, is proposed for inclusion in this alternative. The Pass-Me-By Mine has the lowest pH and contributes the highest loads of copper, iron, and aluminum of any of the mining sites.

The instream flow project is included to restore some of the natural river function downstream of Terrace Reservoir.

Finally, the Terrace Reservoir dewatering management plan was proposed in combination with a sediment quality study. The sediment quality study will provide more information on how to best manage sediments if it is necessary to drain the reservoir.

#### **4.1.3 Trustee Preferences Alternative**

The Trustee Preferences Alternative was developed by the Trustees based on their natural resource restoration goals for the Alamosa River watershed. Their alternative is similar to the other two alternatives (see **Figure 4-3**). The Trustees included Project 32, acquisition of equivalent resource in the San Luis Valley for high quality habitat and recreation. This project would involve the acquisition of equivalent resources in the neighboring Conejos River watershed for high quality habitat and recreation. This project was important to the federal Trustees as it would provide immediate restoration, by the protection from residential development, of wildlife and recreation resources deemed important to the state and federal Trustees.

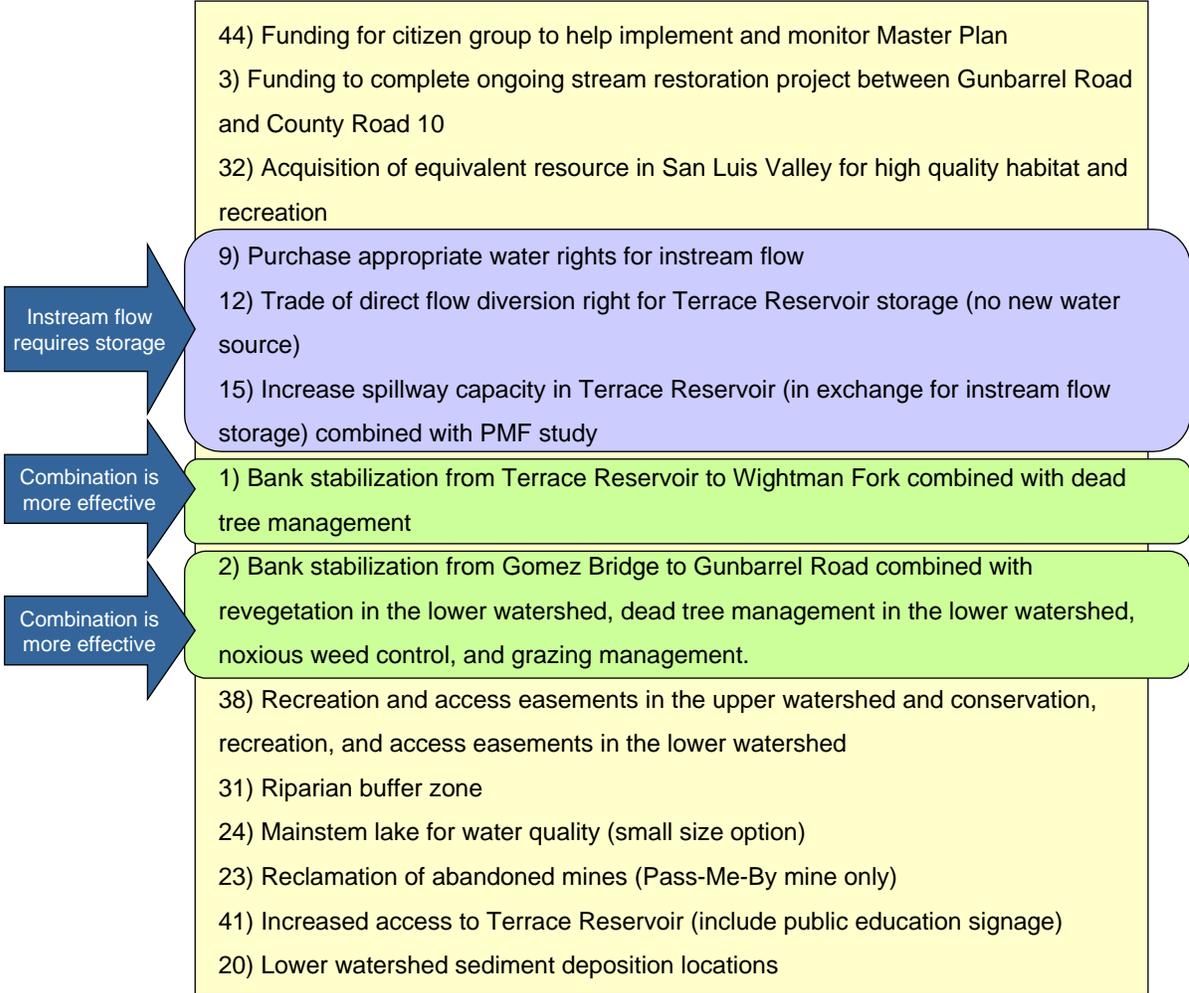


Figure 4-3. Trustee Preferences Alternative

### 4.2 Evaluation of Impacts of Watershed Alternatives

This section compares the prioritization of projects between the three alternatives and discusses the benefits and uncertainties of the projects.

#### 4.2.1 Project Priority Comparison

The three watershed alternatives were each organized into three alternative funding levels, \$5, \$10, and \$15 million. The first funding level is what is already available through the Summitville settlement. The other two funding levels are discussed because the Foundation and Trustees plan to seek additional funding sources to leverage the funds that are already available. The different funding levels required that projects be prioritized and evenly divided into parts as needed to fit into three tiers. Prioritized alternatives are shown in **Table 4-1**. Projects that are the same amongst the alternatives are shown in the same color. The table shows that the alternatives are almost the same in terms of content. The major difference is the order that projects are listed.

Table 4-1. Three Preliminary Watershed Alternatives

By Highest Project Score	\$M	Watershed Objectives	\$M	Trustee Preferences	\$M
44. Funding for citizen group	0.3	44. Funding for citizen group	0.3	44. Funding for citizen group	0.3
3. Funding to complete project between Gunbarrel Rd and County Rd 10	0.12	9. Purchase appropriate water rights for instream flow	3.3	3. Funding to complete project between Gunbarrel Rd and County Rd 10	0.12
9. Purchase appropriate water rights for instream flow	4	12. Trade of direct flow diversion right for reservoir storage (no new water source)	0.1	32. Acquisition of equivalent resource in San Luis Valley for high quality habitat and recreation	0.8
12. Trade of direct flow diversion right for reservoir storage (no new water source)	0.1	2. Bank Stab Gomez to Gunbarrel / Reveg in lower watershed / dead tree mgmt / noxious weed control / grazing management	1.2	9. Purchase appropriate water rights for instream flow	2.5
1. Most important Stream restoration areas from Terrace to Wightman Fork	0.5	3. Funding to complete restoration project from Gunbarrel to Cty Rd 10	0.12	12. Trade of direct flow diversion right for reservoir storage (no new water source)	0.1
				1. Bank Stab Terrace to Wightman Fork / dead tree mgmt upper watershed	1.2
<b>Subtotal</b>	<b>5.02</b>	<b>Subtotal</b>	<b>5.02</b>	<b>Subtotal</b>	<b>5.02</b>
1. Complete Stream restoration Terrace to Wightman Fork / dead tree mgmt upper watershed	0.7	9. Finish purchasing water rights	0.7	9. Finish purchasing water rights	1.5
15. Increase spillway capacity (in return for instream flow storage) / PMF Study	1.52	22. Sediment trap pilot project with water quality on Alum Creek	1	2. Bank Stab Gomez to Gunbarrel / Reveg in lower watershed / dead tree mgmt / noxious weed control / grazing management	1.2
2. Bank Stab Gomez to Gunbarrel / Reveg in lower watershed / dead tree mgmt / noxious weed control / grazing management	1.2	23. Reclamation of abandoned mines (Pass me by mine only)	0.35	15. Increase spillway capacity (in return for instream flow storage) / PMF Study	1.52
4. Stream restoration County Rd 10 to County Rd 13	0.4	1. Bank Stab Terrace to Wightman Fork / dead tree mgmt upper watershed	1.2	38. Conservation / recreation / access easements in lower watershed (500 acres)	0.5
31. Riparian Buffer Zone	0.2	15. Increase spillway capacity (in return for instream flow storage) / PMF Study	1.52	31. Riparian Buffer Zone	0.2
22. Sediment trap project phase 1 (suggest Alum Creek)	1	41. Increased access to Terrace Res (include parking lot, public education, trail)	0.2		
		38. Recreation / access easements in upper watershed (2 locations, 100 acres total)	0.1		
<b>Subtotal</b>	<b>10.04</b>	<b>Subtotal</b>	<b>10.09</b>	<b>Subtotal</b>	<b>9.94</b>
22. Complete sediment trap project	1	38. Conservation / recreation / access easements in lower watershed (500 acres)	0.5	24. Mainstem lake for water quality (small)	4
38. Recreation / access easements in upper watershed (2 locations, 100 acres total)	0.1	24. Mainstem lake for water quality (small)	4	23. Reclamation of abandoned mines (Pass me by mine only)	0.35
38. Conservation / recreation / access easements in lower watershed (500 acres)	0.5	20. Lower watershed sediment deposition locations	0.2	41. Increased access to Terrace Res (include parking lot, public education, trail)	0.2
23. Reclamation of abandoned mines (Miser, Pass-me-By major projects, small projects at other sites)	1.5	35. Fish stocking at Terrace Reservoir	0.05	20. Lower watershed sediment deposition locations	0.2
18. Improve Terrace Reservoir outlet works (tower)	3	48. Terrace dewatering management plan / sediment quality study	0.1		
<b>Total</b>	<b>16.14</b>	<b>Total</b>	<b>14.9</b>	<b>Total</b>	<b>14.7</b>

Note: Projects that were split between funding levels are indicated by an arrow. Only projects that can be completed in increments were split. The cost of combined projects, such as stream restoration and revegetation was estimated as 80 percent of their combined total due to economy of scale for doing them at the same time.

## 4.2.2 Project Benefits and Uncertainties

At this stage of the restoration planning process, the draft Master Plan describes project concepts and general plans with cost estimates, but not specific, detailed project proposals with itemized implementation costs. Submission of such detailed plans will be the next step toward the ultimate implementation of selected restoration actions. Thus, it is not possible to do a quantitative benefit/cost analysis at this preliminary stage of project development.

The benefits and uncertainties of the different projects included in the three alternatives can be discussed qualitatively. The benefits of all of the projects are discussed in Section 3. The projects with the most uncertainty are discussed here to reiterate the significant obstacles that may exist for implementing these projects. The projects with the most uncertainty are instream flow, the sediment trap, the mainstem lake, and reclamation of abandoned mines. The uncertainty in each of these projects is discussed below. Despite the significant uncertainty, these projects are included in restoration alternatives because the stakeholders feel that their benefits are important and that they may be possible to implement.

### *9) Purchase Appropriate Water Rights for Instream Flow*

This project will help meet many of the Master Plan objectives and will lead to benefits in many resource categories. However, there is considerable uncertainty in its implementation as discussed below:

- The project requires a willing seller of an appropriate water right at a reasonable price. Only the most senior water rights are able to provide a reliable flow. There may not be a willing seller in the near future.
- The project will require a change of water right, which must be approved in water court. By law, a change in water right cannot negatively impact other water users, particularly downstream users who have historically relied upon agricultural return flows. The instream flow water right may not be able to claim the entire historical diversion right. Under the worst case scenario, only the historical consumptive use could be transferred. The exact ruling of a water court case cannot yet be predicted.
- Storage must be obtained to hold the water from the time it is in priority in spring and summer, to when it is beneficial in the stream, fall, winter, and early spring.
- The eventual holder of the water right will need to be determined if a seller is identified. The Colorado Water Conservation Board is the only entity in Colorado legally entitled to hold instream flow water rights.
- The water right seller does not have to sell the land associated with the water right. However, if land is included as part of the sale, a new owner for the land will have to be determined. The subsequent disposition of that land in a non-irrigated status could also pose management issues.
- The final plan for storage and delivery of an instream flow should be based on the most economically efficient methodology. Therefore, although a framework has been suggested, the most economical methodology to achieve an instream flow is uncertain until negotiations are entered into for storage and delivery options.

The uncertainties listed above are significant. However, the project benefits are important enough to the stakeholders and Trustees such that further research into the project and the availability of a willing seller is at least warranted. If after some period of time, such as 5 years, there is no willing seller, the Trustees and stakeholders can decide to reallocate funds reserved for the instream flow project to other restoration projects.

### ***22) Sediment Traps at Upper Tributary Confluences***

There were few water quality projects expected to have significant benefits with reasonable cost. The sediment trap at upper tributary confluences project could improve the water quality of the Alamosa River. Tributaries such as Alum Creek contain a very high load of sediment contaminated with metals. However, there is uncertainty over how effective a sediment trap project would be because there is little space at the tributary confluences to construct a project. The water quality impacts of the project are expected to be positive, but it is possible that removing easily settled metals such as aluminum and iron could actually increase the downstream concentration of other metals such as copper and zinc. Results of the pilot study will determine the overall impact of the project on water quality.

In addition, the project will need permission from the USDA Forest Service to construct in the National Forest.

### ***24) Mainstem Lake***

The mainstem lake could remove the majority of suspended sediments and particulate iron, copper, and aluminum from the Alamosa River. It has the potential to make the most significant water quality improvement of any restoration project. However, there is substantial uncertainty in the implementation of the project. There are considerable permitting obstacles to creating a lake on the mainstem of a river due to environmental impacts, and these obstacles may even be sufficient to preclude the project. Permission would be needed for construction on National Forest lands. In addition, a water court action will be needed to initially fill the lake and account for additional evaporation from the reservoir surface.

### ***23) Reclamation of Abandoned Mines***

The reclamation of abandoned mines project will have limited water quality benefits. The major uncertainty in this project is obtaining permission to do water quality activities on private lands. Work on abandoned mines would require permission from landowners who may not be interested in water quality projects.

## **4.3 Preparation of Preferred Alternative**

This section provides background information on the cost estimates for the projects and their major cost items that are common to the three alternatives in preparation for assembling a preferred alternative.

### ***44) Funding for a Citizen Group to Help Implement and Monitor the Master Plan***

The Alamosa River Foundation would assist the Trustee Council in locally overseeing and monitoring restoration. The total cost of this project, \$300,000 was based on \$30,000 for 10 years to fund a part-time worker.

The Trustees will have the flexibility to provide more than \$30,000 per year for the first three to five years if they determine it would be beneficial. Additional funds could allow the Foundation to hire a more qualified person with engineering and grant writing experience, or they could hire someone for more than half time. Much of the Foundation's work can be done or planned for during the first five years of Master Plan implementation and then the funds could taper off. The Foundation could also apply for funds from different sources to help cover the cost of their work.

### ***9) Purchase Appropriate Water Rights for Instream Flow***

This project is estimated to cost between \$1 and \$4 million. The large cost range is due to the lack of basis for the cost of such a project within the watershed. The cost estimate is based on the cost of irrigated land within the Alamosa River watershed, which could range from \$500 to \$2,000 an acre. It is assumed that approximately 2,000 acres of irrigated land would be needed to obtain enough consumptive use water to meet the flow goal in the Alamosa River. The project will also incur significant legal costs for the transfer of use to instream flow. It is assumed that the \$4 million estimate is conservative enough to cover all legal costs.

### ***12) Trade of Direct Flow Diversion Right for Terrace Reservoir Storage***

The cost of this project, estimated at \$100,000 is based purely on legal costs to establish an agreement between Terrace Irrigation Company and the holder of the instream water right for storage and release of instream flow waters. There is no physical construction included in this project.

### ***Stream Restoration Projects (Projects 1-4)***

Cost estimates for each stream restoration project were developed using the same method. The costs were based on a unit cost of \$100,000 per mile with a 20 percent contingency added for design, planning, and permitting costs. For the stream restoration projects between Terrace Reservoir and Wightman Fork, where only isolated banks would need attention, only half the length of the reach was used to calculate the project cost.

### ***23) Reclamation of Abandoned Mines***

Cost estimates for reclaiming abandoned mines to improve water quality were based on \$325,000 each for building typical structures such as limestone trenches and wetlands for the Pass-Me-By and Miser mines. These two mines have the largest flow and estimated metals load on an annual basis. It was estimated that for an additional \$50,000, improvement could be made at some of the other mines that are smaller and would require less extensive engineering and construction. It was estimated that the entire project would cost \$750,000 total. The cost estimates are based on the consultant team's experience with private mine reclamation companies in southwest Colorado.

The entire mine reclamation project was included in the Highest Project Score alternative. In the other two alternatives, only treatment of the Pass-Me-By Mine was included, for a total cost of \$325,000.

### ***15) Increase Terrace Reservoir Spillway Capacity***

A study should be conducted to determine the most cost-effective method of increasing the Terrace Reservoir spillway capacity in order to increase the water storage capacity of the reservoir. There are numerous options, as discussed in **Section 3**. It is likely that either a concrete labyrinth or roller compacted concrete spillway will be the most efficient. However, because each spillway is unique, there are no rules of thumb that can be applied to estimate the cost of a spillway. A total cost of \$1.5 million for studies, engineering and design is the best conceptual estimate.

### ***38) Conservation/Recreation/Access Easements***

The cost of this project was assumed to be \$1,000 per acre for an estimated 500 acres of lands along the Alamosa River, approximately half the estimated cost of property with river access.

### ***22) Sediment Trap Pilot Project***

The cost to implement the sediment trap pilot project could vary based on the extent to which pilot water quality improvement options are explored and the degree to which future maintenance is funded. Installation of the containment berm, redirection of Alum Creek, and removal of downstream sediments would probably cost on the order of \$500,000. However, funds will have to be reserved for future removal of sediments from the sediment detention area, as well as for future lime addition if

that option proves favorable. A number of different water quality improvement processes could also be explored at the site. Therefore, a total cost of \$1 million was estimated. The scope and funding of research projects could potentially rely on groups such as the U.S. E.P.A., the National Science Foundation, or universities, possibly reducing the NRD share of the cost.

#### ***24) Small Mainstem Lake for Water Quality***

It is likely that a roller compacted concrete dam with an integrated spillway may be the most cost effective design for a small mainstem lake. However, the cost and most appropriate design for the dam is uncertain until geotechnical investigations can be conducted at the suggested dam location and at other potential locations. There is also uncertainty in the efforts that would be needed for studies and environmental permitting. The current best estimate for engineering and construction of a small dam at the suggested location is \$4 million as long as permitting obstacles are not insurmountable.

### **4.4 Preferred Restoration Alternative**

The preferred alternative was determined in a stakeholder meeting held in La Jara on December 13, 2004. Stakeholders were presented with the three alternatives shown in **Table 4-1**. The three alternatives include many of the same projects. The benefits and constraints of some of the projects were discussed and the preferred projects were added to the preferred alternative with the consensus of the group.

Project 32, Acquisition of equivalent resources outside of the watershed, was strongly supported by the stakeholders and Trustees as a project with important benefits that should be implemented. However, the stakeholders were opposed to using Natural Resource Damage funds to purchase land outside of the watershed. Furthermore, the Trustees' agreed that although the project was a high priority, it did not meet the intent of the consent decree.

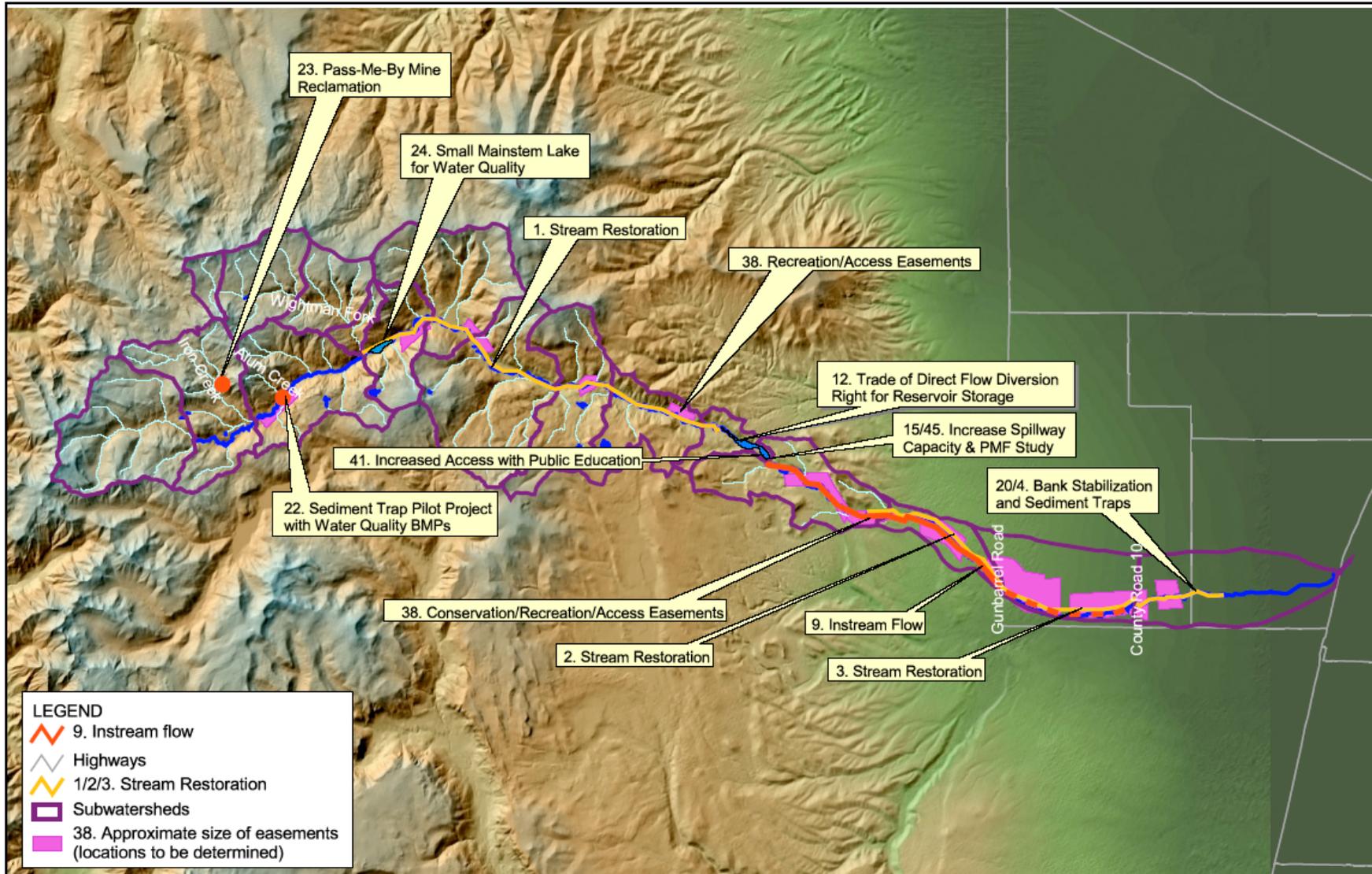
The preferred alternative is listed in **Table 4-3** for funding levels of \$5, \$10, and \$15 million. Some of the projects described individually in **Section 3** have been combined into one logical combination. For instance, the stream restoration projects are combined with revegetation and noxious weed control.

**Table 4-3. List of Projects in Preferred Alternative**

<b>Project</b>	<b>Cost</b>
44. Funding for Alamosa River Foundation to Help Implement and Monitor Master Plan	\$300,000
3. Funding to complete ongoing streambank project between Gunbarrel Road and County Road 10	\$120,000
2. Stream restoration from Gomez Bridge to Gunbarrel Road; Revegetation, dead tree management, noxious weed management, and grazing management in lower watershed	\$1,200,000
9. Purchase appropriate water rights for instream flow downstream of Terrace Reservoir	\$3,300,000
12. Trade of direct flow diversion right for storage of instream flow water rights in Terrace Reservoir (no new water source)	\$100,000
<b>Subtotal</b>	<b>\$5,000,000</b>
9. Finish purchasing water rights	\$700,000
1. Stream restoration from Wightman Fork to Terrace Reservoir; dead tree management in upper watershed	\$1,200,000
15. Increase Terrace Reservoir spillway capacity to remove storage restriction (in return for instream flow storage); PMF Study	\$1,520,000
31. Riparian buffer zone	\$200,000
22. Sediment trap pilot project with water quality best management practices on Alum Creek	\$1,000,000
23. Reclamation of abandoned mines (Pass-Me-By mine only)	\$325,000
<b>Subtotal</b>	<b>\$10,000,000</b>
38. Recreation or access easements in upper watershed (2 locations, approximately 100 acres total)	\$100,000
38. Conservation / recreation / access easements in lower watershed (approximately 500 acres total)	\$500,000
20/4. Lower watershed sediment deposition locations combined with stream restoration from County Road 10 to County Road 13	\$300,000
24. Mainstem lake for water quality (small size option)	\$4,000,000
41. Increased access to Terrace Reservoir (include parking lot, public education, trail)	\$100,000
<b>Total</b>	<b>\$15,000,000</b>

Note: Arrow indicates that Project 9 is split into two phases. The cost of combined projects, such as stream restoration and revegetation was estimated as 80 percent of their combined total due to economy of scale for doing them at the same time.

**Figure 4-4** depicts the location of the proposed projects in the watershed. The location of easements is shown only to represent the suggested sizes of easement, not their physical location. Easements can only be implemented with the consent of the landowner.



<p>2 0 2 4 Miles</p> 	 <p style="text-align: center;"><b>Alamosa River Watershed Restoration Master Plan</b></p> <p style="text-align: center;">MWH in association with Agro Engineering, Lidstone and Associates, and SWCA</p>	<p><b>Figure 4-4. Preferred Alternative Project Locations</b></p> <p>Note: Projects without a location such as funding for the Foundation are not shown. Riparian buffer zone would cover the entire riparian corridor of the Alamosa River.</p>
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#### **4.4.1 Funding for Alamosa River Foundation to Help Implement and Monitor the Master Plan**

Several citizens groups have formed to promote the health of the watershed and represent the interests of its residents. However, these groups are volunteer organizations. The Alamosa River Foundation was involved in the development of the Master Plan from its inception. It is recommended that the Alamosa River Foundation be provided with funding for a part-time staff person or persons to assist the Trustee Council by performing the following tasks:

- Act as watershed coordinator to facilitate community meetings.
- Assist in restoration project monitoring activities. Coordinate professionals and volunteers for restoration project monitoring as described in **Section 5.3**.
- Act as a restoration project sponsor/manager to submit proposals to Trustee Council for NRD funding.
- Act as project manager to implement restoration projects listed in the Master Plan but not receiving NRD funding.
- Seek additional funding from other sources for restoration projects to increase the funding available for watershed efforts well beyond the NRD funding.
- Seek additional funds for operating the Alamosa River Foundation to increase the scope and scale of activities the Foundation is able to perform.
- Work with the Colorado Tourism Office and other agencies and non-profit groups to promote tourism and recreation in the Alamosa River watershed.
- Conduct a public relations campaign to publicize watershed improvement projects, increased recreational opportunities in the watershed, and success stories.
- Communicate potential work opportunities to local businesses by publicizing RFPs, contracting, and project management opportunities. Using local project managers and contractors may help maximize cost savings and increase local ownership of the watershed restoration effort.
- Strive to manage and complete projects in the most cost-effective way in order to maximize the goals that can be achieved with available funding.

#### **4.4.2 Instream Flow Projects**

The instream flow project requires four projects discussed independently in Section 3 and 4.2.2:

- Purchase appropriate water rights for instream flow.
- Trade of direct flow diversion right for Terrace Reservoir storage.
- Increase Terrace Reservoir spillway capacity in return for instream flow storage.
- Probable maximum flood study.

##### ***Instream Flow Water Rights***

This project would acquire water rights to maintain streamflow during periods when the river is dry under existing conditions. The minimum release from Terrace Reservoir needed to significantly improve water quantity conditions below Terrace Reservoir is not known for certain. It has been assumed that reasonable targets are a 10 cubic feet per second flow from Terrace Reservoir to Gunbarrel Road and a 5 cubic feet per second flow from Gunbarrel Road to County Road 10. A senior priority water right would be purchased from one or more willing sellers to provide sustained instream flows in virtually every year. A senior right could be combined with other lower priority rights until the target flow is established.

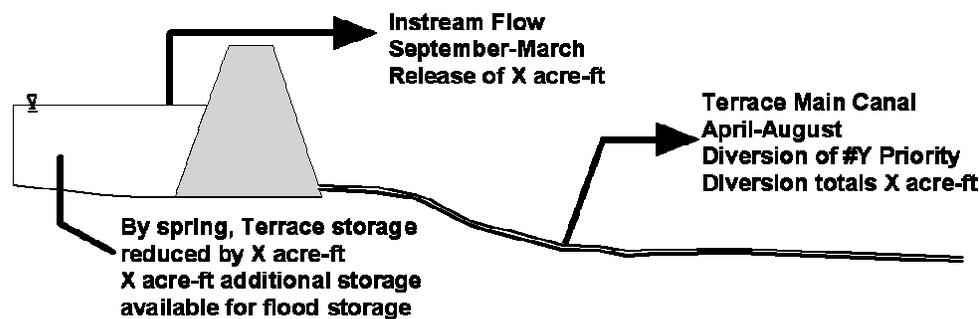
If willing water right sellers are identified, there are still several challenges to implementing this project including:

- Acquiring a water right to establish a more sustainable instream flow lasting longer than the current flow management will only be successful if storage is available for that flow.
- Negotiations with the Colorado Water Conservation Board (CWCB) will be required to create an instream flow donation or lease agreement.
- Applications to change the water right to instream flow uses must be formulated by an attorney and filed with the water court.
- The water right may be obtained with or without the associated land. If land is acquired as part of the transfer, a plan for long term management of the property will have to be developed.

### ***Trade of Direct Flow Diversion Right for Reservoir Storage***

Storage of the acquired water rights would be needed to capture spring and summer runoff for release throughout fall and winter. Assuming storage could fill over 6 months and release over 6 months, about 3,600 acre-feet of storage would be needed.

This project is an option for storing acquired water rights in Terrace Reservoir without construction of new storage facilities. Potentially, Terrace Irrigation Company could use the acquired water right as it is available in the spring and summer for irrigation purposes. The amount diverted would vary based on the water year. Then, an equal amount could be released from Terrace Reservoir during late fall, early spring, and perhaps winter months as a trade. **Figure 4-5** shows a simple schematic of a potential trade of use.



**Figure 4-5. Schematic of Trade of Direct Flow Right for Storage for Instream Flow**

By spring, the release out of Terrace Reservoir would reduce the volume of stored water in Terrace Reservoir by the total amount diverted the previous season through the Terrace Main Canal. This additional space could then be used to capture high spring flows. Therefore, the storage available for Terrace Irrigation Company to capture high flows would not be reduced. However, the Terrace Irrigation Company would probably be forced to divert more water early in the irrigation season while the acquired water right was in priority and reduce stored water that would be available late in the irrigation season.

This project would require Terrace Irrigation Company to agree to the trade, and reservoir improvements may be needed as an exchange for the trade. It would also require approval from the Division Engineer and potentially a water right change.

### ***Increase Spillway Capacity in Return for Instream Flow Storage***

Increasing the Terrace Reservoir spillway capacity, thus allowing for the removal of the State Engineer-imposed filling restriction is the most economical way to increase the physical storage capacity available in Terrace Reservoir. Removing the filling restriction would recover about 2,200 acre-feet of storage capacity. This project could potentially be done in place of or in addition to Project 12, Trade of Direct Flow Diversion Right for Reservoir Storage. There are many options for increasing the spillway capacity that should be investigated through a feasibility study prior to design and construction. **Section 3.7.1** describes several spillway improvement options.

### ***Probable Maximum Flood Study***

Conducting a site-specific probable maximum flood (PMF) study for the basin could potentially reduce the cost of increasing the spillway capacity. Site-specific PMF studies are frequently successful in reducing the anticipated amount of flow that structures are required to pass. A more specifically calculated anticipated flood event could reduce the cost required to improve the spillway and remove part or all of the State Engineer's restriction on the reservoir. This project would be done in conjunction with Project 15, Increase Terrace Reservoir Spillway Capacity.

### **4.4.3 Stream Restoration and Vegetation Projects**

The stream restoration projects will stabilize the channel and banks, thereby decreasing the amount of sediment entering the river, promoting native streambank vegetation, and enhancing fish and migratory bird habitat. The main focus of the proposed stabilization and restoration projects is to limit the amount of sediment entering the river due to stream bank erosion. Mitigating sediment supply will improve channel stability at irrigation diversions and bridges, and will help maintain channel capacity. The four channel stabilization projects included in the preferred alternative are:

- Terrace Reservoir to Wightman Fork
- Gunbarrel Road to Gomez Bridge
- County Road 10 to Gunbarrel Road
- County Road 13 to County Road 10

In addition to these four restoration projects, three vegetation projects are included:

- Dead tree management
- Revegetation
- Noxious weed management

#### ***Stream Restoration Terrace Reservoir to Wightman Fork***

It is recommended that the bank stabilization efforts in this reach focus on small areas of the river channel impacted by human influences or with high rates of erosion. It will also repair areas where the river is encroaching on the access road. Fish habitat enhancement features could be incorporated into the design to provide areas for fish if the water quality improves.

#### ***Stream Restoration Gunbarrel Road to Gomez Bridge***

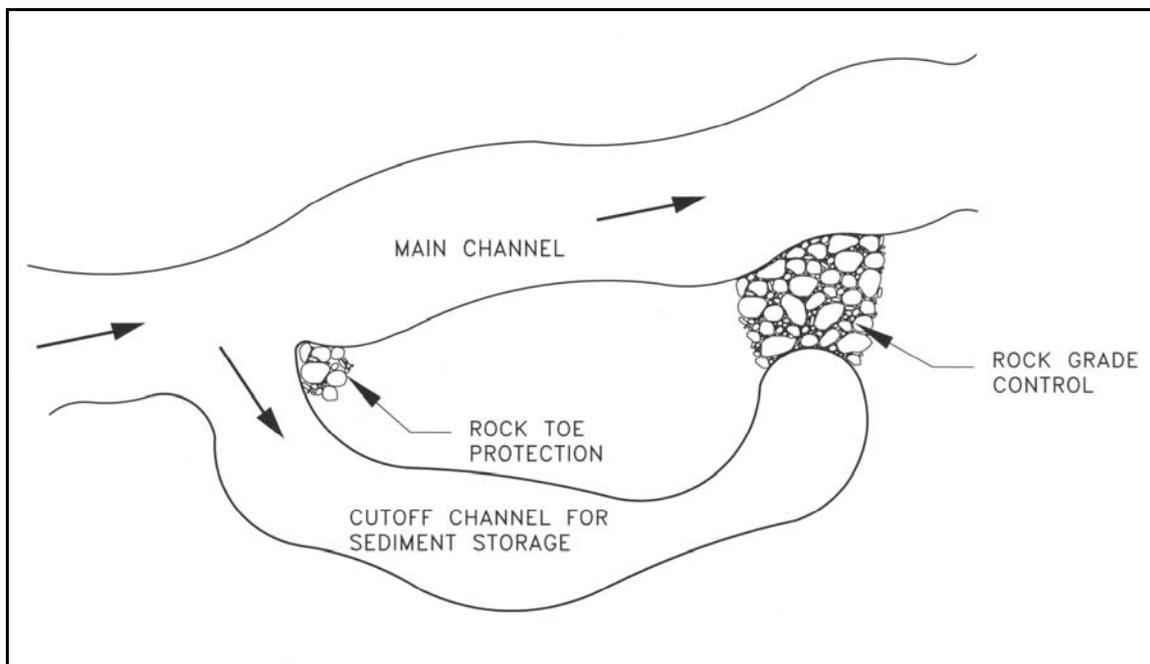
In the reach from Gunbarrel Road to Gomez Bridge there are steep eroded banks with the potential to introduce significant sediment load to the channel. During periods of high flow, this sediment is transported downstream of Gunbarrel Road where the sediment drops out and clogs the channel. Stream restoration to protect these banks would improve habitat in the downstream area most benefited by the instream flow project.

### ***County Road 10 to Gunbarrel Road***

There is currently a channel stabilization project underway between County Road 10 and Gunbarrel Road. Although construction started on the project in 2004, there are not enough funds available to complete the implementation. Completion of this restoration project will minimize the amount of sediment transported to downstream reaches and improve the efficiency of diversion structures.

### ***County Road 10 to County Road 13 – Combined with Sediment Deposition***

The main focus in this reach will be to stabilize the few isolated, eroded banks and manage sediments that tend to accumulate in the channel. Creation of sediment storage and deposition sites is recommended to manage existing and anticipated sediment load. **Figure 4-6** shows an artificial cutoff channel. This feature creates a location off of the main channel for excess sediment to drop out, thus promoting channel stability. The artificial channel is created by excavating material parallel to the main river channel and connecting the upstream end of the cutoff channel to the river.



**Figure 4-6. Artificial Cutoff Channel**

### ***Dead Tree Management***

There are areas near Jasper where trees have fallen in the river causing water to backup, potentially causing flooding. The trees should be removed from the river.

Downstream of Capulin, there is a stretch of cottonwood trees that are dead and will eventually fall into the river. These trees should be selectively removed if they are in danger of falling into the river or damaging river structures. Trees not in danger of falling should be left for wildlife habitat. Larger areas of dead trees could be removed when combined with revegetation efforts. The removed trees could be used as material for stream restoration and aquatic habitat projects.

### ***Revegetation***

After instream flow and any recontouring projects are completed, portions of the lower watershed should be revegetated with native plants. Riparian revegetation should be concentrated on the river from County Road 10 upstream to Terrace Reservoir. The dead cottonwood trees, combined with a lack of understory shrubs and saplings, results in a virtual lack of riparian corridor. Revegetation

should focus on creating multistory layers of cottonwoods and willows. Cottonwood trees require overbank flooding and shallow groundwater levels to flourish.. Although revegetation has been shown to be possible without instream flow, revegetation efforts must consider the amount of water available so that projects have a high likelihood of success.

### ***Noxious Weed Management***

The primary focus envisioned for this effort is to control noxious weeds in riparian areas that are restored or protected by stream restoration, revegetation, and riparian buffer projects. The aim of stream restoration is to eventually restore a vegetative cover that will stabilize banks and provide habitat. Noxious weed management will be a component of restoring healthy native vegetation to stream banks and riparian areas.

Currently, there are existing groups attempting to control weeds in the lower watershed primarily in agricultural areas. The existing weed management control district could be funded to control weeds in the riparian area of the Alamosa River or in the specific project areas.

#### **4.4.4 Riparian Buffer Zone**

A riparian buffer is an area adjacent to a water body that has been set aside for conservation and maintenance to protect stream and riparian habitat quality. Activities such as farming and development are limited in the buffer zone. The typical width of a buffer zone is 100 feet on either side of the channel with additional space in wetland areas or areas with significant streambank erosion. Buffers can be created through a combination of ordinances and easements, or can be implemented on a voluntary basis. In the Alamosa River where development pressure is minimal, a voluntary stream buffer implemented through education and easements may be the preferred option. A number of financial incentives for agricultural landowners to establish riparian buffers exist from government and private sector programs such as the Conservation Reserve Program.

#### **4.4.5 Sediment Trap Pilot Project with Water Quality BMPs on Alum Creek**

During high flows, Alum Creek carries a tremendous bedload of sediments derived from hydrothermally altered rocks to the Alamosa River. These rocks typically contain sulfide-rich accessory minerals, which when oxidized contribute metal loading as well as low pH runoff and acidic conditions in the Alamosa River. Following spring runoff, a large fan of materials is deposited at the terminus of the creek, and these sediments are then progressively eroded and carried downstream by the Alamosa River. . **Figure 4-7** shows a photo of the sediment fan looking upstream as it was being eroded during summer of 2004.



**Figure 4-7. Photo of Alum Creek Sediment Fan Being Eroded by Alamosa River**

A sediment trap and water quality project would consist of regrading the fan area, stabilizing the adjacent river bank with limestone rock, constructing limestone rock check dams within the Alum Creek channel to trap a portion of the annual bedload, and directing the lower portion of Alum Creek to a flow-through pond. There are several options for water quality improvements that could be tested on Alum Creek as pilot projects and potentially implemented if successful and if funds are available. However, any sediment trap and water quality project would require significant, regular maintenance.

#### **4.4.6 Reclamation of Pass-Me-By Mine**

Contaminant loads from smaller historical mining sites are less significant on a watershed scale than loads from the Summitville site and loads from natural sources. These smaller mine sites represent less than one percent of the watershed contaminant load for copper, zinc, and magnesium, and less than 3 percent of the contaminant load for iron and aluminum. However, as point sources the mines are more readily treatable than non-point sources. The Pass-Me-By Mine produces the highest contaminant loads of all of the smaller sites. The project could include a combination of an anoxic limestone drain at the collapsed mine portal followed by a sulfate reducing wetland or settling basin as well as capping and diversion of drainage around the mine tailings dump. The Pass-Me-By Mine is located on private property and an agreement would be needed from the landowner to implement the project.

#### **4.4.7 Easements**

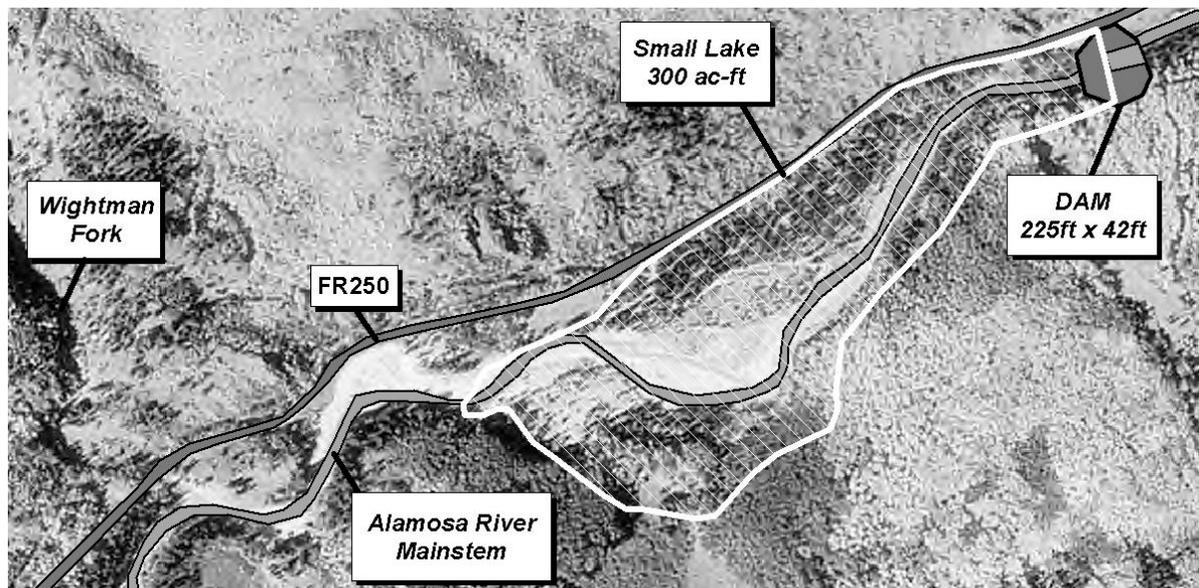
Easements may be negotiated with willing landowners along the Alamosa River for various purposes such as conservation, recreation and access to the Alamosa River. Conservation easements are a tool to protect and enhance existing quality habitat and areas that can be improved through restoration projects such as those in the riparian corridor. Conservation easements are legal agreements between a landowner and a public agency or conservation group, in which the parties agree to protect certain natural resource values of the land or provide access to the public. Due to the extensive private

ownership along the river, access and recreation easements are proposed to allow the public to benefit from the restoration projects.

#### 4.4.8 Mainstem Lake for Water Quality

A lake constructed on the mainstem of the Alamosa River below Wightman Fork could significantly improve water quality conditions downstream in the watershed. The primary water quality improvement mechanism of a lake is the capture of sediments. Suspended sediments and metals in particulate form would be removed from the Alamosa River by such a lake. Lime addition or injection within the lake is an additional active process that could potentially reduce all water quality contamination and help meet water quality standards. In order to maintain the lake's capacity, sediments would periodically need to be removed.

**Figure 4-8** shows the potential location for a small, 300 acre-feet, lake on Forest Service land just below Wightman Fork. The size of the lake was estimated so that the current Forest Service road would not be inundated.



**Figure 4-8. Conceptual View of Small Mainstem Lake Below Wightman Fork**

#### 4.4.9 Increased Access to Terrace Reservoir

Improving public access to Terrace Reservoir should increase recreational utilization of the reservoir area. Improvements can include increased parking on FR 250, the establishment of a maintained trail from the parking area to the reservoir shore, fishing access, small boat and picnicking facilities, and lavatories. Educational signage could be included to teach visitors about water quality, mining impacts, and the Master Plan.

## 4.5 Environmental Consequences

The environmental consequences of the three preliminary alternatives, the Preferred Alternative, and the No Action Alternative are discussed below. The alternatives are referred to as alternatives 1 through 5:

- Alternative 1 – No Action
- Alternative 2 – Project Rank Preliminary Alternative
- Alternative 3 – Watershed Objectives Preliminary Alternative
- Alternative 4- Trustee Preferences Preliminary Alternative
- Alternative 5 – Preferred Alternative / Proposed Action

This section is based on the assumption that all actions identified under each alternative would be implemented successfully.

The environmental consequences of Alternative 1, the No Action Alternative, are what would happen if none of the Master Plan projects were implemented. Consideration of this alternative is a requirement of the National Environmental Policy Act (NEPA). These consequences are discussed in **Section 4.5.1**. Alternatives 2 through 5 are considered the action alternatives. Most of the projects included in the action alternatives are the same for all alternatives. Therefore, the similar environmental consequences of the action alternatives are discussed together in **Section 4.5.2**. Then, in **Sections 4.5.3** through **4.5.6**, each action alternative is discussed independently to cover the different environmental consequences that would occur as a result of the varying projects implemented in each alternative. **Section 4.5.7** summarizes the environmental consequences of all of the alternatives.

### 4.5.1 Alternative 1 – No Action

NEPA requires that a No Action Alternative be considered. The No Action Alternative consists of the expected conditions under current programs pursued outside the NRDAR process. These current programs include management of the Rio Grande National Forest, efforts of the Alamosa River Foundation, and CDPHE's cleanup programs at Summitville, all at current funding levels. It is assumed that the stream restoration project currently in progress between Gunbarrel Road and County Road 10 would be completed and that the Summitville Treatment Plant and other water quality mitigation measures would continue to operate at their current capacity. The No Action Alternative is the baseline against which the other actions are compared. If this alternative were implemented, the Trustees would not initiate specific actions to restore natural resources potentially injured by Summitville releases to the environment.

The No Action alternative is moot in that restoration is a court ordered action required by the settlement described in Section 1.3. The No Action Alternative is described here as a basis of comparison for the other alternatives.

#### ***Surface Water Impacts***

The lower Alamosa River would continue to be dry between late fall and early spring. Water quality between Wightman Fork and Terrace Reservoir would continue to be degraded from high metals load, high sediment transport, and low pH.

#### ***Groundwater Impacts***

Regional groundwater levels will continue to decline.

***Habitat Impacts***

The riparian habitat and aquatic habitat of the lower Alamosa River would continue to degrade due to lack of sustained flow. Poor water quality would continue to impact the aquatic and riparian habitat in the watershed due to high metals loading and low pH.

***Biological Impacts***

The degrading riparian habitat would lead to fewer riparian dependent species in the watershed. There would be no sustainable fish populations in water quality impacted reaches upstream of Terrace Reservoir and the flow impacted reaches downstream of Terrace Reservoir.

***Listed, Proposed and Candidate Species***

The southwestern willow flycatcher, bald eagle, and Canada lynx are endangered species with potential to inhabit the Alamosa River watershed. In the current condition of degraded wildlife habitat along the Alamosa River, there have been no documented occurrences of these species in the watershed (as discussed in **Section 2.9**). Therefore, no change to listed, proposed, or candidate threatened or endangered species or their critical habitats are expected.

***Cultural Resources***

There would be no change in cultural resources.

***Environmental Justice Issues***

Under the No Action Alternative, recreational opportunities would not be improved and environmental quality would not be enhanced. Commonly available recreation such as fishing, hiking, hunting and other activities would continue to be largely unavailable along the Alamosa River.

***Socioeconomic Issues***

Under the No Action Alternative, the image of the watershed as a “dead watershed” would continue and visitors would be discouraged from visiting and enjoying the natural resources. The Master Plan would not be implemented and would not provide opportunities for jobs in the watershed.

***Land Use Issues***

There would be no change to the current land use and traffic patterns. Channel instability would continue to pose problems for irrigators.

***Cumulative Impacts***

If the No Action Alternative were chosen, riparian and aquatic habitat would continue to be in a degraded condition due to natural and human-induced factors. Species dependent on riparian and aquatic habitat may also be further harmed due to continued degradation of existing habitat. The image of the watershed would still be of damaged natural resources and poor water quality. Channel instability would continue to pose problems for irrigators and no additional jobs would come to the watershed for restoration projects.

**4.5.2 Environmental Consequences Common to Alternatives 2 through 5 (Action Alternatives)**

The following projects are common to each of the action alternatives:

- Funding for the Alamosa River Foundation to help implement and monitor the Master Plan
- Funding to complete ongoing streambank project between Gunbarrel Road and County Road 10
- Stream restoration from Gomez Bridge to Gunbarrel Road

- Stream restoration from Wightman fork to Terrace Reservoir
- Purchase appropriate water rights for instream flow downstream of Terrace Reservoir
- Trade of direct flow diversion right for storage of instream flow water rights in Terrace Reservoir
- Increase Terrace Reservoir spillway capacity and probable maximum flood study
- Reclamation of Pass-Me-By Mine
- Conservation / recreation / access easements in the lower watershed (approximately 500 acres)
- Revegetation
- Dead tree management
- Noxious weed management
- Grazing management

The common environmental consequences of these projects are discussed below.

### ***Groundwater Impacts***

Local groundwater levels would increase, or decline at a slower rate, due to infiltration of surface water into the groundwater in the channel downstream of Terrace Reservoir.

### ***Surface Water Impacts***

Surface water quantity downstream of Terrace Reservoir would be improved due to longer sustained flows. Water quality would be slightly improved due to abandoned mine reclamation and reductions in sediment loading from mine banks and other sources.

### ***Habitat Impacts***

Generally, upland conifer forests, which are the dominant habitats in the upper watershed, appear to be in good condition and would not be impacted by the action alternatives.

Available habitat in the riparian corridor was impacted by placer mining and excessive sedimentation. Abandoned mine reclamation and stream restoration in the action alternatives would reduce these impacts. In-stream aquatic habitat and riparian habitat would be improved by the action alternatives through improved water quality and a more sustained flow in the river downstream of Terrace Reservoir. Improved surface water conditions would lead to enhanced riparian vegetation conditions.

There would be short-term impacts to habitat due to needed earth moving for stream restoration. However, these projects would eventually improve the habitat quality due to the associated revegetation and channel stabilization.

### ***Biological Impacts***

The action alternatives would benefit many different species of fish and wildlife found in the Alamosa River watershed. Preservation and improvement of riparian areas, stream restoration, and instream flow would benefit waterfowl, sparrows, warblers, raptors, beaver and other species known to inhabit these habitats. Water quality improvements and establishment of an instream flow would benefit fish directly and would improve riparian habitat quality and those species dependent upon the riparian zone. Stream restoration projects would create localized scour pools, provide instream cover, and encourage development of small gravel bars for fish habitat. Revegetation would provide additional locations for forage and cover for riparian dependent species. The riparian buffer zone and grazing management would reduce disturbance of the riparian zone.

There would be minimal negative impacts to biological resources from human disturbance caused by increased public access to the river and riparian areas. Public use projects would also protect and potentially minimize human disturbance to fish and wildlife by minimizing human impacts on those resources.

### ***Cultural Resources***

Cultural resources were not investigated in the Master Plan. However, the four action alternatives would either avoid or mitigate any archeological and historic resources or resources that have appreciable cultural value to the Indian tribes of the area. The projects in the action alternatives involving construction would be conducted in a manner complying with the following regulations:

- The National Historic Preservation Act of 1966 (P.L. 89-665 as amended).
- Native American Grave Protection and Repatriation Act (NAGPRA), (P.L. 101-601)
- Archeological Resources Protection Act of 1979 (P.L. 96-95)

### ***Environmental Justice***

Land, easement, and water right purchases would involve transactions with willing landowners paid fair market value. No minority or low-income populations would be displaced or negatively affected in any way. Some of the implemented projects would provide access to low income watershed residents for hiking, fishing, and wildlife viewing.

### ***Socioeconomic Impacts***

Habitat improvements, access, and recreation easements would provide more opportunities for public use and enjoyment of natural resources. Improving natural resource recreation facilities would increase the number of visitors to the Alamosa River watershed, bringing increased business to surrounding communities. Local businesses are likely to be awarded business through the competitive bidding process that would be used to implement the action alternatives. Farmers using irrigation water from the Alamosa River are likely to benefit from improved water quality and channel stability.

### ***Land Use Impacts***

There would be a decrease in the area of agricultural land irrigated by Alamosa River water due to the transfer of water rights to instream flow. This land may or may not be in the natural watershed due to irrigation diversions that currently transport water outside of the watershed. If the land is sold in conjunction with a water right transfer, a management plan for the land would be implemented.

Conservation, recreation, or access easements would be obtained for approximately 500 acres in the lower watershed. This would provide more recreational opportunities for watershed residents and visitors in the lower watershed. The added recreational and access opportunities may lead to more traffic on State Highway 15 and other routes providing access to the river downstream of Terrace Reservoir.

## **4.5.3 Alternative 2 – Project Rank Alternative**

The projects that are in the Project Rank Alternative but not all of the action alternatives are:

- Stream restoration County Road 10 to County Road 13
- Riparian buffer zone
- Sediment trap pilot project on Alum Creek
- Recreation / access easements in upper watershed
- Improve Terrace Reservoir outlet works
- Reclamation of abandoned mines including Miser Mine and other smaller projects (in addition to Pass-Me-By Mine)

***Surface Water Impacts***

Surface water quality in the Alamosa River mainstem downstream of Alum Creek would be improved due to removal of suspended sediment and associated pollutants. Surface water quality will be slightly improved due to reclamation of additional abandoned mines.

Improvements to the Terrace Reservoir outlet works would allow operators to release water of higher quality to downstream uses. Improved outlet works would have less chance of releasing large sediment loads downstream.

***Listed, Proposed and Candidate Species***

The southwestern willow flycatcher, bald eagle, and Canada lynx are endangered species with potential to inhabit the Alamosa River watershed. Riparian habitat enhancements would eventually promote use by these species. Current programs to establish target populations of southwestern willow flycatcher would be supported through these actions.

***Land Use Impacts***

New recreation and access easements in the upper watershed would provide recreational opportunities to watershed residents and visitors. This may cause additional traffic on Forest Road 250.

***Cumulative Impacts***

The instream flow and stream restoration projects would improve riparian and aquatic habitat and increase populations of dependent species. Water quality associated with suspended pollutants would be somewhat improved due the sediment trap on Alum Creek and mine reclamation.

There would be an increase in recreational opportunities in the watershed. Visitors to the watershed and job opportunities for implementing the Master Plan would improve the local economy. Improved channel stability and control over water released from Terrace Reservoir would benefit irrigators. There would be a decrease in the amount of irrigated land due to a transfer of water rights to instream flow. There could be an increase in traffic on roads providing access to the river.

**4.5.4 Alternative 3 – Watershed Objectives Alternative**

The projects that are in the Watershed Objectives Alternative but not all of the action alternatives are:

- Sediment trap pilot project with water quality on Alum Creek
- Increased access to Terrace Reservoir
- Recreation / access easements in upper watershed
- Mainstem lake for water quality
- Lower watershed sediment deposition locations
- Fish stocking at Terrace Reservoir
- Terrace Reservoir dewatering management plan / sediment quality study

***Surface Water Impacts***

Surface water quality in the Alamosa River mainstem downstream of Alum Creek would be improved due to removal of suspended sediment and associated pollutants. Water quality downstream of Wightman Fork would be greatly improved due to the mainstem lake. Suspended sediments and particulate metals would be reduced and low pH winter flows and untreated releases from the Summitville site would potentially be buffered.

***Habitat Impacts***

Additional aquatic habitat would be created by the mainstem lake. Some areas of riparian habitat would be displaced to construct and fill the mainstem lake. Aquatic habitat downstream of mainstem lake would be improved due to improved water quality.

***Biological Impacts***

Water quality improvements due to the mainstem lake and the sediment trap on Alum Creek may be significant enough that fish populations could be sustained between Wightman Fork and Terrace Reservoir. Fish stocked in Terrace Reservoir would increase the number of fish in the vicinity of the Reservoir.

***Listed, Proposed and Candidate Species***

The southwestern willow flycatcher, bald eagle, and Canada lynx are endangered species with potential to inhabit the Alamosa River watershed. Riparian habitat enhancements would eventually promote use by these species. Current programs to establish target populations of southwestern willow flycatcher would be supported through these actions.

***Land Use Impacts***

New recreation and access easements in the upper watershed and new facilities and fish stocking at Terrace Reservoir would provide recreational opportunities and environmental education to watershed residents and visitors. This may cause additional traffic on Forest Road 250.

***Cumulative Impacts***

The instream flow and stream restoration projects would improve riparian and aquatic habitat and increase populations of dependent species. Water quality associated with suspended pollutants would be greatly improved due the sediment trap on Alum Creek and the mainstem lake. Riparian habitat would be displaced in the footprint of the mainstem lake, but could be replaced at the upstream margins of the lake.

There would be an increase in recreational opportunities in the watershed. Visitors to the watershed and job opportunities for implementing the Master Plan would improve the local economy. Improved channel stability and water quality would benefit irrigators. There would be a decrease in the amount of irrigated land due to a transfer of water rights to instream flow. There could be an increase in traffic on roads providing access to the river.

**4.5.5 Alternative 4 – Trustee Preferences Alternative**

The projects that are in the Watershed Objectives Alternative but not all of the action alternatives are:

- Acquisition of equivalent resource in San Luis Valley for high quality habitat and recreation
- Riparian buffer zone
- Mainstem lake for water quality
- Increased access to Terrace Reservoir
- Lower watershed sediment deposition locations

***Surface Water Impacts***

Water quality downstream of Wightman Fork would be greatly improved due to the mainstem lake. Suspended sediments and particulate metals would be reduced and low pH winter flows and untreated releases from the Summitville site would potentially be buffered.

### ***Habitat Impacts***

Additional aquatic habitat would be created by the mainstem lake. Some areas of riparian habitat would be displaced to construct and fill the mainstem lake. Aquatic habitat downstream of mainstem lake would be improved due to improved water quality. Acquisition of the Crowther property would immediately preserve a large area of high quality riparian and endangered species habitat in the Conejos River watershed.

### ***Biological Impacts***

Water quality improvements due to the mainstem lake may be significant enough that fish populations could be sustained between Wightman Fork and Terrace Reservoir. Acquisition of the Crowther property would immediately benefit fish, birds, and wildlife through the preservation of 420 acres of high quality habitat.

### ***Listed, Proposed and Candidate Species***

No negative impacts to listed, proposed, or candidate threatened or endangered species or their critical habitats are expected in the Alamosa River watershed. The acquisition of the Crowther property would preserve 60 acres of endangered southwest willow flycatcher habitat in the Conejos River watershed.

### ***Land Use Impacts***

New facilities at Terrace Reservoir would provide recreational opportunities and environmental education to watershed residents and visitors. Purchasing the Crowther property would preserve fishing areas and increase access on 1 1/2 miles (both sides) of the Conejos River, adjacent to the Alamosa River watershed.

### ***Cumulative Impacts***

The instream flow and stream restoration projects would improve riparian and aquatic habitat and increase populations of dependent species. Water quality associated with suspended pollutants would be somewhat improved due the sediment trap on Alum Creek and mine reclamation. A large area of high quality habitat in the neighboring Conejos River watershed, including habitat for the endangered southwest willow flycatcher, would be preserved. Riparian habitat would be displaced in the footprint of the mainstem lake, but could be replaced at the upstream margins of the lake.

There would be an increase in recreational opportunities in the watershed and in the Conejos River watershed. Visitors to the watershed and job opportunities for implementing the Master Plan would improve the local economy. Improved channel stability and water quality would benefit irrigators. There would be a decrease in the amount of irrigated land due to a transfer of water rights to instream flow. There could be an increase in traffic on roads providing access to the river.

## **4.5.6 Alternative 5 – Preferred Alternative / Proposed Action**

The projects that are in the Preferred Alternative but not all of the action alternatives are:

- Riparian buffer zone
- Sediment trap pilot project with water quality best management practices on Alum Creek
- Recreation or access easements in upper watershed
- Lower watershed sediment deposition locations combined with stream restoration from County Road 10 to County Road 13.
- Mainstem lake for water quality
- Increased access to Terrace Reservoir

### ***Surface Water Impacts***

Surface water quality in the Alamosa River mainstem downstream of Alum Creek would be improved due to removal of suspended sediment and associated pollutants. Water quality downstream of Wightman Fork would be greatly improved due to the mainstem lake. Suspended sediments and particulate metals would be reduced and low pH winter flows and untreated releases from the Summitville site would potentially be buffered.

### ***Habitat Impacts***

Additional aquatic habitat would be created by the mainstem lake. Some areas of riparian habitat would be displaced to construct and fill the mainstem lake. Aquatic habitat downstream of mainstem lake would be improved due to improved water quality.

### ***Biological Impacts***

Water quality improvements due to the mainstem lake and the sediment trap on Alum Creek may be significant enough that fish populations could be sustained between Wightman Fork and Terrace Reservoir.

### ***Listed, Proposed and Candidate Species***

The southwestern willow flycatcher, bald eagle, and Canada lynx are endangered species with potential to inhabit the Alamosa River watershed. Riparian habitat enhancements would eventually promote use by these species. Current programs to establish target populations of southwestern willow flycatcher would be supported through these actions.

### ***Land Use Impacts***

New recreation and access easements in the upper watershed and new facilities at Terrace Reservoir would provide recreational opportunities and environmental education to watershed residents and visitors. This may cause additional traffic on Forest Road 250.

### ***Cumulative Impacts***

The instream flow and stream restoration projects would improve riparian and aquatic habitat and increase populations of dependent species. Water quality associated with suspended pollutants would be greatly improved due the sediment trap on Alum Creek and the mainstem lake. Riparian habitat would be displaced in the footprint of the mainstem lake, but could be replaced at the upstream margins of the lake.

There would be an increase in recreational opportunities in the watershed. Visitors to the watershed and job opportunities for implementing the Master Plan would improve the local economy. Improved channel stability and water quality would benefit irrigators. There would be a decrease in the amount of irrigated land due to a transfer of water rights to instream flow. There could be an increase in traffic on roads providing access to the river.

## **4.5.7 Summary of Environmental Consequences**

**Table 4-3** summarizes the environmental consequences of each alternative.

**Table 4-3. Summary of Environmental Consequences by Alternative**

<b>Attributes</b>	<b>Alternative 1 (No Action)</b>	<b>Alternative 2 (Project Rank)</b>	<b>Alternative 3 (Watershed Objectives)</b>	<b>Alternative 4 (Trustee Preferences)</b>	<b>Alternative 5 (Preferred Alternative / Proposed Action)</b>
Surface water quantity	Continued lack of flow in lower watershed from late fall to early spring.	Longer period of sustained flow in lower watershed.	Longer period of sustained flow in lower watershed.	Longer period of sustained flow in lower watershed.	Longer period of sustained flow in lower watershed.
Surface water quality	Remain degraded due to high sediment and metal load.	Improved water quality associated with mine reclamation and sediment trap on Alum Creek. Additional control of water quality downstream of Terrace Reservoir due to improved outlet works.	Significantly improved water quality associated with mine reclamation, sediment trap on Alum Creek and mainstem lake.	Significantly improved water quality associated with mine reclamation, and mainstem lake.	Significantly improved water quality associated with mine reclamation, sediment trap on Alum Creek and mainstem lake.
Groundwater	Groundwater levels continue to decline.	Groundwater levels rise or decline at a slower rate.	Groundwater levels rise or decline at a slower rate.	Groundwater levels rise or decline at a slower rate.	Groundwater levels rise or decline at a slower rate.
Aquatic habitat	No change	Improved habitat downstream of Terrace Reservoir due to instream flow.	Improved habitat in and downstream of mainstem lake. Improved habitat downstream of Terrace Reservoir due to instream flow.	Improved habitat in and downstream of mainstem lake. Improved habitat downstream of Terrace Reservoir due to instream flow.	Improved habitat in and downstream of mainstem lake. Improved habitat downstream of Terrace Reservoir due to instream flow.
Riparian habitat	Continued loss of habitat due to lack of surface and groundwater and water quality.	Increase of habitat quantity and quality in Alamosa Watershed. Temporary impacts during construction in stream channels.	Increase of habitat quantity and quality in Alamosa Watershed. Displacement of riparian habitat in mainstem lake footprint. Temporary impacts during construction in stream channels.	Increase of habitat quantity and quality in Alamosa Watershed. Preservation of high quality habitat in neighboring Conejos Watershed. Displacement of riparian habitat in mainstem lake footprint. Temporary impacts during construction in stream channels.	Increase of habitat quantity and quality in Alamosa Watershed. Displacement of riparian habitat in mainstem lake footprint. Temporary impacts during construction in stream channels.

Attributes	Alternative 1 (No Action)	Alternative 2 (Project Rank)	Alternative 3 (Watershed Objectives)	Alternative 4 (Trustee Preferences)	Alternative 5 (Preferred Alternative / Proposed Action)
Biological impacts	Continued harm and decrease in numbers of riparian dependent wildlife. No sustainable fish populations in water quality impacted reaches and water quantity impacted reaches.	Fish populations in Terrace Reservoir have potential to migrate downstream of Terrace Reservoir. Increased populations of riparian dependent wildlife.	Improved habitat downstream of mainstem lake due to improved water quality and downstream of Terrace Reservoir due to instream flow. Increased populations of riparian dependent wildlife. Additional fish in vicinity of Terrace Reservoir due to fish stocking.	Improved habitat downstream of mainstem lake due to improved water quality and downstream of Terrace Reservoir due to instream flow. Increased populations of riparian dependent wildlife. Protection of known southwest willow flycatcher and yellow-billed cuckoo habitat in Conejos watershed.	May have sustainable fish populations downstream of mainstem lake and potential for fish downstream of Terrace Reservoir. Increased populations of riparian dependent wildlife.
Cultural resources	No change	Potential impacts to sites and resources will be avoided or mitigated during construction.	Potential impacts to sites and resources will be avoided or mitigated during construction.	Potential impacts to sites and resources will be avoided or mitigated during construction.	Potential impacts to sites and resources will be avoided or mitigated during construction.
Environmental justice issues	No change	Increase in recreational opportunities.	Increase in recreational opportunities.	Increase in recreational opportunities.	Increase in recreational opportunities.
Socioeconomic issues	Image of watershed as “dead watershed” continues. No change in recreational or job opportunities.	Increase in local economy due to improved public image of watershed, recreational opportunities, and additional jobs for Master Plan implementation.	Increase in local economy due to improved public image of watershed, recreational opportunities, and additional jobs for Master Plan implementation.	Increase in local economy due to improved public image of watershed, recreational opportunities, and additional jobs for Master Plan implementation.	Increase in local economy due to improved public image of watershed, recreational opportunities, and additional jobs for Master Plan implementation.
Land use impacts	Water quality and channel instability would continue to degrade the productivity of agricultural areas.	Additional recreation and access in the watershed. Channel stability would benefit irrigators. Decreased land area in production due to transferred water right. Increased reliability and functionality of Terrace outlet works improves water quality.	Additional recreation and access in the watershed and at Terrace Reservoir. Improved water quality and channel stability would benefit irrigators. Decreased land area in production due to transferred water right.	Additional recreation and access in the lower watershed, at Terrace Reservoir, and Crowther property. Improved water quality and channel stability would benefit irrigators. Decreased land area in production due to transferred water right.	Additional recreation and access in the watershed and at Terrace Reservoir. Improved water quality and channel stability would benefit irrigators. Decreased land area in production due to transferred water right.
Traffic impacts	No change	Increased traffic on roads providing access to the river.	Increased traffic on roads providing access to the river.	Increased traffic on roads providing access to the river and Crowther property.	Increased traffic on roads providing access to the river.