Restoration of Rio Grande Cutthroat Trout (*Oncorhynchus clarki virginalis*) and the Native Fish Community to the Upper Rio Costilla Watershed

Draft Environmental Assessment

Prepared By:

New Mexico Department of Game and Fish
Fisheries Management Division
PO Box 25112
Santa Fe, NM 87504

Submitted to:

U.S. Fish and Wildlife Service
Southwestern Region
Federal Aid Division
Albuquerque, New Mexico

Cooperating Agency:

U.S. Forest Service
Southwestern Region
Albuquerque, New Mexico

TABLE OF CONTENTS

List of Figures

List of Tables

1.0 PURPOSE AND NEED FOR ACTION

Purpose for Action: The U.S. Fish and Wildlife Service (USFWS) has proposed to fund in part a project, to be implemented by the New Mexico Department of Game and Fish (NMDGF), seeking to restore the native fish community to the Rio Costilla watershed, Taos County, New Mexico. This Environmental Assessment (EA) was prepared to analyze the potential effects to physical, biological, and cultural resources and socioeconomic conditions that may result from implementing the preferred alternative for the project. This EA will be used by the U.S. Fish and Wildlife Service to determine whether or not the proposed project will be funded and implemented as proposed, if the proposed action requires refinement or additional mitigation measures are necessary, or if further analyses are required through preparation of an environmental impact statement. If the proposed action is selected as described and no further environmental analyses are needed, an Environmental Action Statement and Finding of No Significant Impact will be prepared.

This EA was prepared pursuant to the requirements of the National Environmental Policy Act of 1969 (NEPA) as implemented by the Council on Environmental Quality regulations (40 CFR 1500, et seq.) and the USFWS NEPA procedures.

Need for Action: The proposed action is necessary to restore the native fish community consisting of Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis,* RGCT), Rio Grande sucker (*Catostomus plebeius,*RGS), Rio Grande chub (*Gila pandora,* RGC), and longnose dace (*Rhinichthys cataractae*, LND) to appropriate segments of the upper Rio Costilla within Vermejo Park Ranch (VPR), Rio Costilla Park (RCCLA), and Carson National Forest (CNF). Restoration of the native fish community would require removal of the non-native fishes within streams and lakes within the project area.

Goal: Establish a self-sustaining and widely distributed RGCT population and high quality recreational fishery on VPR, RCCLA, and CNF within the context of overall native fish species conservation in the Rio Costilla drainage.

Project objectives:

1. Increase the distribution of RGCT in New Mexico on VPR, RCCLA, and CNF (NMDGF 2002).

2. Establish a metapopulation of RGCT within the upper Rio Costilla on VPR, RCCLA, and CNF to help secure the long-term persistence of the sub-species (NMDGF 2002).

3. Concurrent with RGCT restoration activities, reestablish the native fish community to suitable habitat within the upper Rio Costilla watershed, including RGCT, RGC, RGS, and LND.

4. Implement a high quality recreational angling program for RGCT in the Rio Costilla watershed.

1.1 Project Background

Rio Grande cutthroat trout are one of 14 recognized subspecies of cutthroat trout native to western North America. Cutthroat trout (*Oncorhynchus clarki)* are distinguished by the red-orange slashes in the gular folds below the jaw. Cutthroat trout once inhabited most coldwater streams throughout western North America. The RGCT is considered the southernmost subspecies of cutthroat trout, and is differentiated from other cutthroat trout by the large spots that are concentrated towards the tail and colorful pink or orange hues on its belly and sides.

Most subspecies of cutthroat trout have suffered large declines within their native ranges. These declines have occurred primarily since the early 1900s due to exotic species introduction, habitat degradation, and over-harvest (Duff 1996). Cutthroat trout thrive in clear mountain streams that provide clean spawning gravel, feeding and resting sites, and food in the form of aquatic and terrestrial invertebrates (Sublette et al. 1990). Ideal habitat conditions have been altered in many locations by human activities including grazing, mining, logging, road building, and agriculture. Since the late 19th century, stocking of non-native trout has been a common practice throughout the western states. Brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) out-compete the native cutthroats for prime habitat areas (Griffith 1988). Behnke (1992) describes a population of greenback cutthroat trout that was virtually replaced by brook trout in five years. Also, cutthroat trout are 20-fold easier to catch than brown trout (Behnke 1992), making them more susceptible to over harvest than non-native trout. Rio Grande cutthroat trout populations currently occupy less than 10% of their original range (Stumpff and Cooper 1996).

RGS was once common in mountain tributaries from southern Colorado to southern New Mexico (Calamusso and Rinne 1999). They prefer habitats with clear water and large substrate. (Sublette et al. 1990). Habitat perturbations and competition with non-native fish such as white sucker (*Catostomus commersoni*) have negatively affected this species (Rees and Miller 2005). Past declines of RGS have been attributed to hybridization with white sucker though recent scientific literature indicates hybridization is rare, if ever (McPhee and Turner 2004). The RGS is now considered endangered in Colorado and declining in New Mexico (Swift-Miller et al. 1999, Calamusso et al. 2002).

Less is known about RGC life history and habitat requirements, but they are considered habitat generalists and can be found in both lotic and lentic environments. They are considered abundant, but declining in New Mexico (Calamusso and Rinne 1999), and declining in Colorado (Sublette et al. 1990). Suitable habitat exists within the proposed project area for RGS and RGC. The RGCT, RGS, and RGC assemblage is currently rare in Colorado and New Mexico streams.

New Mexico Department of Game and Fish has a statutory mandate under Chapter 17 N.M.S.A. to manage RGCT within the state of New Mexico. NMDGF considers RGCT a sensitive species making preservation and expansion of existing populations a priority. Rio Grande sucker and RGC are considered Species of Greatest Conservation Need by NMDGF (NMDGF 2005). Furthermore, the U.S. Forest Service (USFS), USFWS, and NMDGF are signatories to a Range Wide Conservation Agreement for RGCT. The sole goal of the Range Wide Conservation Agreement is to “Assure the long-term persistence of the RGCT subspecies within its historic range by preserving its genetic integrity, reducing habitat fragmentation, and providing sufficient suitable habitat to support adequate numbers of viable, self-sustaining populations" (Conservation Agreement 2003).

To reach this goal, numerous waters in New Mexico are proposed for reintroduction of RGCT. Such projects would establish populations of genetically pure RGCT into hydrologically complex watersheds within the subspecies historic range. Expanded distribution of RGCT would also expand unique angling opportunities for native, southwestern trout. The goals for restoration sites are outlined in the Long Range Plan for the Management of Rio Grande Cutthroat Trout in New Mexico (NMDGF 2002).

The proposed action is a cooperative effort among NMDGF, RCCLA, VPR, USFWS, and CNF to meet the aforementioned objectives. This proposed project is an integral part of the conservation goal for RGCT and would enhance the subspecies status by increasing both the numbers of populations and individual fish. Re-establishing populations of Rio Grande sucker and Rio Grande chub in coordination with RGCT restoration would proactively address historic declines in both species distribution before their status is imperiled. Watershed size, characteristics of the existing fishery, and opportunities to conserve other native fishes support the selection of the Rio Costilla watershed for a restoration project.

1.2 Proposed Action

NMDGF, in cooperation with USFWS, CNF, VPR, and RCCLA, proposes to restore RGCT to the upper Rio Costilla watershed. Where suitable habitat exists, RGC and RGS would be re-established in coordination with RGCT repatriation.

To complete this project, all non-native fish must be removed from a project subsegment prior to reintroducing desired species. The proposed action would remove as many unwanted fish as is logistically feasible, including rainbow trout (*Oncorhynchus mykiss*), cutbow trout (*Oncorhynchus sp.* hybrids), brown trout, brook trout, white sucker, and longnose sucker (*Catostomus catostomus*), with mechanical removals, i.e. angling, electrofishing, and netting. Salvaged trout, via electrofishing or nets, would be stocked into non-project waters where available. A piscicide would be used to remove the remaining fish in the project area. Concurrently LND and pure RGCT, if present in the treatment area, would be collected and held outside of the affected area. Salvaged native fishes would be reintroduced into suitable habitat upon complete removal of unwanted fish in a given segment. Where RGCT do not currently exist, they would be stocked into the restored area post-restoration. Sources for RGCT include transplants from existing wild populations and captive stocks of RGCT reared at the NMDGF Seven Springs Hatchery. Non-native trout stocking would be replaced with RGCT stocking. Upon completion, this action could restore RGCT and the native fish community to over 150 miles of stream habitat, 25 lakes, and Costilla Reservoir in the Rio Costilla watershed and result in one of only a few large stream systems with this native fish community. The proposed action would be implemented in phases over several years. Permanent and temporary fish migration barrier(s) in the Rio Costilla watershed would facilitate implementation over several years. Migration barriers would prevent movement of non-native fish back into the project area. Temporary barriers would facilitate non-native fish removal over a number of years.

1.2.1 Project Area

The proposed project area is the upper Rio Costilla watershed and is divided into three sections. To meet project goals and objectives, NMDGF must remove all non-native fish and restock native fish within the three sections.

Project Area A (Figure 1): Waters within the Rio Costilla drainage on Vermejo Park Ranch including Costilla Creek drainage, #2 (Casias) Drainage, #2 Lake, Seven Lakes Complex, Casias Lakes (4 lakes), Beaver Lake, Long Canyon Creek, Santistevan Creek, Twin Lakes, and Costilla Reservoir and direct tributaries (approximately 63 stream miles, 15 lakes, and the reservoir). This area could be treated independently of Areas B and C due to the Costilla Dam acting as a fish barrier.

Project Area B (Figure 2): Waters within the Rio Costilla drainage on CNF including the Comanche Creek drainage, Powderhouse Creek, La Cueva Creek, mainstem Rio Costilla and other small direct tributaries. (approximately 53 stream miles).

Project Area C (Figure 3): Waters within the Rio Costilla drainage on RCCLA including Latir Creek, Latir Lakes (9 lakes), Midnight Creek, Little Blue Lake, and mainstem Rio Costilla and other small direct tributaries (approximately 31 stream miles and 10 lakes).

Figure 1. Project Area A. Section of the Rio Costilla watershed within Vermejo Park Ranch.

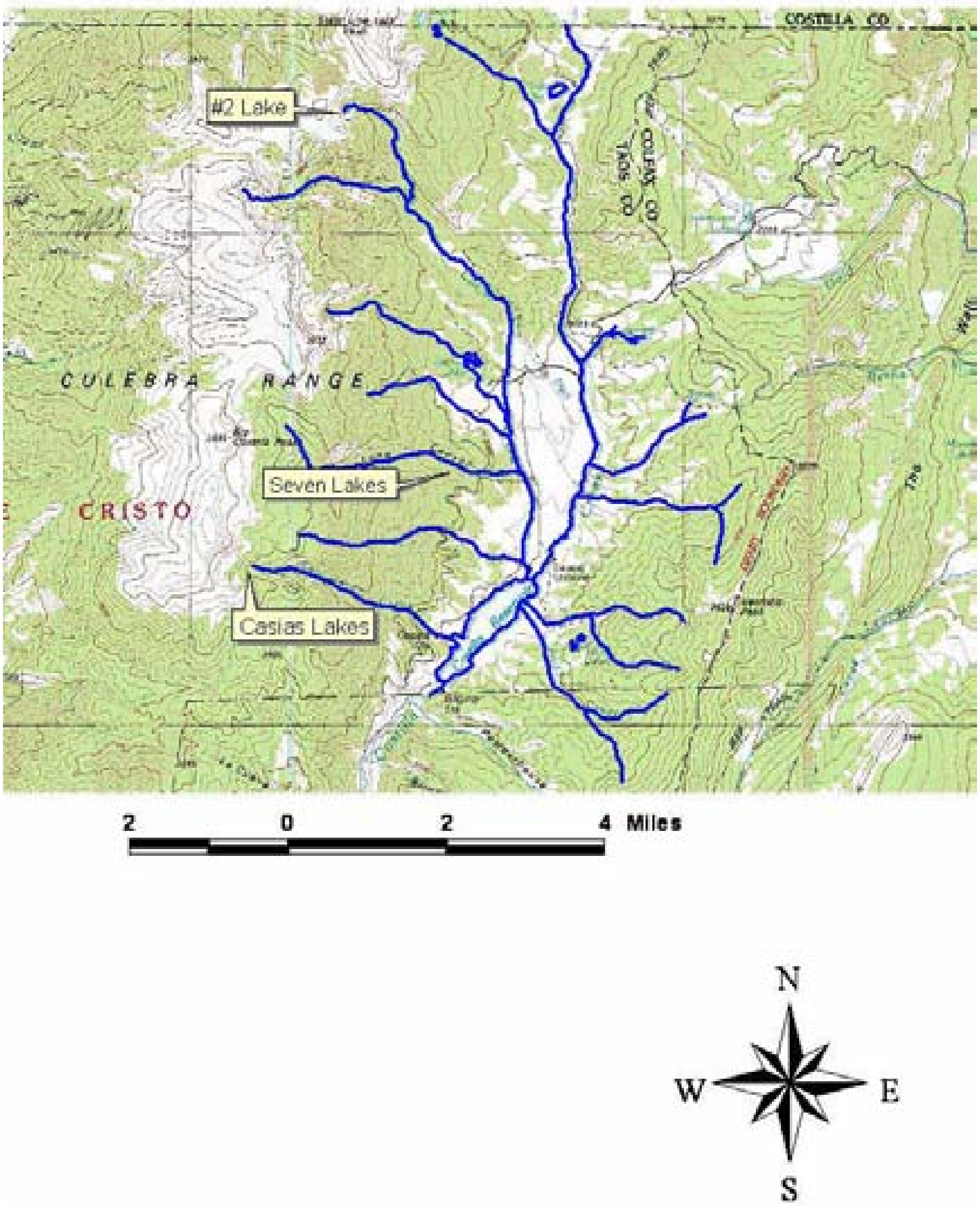


Figure 2. Project Area B. Section of the Rio Costilla watershed within Carson National Forest.

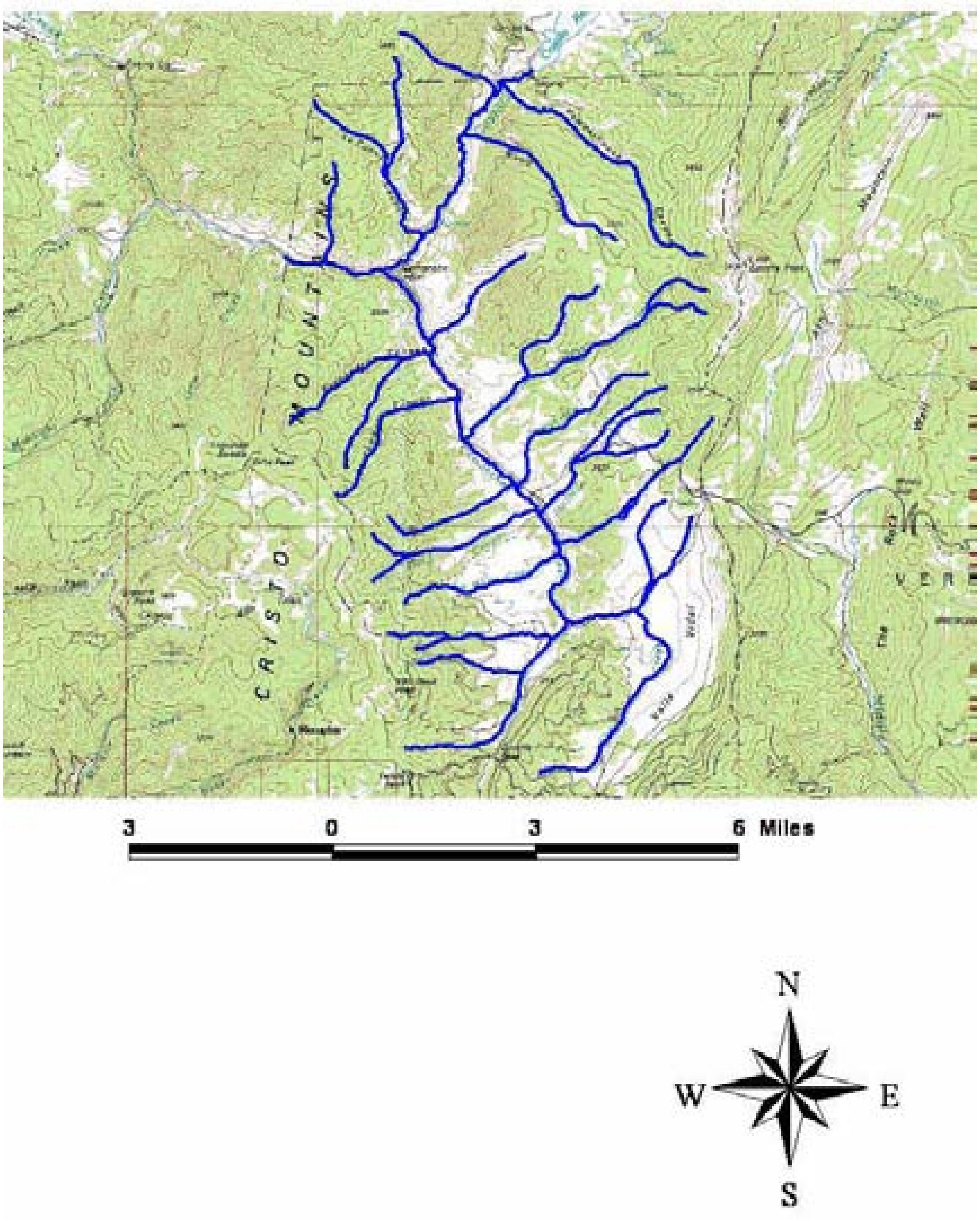
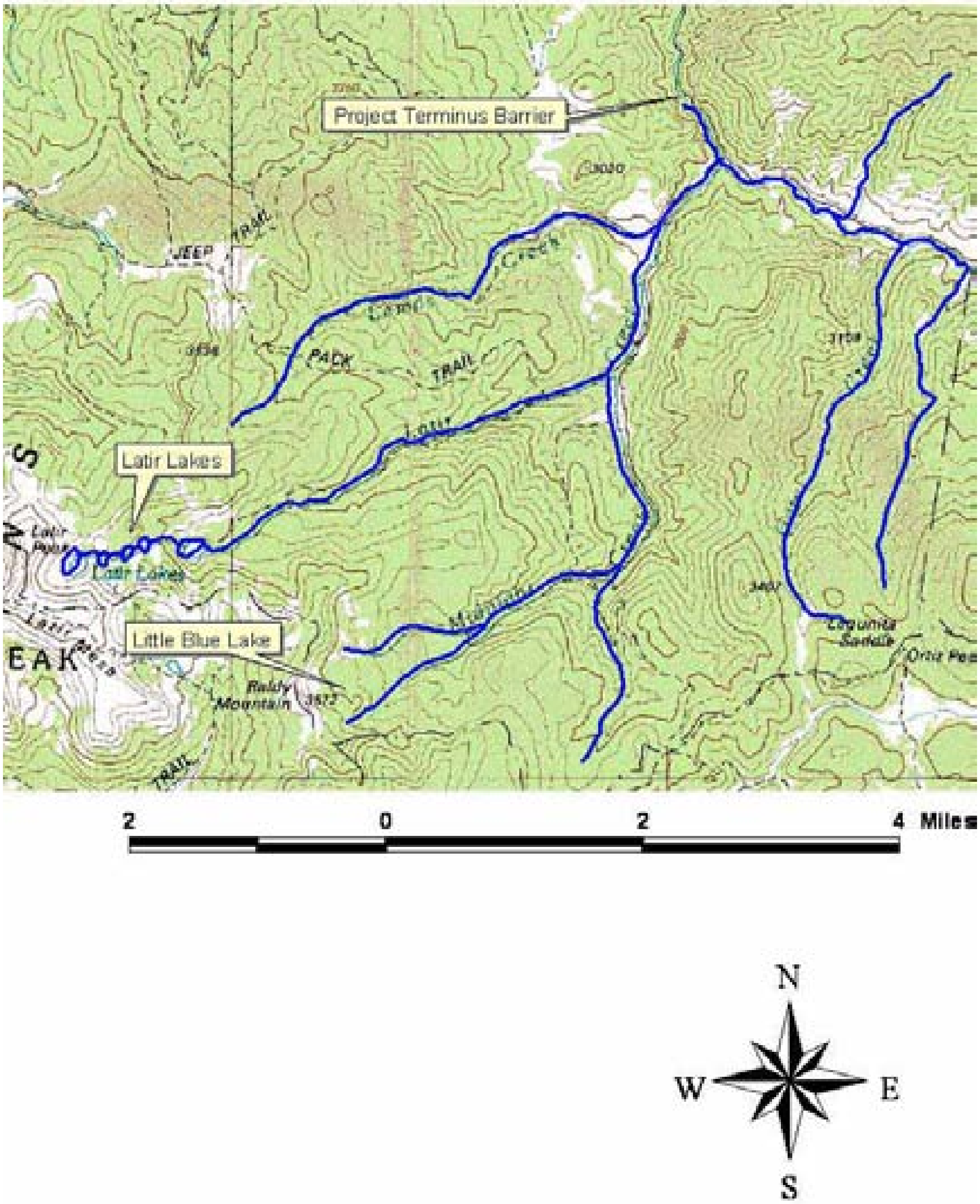


Figure 3. Project Area C. Section of the Rio Costilla watershed within Rio Costilla Park.



1.3 Decisions to be Made

Generally, NMDGF has jurisdiction to manage wildlife and fisheries on all lands within the state of New Mexico with few exceptions. Specifically, NMDGF is responsible for conservation and restoration of RGCT, and has developed a state management plan to guide restoration efforts (NMDGF 2002). Successful completion of this project partially fulfills the objectives of that plan, and NMDGF supports this proposal. The proposed action is a state action and would be partially funded by the USFWS through the Sport Fish Restoration Act and implemented by NMDGF. The Regional Director of USFWS, Region 2, is the responsible official for this EA.

Decisions to be considered for this project include:

- Whether this project would achieve goals associated with the restoration of RGCT and conservation of other native fishes (NMDGF).
- Which alternative is most likely to achieve the proposed project goals for eliminating non-native trout, hybridized trout, longnose sucker, and white sucker within the project area (NMDGF).
- Whether all requirements for the federal Sport Fish Restoration Act Grant have been met for project reimbursement (Regional Director, Region 2, USFWS).
- Whether the proposed action (funding and implementation of the project) would have a significant impact (Regional Director, Region 2, USFWS).

Vermejo Park Ranch and RCCLA will decide whether the proposed action is desirable to meet conservation and economic goals for their respective organizations and whether the project is implemented on their respective properties. While this document provides information to help the decision making process for VPR and RCCLA, a decision by NMDGF or USFWS to fund or implement this project, or any finding of impact in no way binds or commits VPR or RCCLA to project implementation. Vermejo Park Ranch, RCCLA, and NMDGF have agreed in principle, via a Memorandum of Understanding, to work cooperatively towards planning and implementing the project.

1.3.1 Analysis of Related Planning Documents

Local and regional planning or regulatory documents were reviewed to determine whether the proposed action is compatible with goals and objectives outlined in those documents, which include the Multiple Use Area Guide – Valle Vidal Management Unit (USDA 1982), the *Long Range Plan for the Management of Rio Grande Cutthroat Trout in New Mexico* (NMDGF 2002), NM Comprehensive Wildlife Conservation Strategy (NMDGF 2005), and the State of New Mexico *Standards for Interstate and Intrastate Streams* (NMAC 20.6.1 et seq.). The proposed project does not appear to conflict with any of these documents, and is directly supported by the action objectives listed in the RGCT management plan.

1.4 Public Scoping of Relevant Issues

A project scoping letter was mailed to approximately 450 individuals, organizations, tribes and pueblos, and government agencies on January 23, 2006 and invited individuals to attend a public forum on February 18, in Costilla, NM (Appendix A). The letter requested comments by February 27, 2006. Eighteen responses or letters were received (Appendix B). All respondents had one or more comments or questions specific to the project.

NMDGF and project cooperators held a public forum in Costilla, NM on February 18, 2006 to present the proposed project to the public and receive comments. The forum included several topic stations which presented the project need, available methods for addressing project needs, provided piscicide information materials, and RGCT management information (Appendix C). Staff representing NMDGF, USFWS, CNF and members of Trout Unlimited participated in the event. Staff from NMDGF also met with private individuals and organizations on two occasions in January and February 2006 to discuss the project.

Several issues were identified from discussions among interdisciplinary team members and comments from the public during scoping. These issues helped to define possible actions, alternatives, and effects that are discussed in this Environmental Assessment and served as the basis for refining the project and mitigating potential effects.

1.4.1 Comments Studied in Detail

Many respondents asked the agencies to conduct thorough analyses and disclose the effects of the actions being proposed. Comments were summarized as follows:

- disclosure of effects of the restoration actions on quality and quantity of fishing within the project area
- disclosure of the effects of temporary and permanent fish migration barriers on stream hydrology, cultural resources, aesthetics, and Wild and Scenic River eligibility
- disclosure of the effects of electrofishing on target and non-target species
- disclosure of the effects of barriers on downstream water users
- disclosure of native fish salvage plans and associated risks
- disclosure of the history of non-native trout stocking in the project area
- disclosure of the effects on cultural resources
- disclosure of historic RGCT restoration projects in New Mexico
- disclosure of evidence documenting the existence of RGCT populations

1.4.2 Significant Issue

Use of a piscicide to remove non-native fish and the effects of such action on non-target aquatic and terrestrial biota, human health, livestock, downstream water users, and compliance with water quality regulations was identified as a significant issue and was used to formulate the alternatives.

1.4.3 Comments not Studied in Detail

Potential Listing of RGCT as Threatened or Endangered under the Endangered Species Act

The USFWS concluded in two status reviews that RGCT need not be listed as endangered or threatened under the Endangered Species Act (ESA) (67 FR 39936). Since that time, forward progress has been made in restoring the subspecies within the historic range. Formalized conservation efforts are considered as further evidence that listing under the ESA is not warranted (68 FR 15100). Projects as proposed should help preclude the need for RGCT listing under ESA. A recent district court decision dismissed a challenge to the USFWS decision that listing of RGCT as threatened or endangered was not warranted. This decision by the district court Court was appealed to the 10th Circuit.

No Concurrent Restoration of Rio Grande Chub and Rio Grande Sucker
The distribution of RGC and RGS has declined across each species historic range. They are part of the native fish assemblage that was present with RGCT prior to habitat degradation and introduction of non-native fishes. Proactive conservation efforts now would proactively address these issues and prevent further decline of the species. In addition, RGS and RGC would be established only in areas with suitable habitat within the project area.

Water Management in the Rio Costilla Drainage
No proposals connected with this project seek to change the amount, timing, or delivery of water in the Rio Costilla drainage. All analysis has been done on the assumption that the current water management practices will continue into the future.

Proposed coal-bed methane gas drilling in the Valle Vidal
Planning for the proposed action began in 2003 prior to any proposals for coal-bed methane gas drilling in the Valle Vidal. Coal-bed methane gas drilling is not proposed within the project area. Any coal-bed methane gas drilling on the Valle Vidal could adversely affect water resources associated with, if this project were completed, the largest population of RGCT in New Mexico.

2.0 DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter describes alternatives considered for native fish restoration in greater detail. To successfully restore an area for RGCT and other native fishes, all non-native fish and introgressed trout must be removed. Alternatives presented were formulated through interagency discussions, technical information, public safety concerns, and records of public input. Proposed areas were selected considering requirements to establish viable RGCT populations and potential barrier locations.

2.1 Alternative 1. No Action

No action would maintain the current fish assemblage in the upper Rio Costilla watershed. Management of the current fishery, including stocking, monitoring, angling, and enforcement of fishing regulations, would remain the same. Hybridization of existing populations of RGCT in the Rio Costilla watershed would continue. The range of other fish species, RGC and RGS, would remain the same.

2.2 Alternative 2. Restoration of RGCT and the Native Fish Community Using Angling, Electrofishing/Netting and Chemical removal in the Upper Rio Costilla watershed – Preferred Action

The proposed project includes four key elements: permanent and temporary fish migration barriers, salvage and repatriation of native fish, removal of non-native fish, and monitoring restoration success. Total mileage of streams proposed for restoration is greater than 150 mi. but would depend upon the water year. Total number of lakes proposed for restoration includes 10 on RCCLA and 15 on VPR and Costilla Reservoir. Whether restoration would actually occur within all of this area would depend upon the water year, persistence of natural barriers limiting the current distribution of non-native fish, and whether non-native fish invade waters currently uninhabited (See Section 3.2 for further discussion).

The proposed project would take approximately 10-15 years to complete. As allowed by project progress, NMDGF would replace non-native stocking with RGCT stocking. Early in the planning phase of the project, project subsegments were designated as Tier 1, 2, and 3 (Figure 4). Such designations indicate subsegment dependency. Tier 1 waters can be isolated by a temporary fish migration barrier and restored independently of one another. Restoration of Tier 2 waters is dependent upon successful restoration, including piscicide application and fish stocking, of upstream segments of the Tier 1 waters within a given subsegment. Likewise, restoration of Tier 3 waters is dependent upon successful restoration of Tier 2 waters. Further subdivision of Tiers is possible if warranted.

Tier 1
Upper Comanche drainage (Little Costilla to headwaters) (CNF)
Upper Casias drainage including Lake #2 (VPR)
Upper Costilla drainage (VPR)
Latir Drainage (RCCLA)
Gate Creek (RCCLA)
Long Canyon Creek (including 7 Lakes complex) (VPR)
Casias Lakes (VPR)
Allen Creek (VPR)
Santistevan Creek (outflow from Casias Lakes) (VPR)
Beaver Lake and tributaries (VPR)

Tier 2
Lower Casias and tribs (to reservoir) (VPR)
Lower Costilla #1 and tributaries (to reservoir) (VPR)
Costilla Reservoir and lower ends of tributaries (VPR)

Tier 3
Powderhouse Creek and La Cueva Creek (CNF)
Rio Costilla and tributaries (below reservoir) (All)
Lower Comanche Creek and tributaries (CNF)

Access
Access for implementation would involve use of existing roads, horseback, and foot travel. No new or temporary roads are required under the proposed action.

Barriers
A permanent barrier below the confluence of Latir Creek with the Rio Costilla is required to complete the proposed action (Figure 5). The permanent barrier would be anchored into the

canyon walls with rebar, constructed of concrete, minimize pooling, and function under a variety of flow regimes. Prior to conducting any treatment, where success of that particular treatment is dependent upon the project terminus barrier, the barrier would be in place and functioning. Temporary barriers would be installed to subdivide the project area into subsegments. Temporary barrier locations would be selected based upon channel characteristics and biological needs for the treatment. Structural design would range from gabion/concrete drop structures, culvert modifications, or other applicable designs. Concrete drop structures are currently present within the project area and protecting RGCT populations from non-native fish. Temporary barriers would remain in the channel until downstream locations were restored to secure native fish populations and then removed or altered to enable fish migration among sections. Temporary barriers would likely be constructed on lower Casias Creek, Latir Creek, Comanche Creek, Allen Creek, Santistevan Creek, and Long Canyon Creek (Figure 4). Temporary barriers on Allen Creek, Santistevan Creek, and Long Canyon Creek would involve extending the existing culvert to create a drop impassable by resident fishes. A culvert modification along FR 1950 just below the confluence of Comanche Creek and Little Costilla Creek is planned for construction in fall 2006. This action was previously analyzed by a categorical exclusion and subsequent decision notice by Carson National Forest and designed to protect RGCT in the upper Comanche Creek watershed from further invasion of non-native trout independent of any restoration efforts (Appendix D).

No restoration activity would occur within a project subsegment prior to construction of a temporary or permanent barrier which would inhibit non-native fish from re-invading that particular subsegment. Any required permits (404, 401 and SHPO) would be obtained prior to barrier construction.

Figure 4. Map of project area subdivided by Tiers 1, 2, and 3.

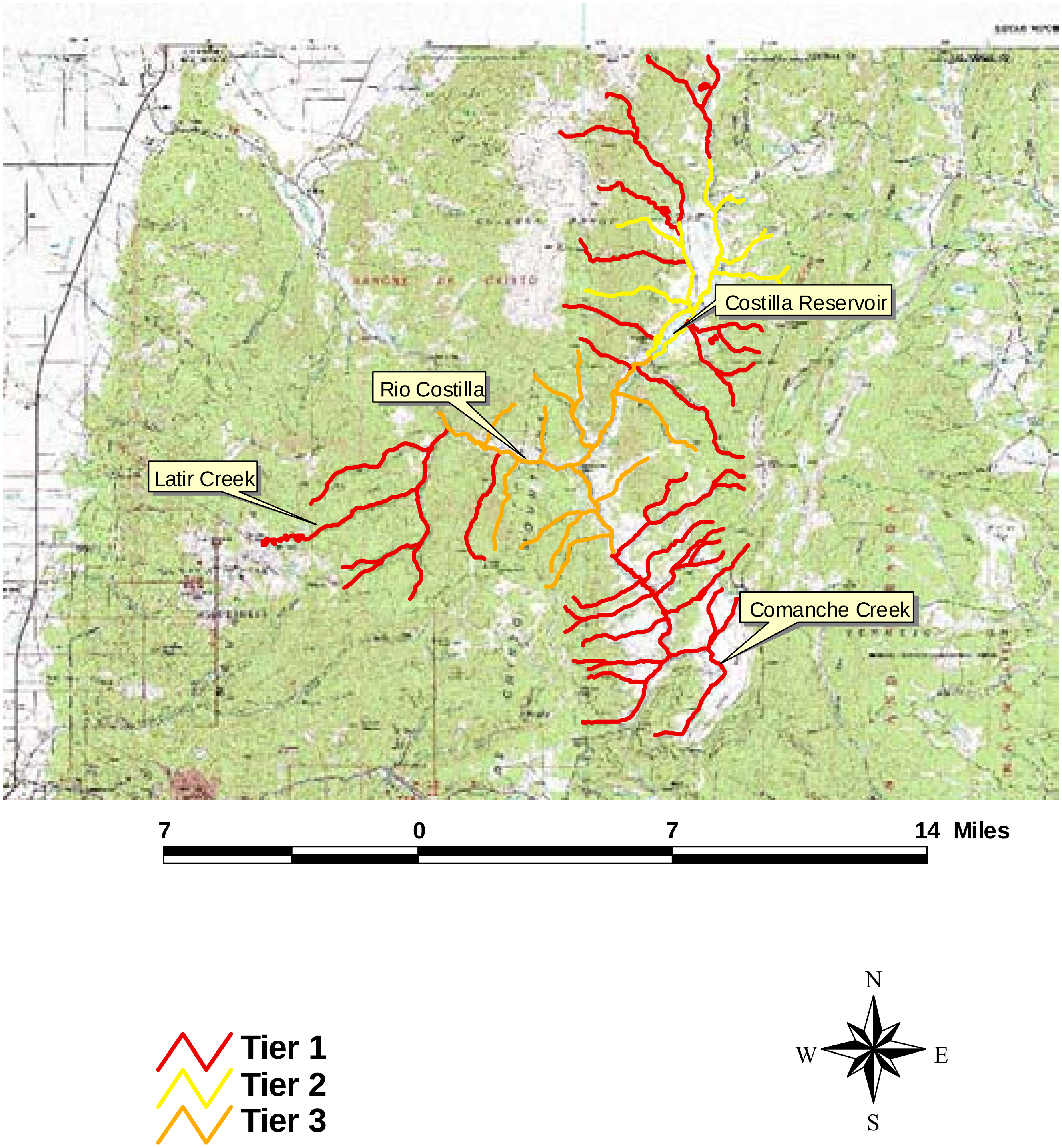
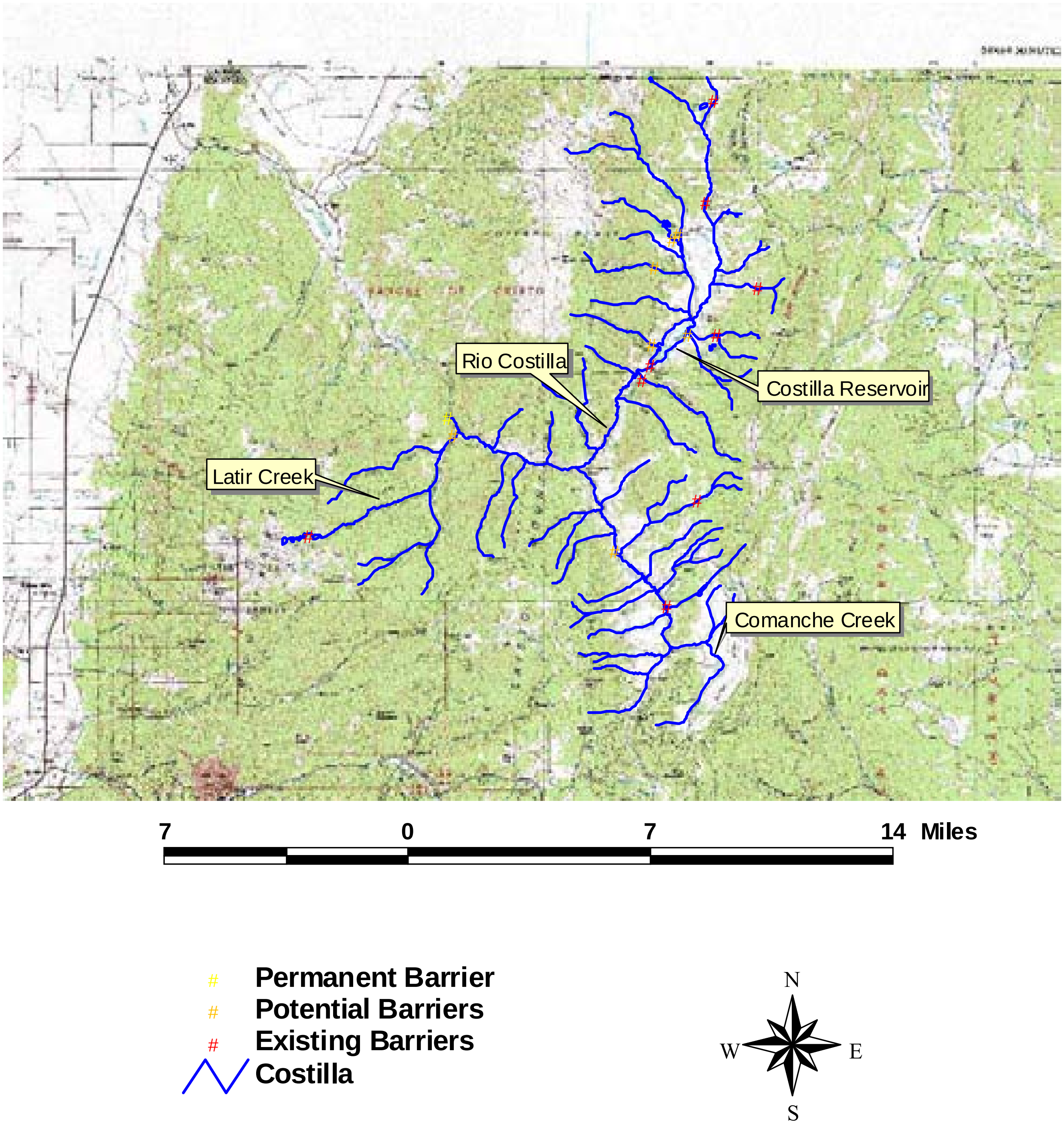


Figure 5. Locations of likely temporary and permanent barriers and existing barriers within the upper Rio Costilla watershed.



Mechanical Removal
Within a project subsegment, angling restrictions would be relaxed or removed to allow anglers to harvest fish, where appropriate. Current stocking practices within a project subsegment would cease prior to regulation changes for a particular segment (Appendix E). Changes to angling restrictions would occur within the same field season as other expected restoration activities to preclude the opportunity for remaining fish to reproduce during subsequent spawning periods. Field staff would then conduct electrofishing and/or net removals to attempt to remove the remaining fish from a project subsegment. Exact number of electrofishing passes through a subsegment would depend upon length of stream but a minimum of two passes is expected. Exact number of gill net sets is equally difficult to predict as effort would depend upon waterbody size. A minimum of 10 net nights would be conducted on any given lentic waterbody. Non-native trout and hybrid trout would be restocked into waters where the species is already established. White sucker and longnose sucker, both non-natives, would not be restocked.

Native Fish Salvage
If native fish are present in a project subsegment (e.g. upper Comanche Creek), they would be collected with electrofishing (no native fish are present in any lentic waterbodies where gill nets would be appropriate). Native fish would be transported in five gallon buckets or horse panniers, temporarily held in other areas, and restocked when all non-native fish are removed from a project segment. Options for holding native fish include live-cars within the project area, modified holding tanks (e.g. stock tanks), lakes within the project area, or a hatchery. To ensure pure RGCT are returned to a stream or lake, PIT (Passive Integrated Transponder) tags may be implanted into fish to facilitate accurate identification upon recapture. Genetic sampling would be conducted to confirm the genetic purity of individual RGCT.

Chemical Application
It is likely that mechanical removal (Appendix F) would not remove all non-native fish and the remainder would be eliminated with a piscicide. The piscicide chosen would depend upon the physical and chemical parameters of the treatment site. One commercial formulation of antimycin is available, Fintrol. Several formulations of rotenone are available. CFT Legumine and Prentox Fish Toxicant Powder are the proposed rotenone formulations for this project. Application timing would depend upon several factors including effective treatment times for target species, streamflow, water temperature, pH, organic loading, and turbidity. Piscicide selection would depend upon the waterbody in question. Fintrol would be the primary piscicide for stream applications though CFT Legumine would also be considered and used if it is determined that success is more likely with that product. Fintrol or CFT Legumine would be options for small lake applications. Prentox Fish Toxicant Powder and CFT Legumine would be used to treat Costilla Reservoir.

Piscicide treatments would be initiated in stages in a given subsegment depending upon hydrologic complexity. Treatments would begin in tributaries and proceed downstream to the subsegment terminus (i.e. migration barrier). Piscicides would be applied according to label directions to eradicate the fish species present in a subsegment. Typically, antimycin concentrations required to eradicate trout is 8-10 parts per billion of active ingredient. Rotenone concentrations required to eradicate trout ranges from 1-2 parts per million of product (50-100 ppb active ingredient). Onsite bioassays under field conditions in a subsegment would determine the concentration of piscicide actually needed to remove the target species. Live cars with target species would be placed in the waterbody during the piscicide treatment to assess treatment effectiveness. Application of piscicide in streams would be made using drip stations (Stefferud and Propst 1996) and using backpack sprayers in springs, seeps, and side channels. Application of piscicide in lakes and the reservoir would require a venturi pump or mixing with boat prop wash. In deeper lakes, pumping the piscicide to deeper water may be necessary. Powdered rotenone would be mixed with water to form a slurry prior to application. The piscicide would be applied in a grid like manner through the lake or reservoir to ensure equal distribution in the waterbody. Backpack garden sprayers would be used to apply piscicide to shallow waters, springs and seeps. If inlets or outlets are present, application of piscicide would be applied using the same methods discussed above for stream application. Application of piscicides would occur during suitable periods anytime from June to October each year. No aerial application of any piscicide is proposed for this project. Signs would be posted at entrance areas to the project area to inform the public of the use of piscicides within the area.

Total number of piscicide treatments in a project subsegment would depend upon the waterbody involved. It is expected that at least two applications would be required to completely remove non-native fish from a subsegment.

Fish killed by piscicides would be collected in accordance with NMDGF protocols, identified by species, and counted. A sub-sample of fish would be measured and weighed. Dead fish would be buried in small pits within the project area and pits would be located away from known cultural resources.

At the terminus of a project subsegment any residual antimycin or rotenone would be neutralized with potassium permanganate, a common reagent for detoxification (Lawrence 1956, Marking and Bills 1975). Because organic matter in the water binds potassium permanganate, the required concentration to neutralize the fish toxicant (generally 1-4 ppm) would be determined with bioassays. A primary detoxification station would dispense potassium permanganate at the downstream end of the treatment section at least one hour before treated water is expected to reach the treatment area terminus. A secondary site would be located downstream for further neutralization. Live cars with target species would be located downstream of the primary and secondary stations, allowing for sufficient contact time between the piscicide and the potassium permanganate (Archer 2001), to assess detoxification.

Native Fish Repatriation

Pure RGCT would be stocked into the restored areas after eradication of non-native fish is confirmed. RGCT would be stocked at appropriate rates to reestablish the population from a genetically pure, disease free source. Multiple size classes of RGCT would be stocked to hasten the population establishment process. Longnose dace would be restocked following successful removal of non-native fish and sources would be limited to within the project area. RGCT would be the only trout species stocked in the future.

Monitoring

The reestablished RGCT population would be monitored for several years including spot checks, population surveys, genetic sampling, and disease testing. After RGCT populations are established, waters would be evaluated for suitable areas to reintroduce RGS and RGC from appropriate donor populations.

Implementation Timeline
An exact timeline for the project is not possible to describe. If approved, this alternative may be implemented as soon as summer 2007. Tier 1 waters which could be restored first include upper Comanche Creek, Long Canyon Creek, or Casias Creek. The proposed action would be implemented in a step-wise manner in each project subsegment. The mechanical removal efforts in a project subsegment would begin in early to mid-May of a particular year. Piscicide applications could take place from early June to October depending upon whether the target species is a spring or fall spawner(s) and streamflow conditions in a particular year. Multiple applications within a project subsegment may occur within the same season or in consecutive years. Piscicide application to Costilla reservoir would take place late in the season when irrigation withdrawals have reduced the volume of water required to treat. Piscicides applications must occur within the same field season as mechanical removals to prevent spawning by remaining fish. Actual work years may not be consecutive due to other project needs that exist around the state.

2.3 Alternative 3: Restoration of RGCT and Native Fish Community using Angling, and Electrofishing/Netting

Within a project subsegment, angling restrictions would be relaxed or removed to allow anglers to harvest fish, where appropriate. Current stocking practices, if they exist in a subsegment, would cease prior to regulation changes for a particular segment (Appendix E). Field staff would then conduct electrofishing and/or net removals to attempt to remove the remaining fish from a project subsegment. Native fish would be returned to their point of capture. Non-native or introgressed trout would be stocked outside of the project subsegment in waters where they are already established. White sucker and longnose sucker, both non-native fishes, would not be restocked. Electrofishing passes or gill net sets, depending upon the waterbody type, would be conducted until all non-native fish are removed from a project subsegment. Exact number of electrofishing passes through a subsegment would depend upon the length of stream but a minimum of two passes in a given year is expected. Exact number of gill net sets is equally difficult to predict as effort would depend upon waterbody size. A minimum of 10 net nights would be conducted on any given lentic waterbody. Considering the long-term effort for mechanical removal to have any probability of completely removing non-native fish, mechanical removals would be implemented in multiple segments at one time. Mechanical removals would be continued within a subsegment until all non-native fish are removed.

Temporary barrier locations would be selected based upon channel characteristics and biological needs for the treatment. Structural design could range from gabion drop structures, culverts, or other applicable designs. Temporary barriers would remain in the channel until downstream locations were restored to secure native fish populations and then removed or altered to provide fish passage. Expected barrier locations and structure would be similar to those discussed in Alternative 2. Any required permits (404, 401 and SHPO) would be obtained prior to barrier construction.

A permanent barrier below the confluence of Latir Creek with the Rio Costilla is required to complete the proposed project. The permanent barrier would be anchored into the canyon walls with rebar, constructed of concrete, minimize pooling, and function under a variety of flow regimes. Prior to conducting any treatment, where success of that particular treatment is dependent upon the project terminus barrier, the barrier would be in place and functioning.

In segments where native fish are currently absent, native fish would be stocked once all non-native fish are removed. In segments where native fish are currently present, native fish would be released at or near their point of capture. Temporary holding options for native fish described in alternative 2 are not feasible due to the extended timeframe for implementation. The same stocking procedures would be followed as described under Alternative 2.

2.4 Mitigation and Monitoring

Mitigation measures are prescribed to avoid, reduce, or compensate for the effects of an action. The following measures would be implemented for the project:

- Use only established roads where available for vehicle access (both action alternatives)
- Collect and bury piscicide killed fish away from known archaeological sites (preferred alternative)
- Permanent barrier would be colored and textured to blend with surrounding landscape within limits of engineering design (both action alternatives)
- Post signs to notify public of piscicide use (preferred alternative)
- Collect juvenile amphibians, if observed within a project subsegment, and hold off-site to preclude piscicide exposure (preferred alternative)
- Strict adherence to the piscicide label for transportation, storage, application, and personal protective equipment (preferred alternative)
- Piscicide use records would be kept (preferred alternative)
- Benthic macroinvertebrate sampling prior to, post and one-year post-treatment of a piscicide (preferred alternative)
- Salvage and restocking of native fishes (preferred alternative)
- Collect and analyze water quality samples prior to and post-application of piscicides (preferred alternative)
- Current fish health certification for any RGCT donor stream or hatchery (both action alternatives)
- Restock non-native trout mechanically removed in non-project waters for recreational fishing opportunities, where appropriate (both action alternatives)

2.5 Comparison of Proposed Alternatives

Table 1 summarizes how each alternative would achieve the project objectives stated in Section 1.0. Table 2 summarizes each alternative and the primary environmental consequences of each for comparison.

Table 1. Comparison of alternatives meeting project objectives.

Objective	Alternative 1 – No Action	Alternative 2 – Angling, Electrofishing/Netting and Piscicide	Alternative 3 – Angling and Electrofishing/Netting
Expand range of RGCT on VPR, RCCLA, and CNF for recreation and ecological purposes. (NMDGF 2002)	No progress made. Continued decline, introgression, and confinement to headwaters of RGCT populations in Rio Costilla watershed.	Expand RGCT distribution by >150 stream miles and over 100 lake surface ac.	Expand range of RGCT. Population security unlikely.
Establish a metapopulation within the upper Rio Costilla on VPR, RCCLA, and CNF to help secure the long-term persistence of the sub-species (NMDGF 2002).	No progress made. Currently the largest population of pure RGCT in NM occupies less than 15 miles of stream habitat.	Would likely create two metapopulations composed of at least 5 large RGCT populations.	Metapopulation(s) not obtained. Populations still susceptible to introgression and/or competition from remaining trout.
Concurrent with restoration activities, consider the opportunities to reestablish the native fish community to the upper Rio Costilla, including RGS and RGC.	No progress made. White sucker populations would continue to dominate fish community in lower watershed. Distribution of RGS and RGC may continue to decline.	Would provide habitat for native fishes within the lower/mainstem portions of the project area.	Non-native suckers still present in watershed. Security of RGS and RGC not possible. No establishment of historic RGS, RGC, LND and RGCT community.
Implement a high quality recreational angling program for RGCT.	Angling would continue with current management including native and non-native trout. White sucker populations may continue to increase.	Would create extensive angling opportunities for RGCT. Temporary losses in angling opportunities may exist during treatment.	Temporary angling opportunities for RGCT. Repeated exposure of RGCT to electric current. Long-term reduction in angling opportunities. Non-native sucker would continue to dominate portions of fish community.

Table 2. Summary of environmental consequences by alternative.

Resource Affected or Issue	Alternative		
	Alternative 1 – No action	Alternative 2- Preferred Alternative	Alternative 3
Water quality	No effect.	Short-term turbidity increase from humans walking in stream and along riparian corridor. Short-term effect from piscicide application.	Repeated short-term turbidity from humans walking in stream and along riparian corridor. Short-term increase in turbidity during barrier

		Short-term increase in turbidity during barrier construction	construction.
Water quantity	No effect.	No effect.	No effect.
Wetlands	No effect.	No effect.	No effect.
Aquatic Habitat	No effect.	Fish migration barriers would modify stream channel in limited areas.	Fish migration barriers would modify stream channel in limited areas.
Aquatic Biota	Continual decline in number and genetic purity of RGCT in Rio Costilla watershed. No expansion of RGS and RGC range.	Expanded range of RGCT, RGS, and RGC. Elimination of non-native fishes, temporary reduction in invertebrate abundance and diversity.	Temporary elimination of non-native fishes. Continual exposure of RGCT and LND to electric current. Continual disturbance of invertebrate community.
Special Status Species	Would not expand range of three sensitive fish species.	Expand range of RGCT by >150 miles. Potentially expand range of RGC and RGS.	Temporarily expand range of RGCT. Continually expose RGCT to electric current.
Terrestrial Habitat	No effect.	Short-term presence of humans in project area.	Repeated, long-term presence of humans in project area.
Terrestrial Wildlife	No effect.	Short-term presence of humans in project area	Repeated, long-term presence of humans in project area.
Cultural Resources	No effect.	No effect.	No effect.
Wilderness	NA	NA	NA
Recreation	Maintain, possibly decreased, RGCT angling opportunities.	Temporary loss of angling opportunities in portion of project area.	Long-term loss of angling opportunities in multiple portions of project area.
Scenic Quality	No effect.	Presence of temporary and permanent fish migration barriers.	Presence of temporary and permanent fish migration barriers. Repeated, long-term human presence in project area.
Socioeconomic	Continual loss of RGCT angling opportunity. Potential listing of RGCT as threatened or endangered.	Increased RGCT angling opportunities.	Temporary increase in RGCT angling opportunity. Potential listing of RGCT as threatened or endangered.

2.6 Alternatives Considered and Eliminated from Detailed Study Because Project Objectives would not be met

Repatriation of RGCT in Rio Costilla drainage without the Removal of Existing Non-native Fish Populations

A primary factor in the decline of RGCT continues to be displacement by brook and brown trout as well as hybridization with non-native trouts (Behnke 1992). Without complete reproductive isolation, hybridization will continue with rainbow trout and hybrid cutthroat trout. As well, brown trout and brook trout will continually displace RGCT. Project failure would occur within a few generations. In addition, repatriation of RGCT only will do nothing to expand the range of RGS and RGC.

Angling

Excessive angling alone would not meet project objectives. Overfishing can suppress a population. However, angling only affects fish of sizes susceptible to capture with tackle and it is highly unlikely all fish would be caught. Once angling quality has declined, angler use would decline which releases the target population from suppression. Remaining fish, whether adult or young, would grow, reproduce and the population would quickly return to pre-angling levels within a few years after angling declines. However, angling has been incorporated into two of the alternatives.

Netting

Netting alone would not meet project objectives. Netting methods will not effectively capture fish within stream systems. Within lake systems, gill nets could reduce and in some cases remove all unwanted fish. Considering the morphology and interconnectedness of the lake systems within the project area, netting alone would not meet project objectives (Appendix F). However, the use of gill nets has been incorporated into two of the alternatives.

Dewatering.

To effectively dewater a system the size of the Rio Costilla watershed, extensive modifications to the terrestrial, riparian, and aquatic systems would be necessary. In effect, this activity would be destructive to the whole ecosystem. Resident fish would still inhabit residual pools, especially Costilla Reservoir. Given the destructive nature of dewatering and little probability of any success, this alternative cannot be reconciled with project objectives.

Renovation without Concurrent Reestablishment of RGS and RGC.

A positive aspect of the proposed project is multi-species rather than single species restoration. Project objectives seek to remove all non-native fish from the project area, including non-native white sucker and longnose sucker, resulting in an open niche for RGC and RGS. Populations of these species could be re-founded from neighboring streams and is proactively addressing future threatened or endangered species issues. Restoration for RGS and RGC will be required in the future and the Rio Costilla watershed is an ideal location for such efforts.

Genetic Swamping

Genetic swamping involves stocking pure RGCT into the existing populations with hopes of creating a pure population of RGCT. New Mexico Department of Game and Fish currently classifies RGCT populations that are >99% pure as fully representative of the subspecies and a Core Conservation Population. Populations of RGCT that are >90% pure are considered Reserve Conservation Populations. These criteria were developed in cooperation with other states throughout the west that also manage cutthroat trout. Core Conservation Populations are the highest priority for long range conservation management and are the foundation of future reintroductions and development of conservation hatchery broodstock. In a 2002 status review of RGCT, the USFWS only considered populations >99% (i.e. a Core Conservation Population) as counting towards the overall distribution of RGCT with regards to listing under the ESA. This alternative will not meet project objectives, as the time frame to even evaluate effectiveness does not meet management objectives. There is no evidence in the scientific literature that genetic swamping will ever establish a Core Conservation Population of RGCT and meet project objectives. In addition, non-native trout such as brook trout and brown trout, which genetic swamping will not affect, will continually out-compete RGCT in the project area. Finally, this method will do nothing to expand the current distribution of RGS and RGC. RGS do not readily hybridize with white sucker and thus genetic swamping would not work in this case as well (McPhee and Turner 2004).

Decreasing Genetic Purity Standard of RGCT
Decreasing the genetic purity standard would neither expand the range of RGCT nor address the isolated nature of most populations of RGCT. Many populations would still be susceptible to non-native competition and catastrophic events such as fire. Modifying the genetic purity standard would simply increase the number of populations that would be susceptible to local population level extinction and not meet the purpose and need for the proposed action.

Restoration without Angling and Salvage Orders
This alternative would not comply with NM Game Commission directives to analyze the efficacy of mechanical removal efforts, including angling, into restoration activities.

Habitat Improvement
Habitat improvement or natural recovery is ongoing in substantial portions of the project area. Habitat improvement alone, however, does not address hybridization and competition with non-native fishes. Habitat improvement would also improve habitat for non-native trout. Without the proposed action, the range of RGCT will not be expanded within the project area.

Introduction of Beaver in the Project Area as a Member of the Aquatic Community
Beaver played a historic role in maintaining streamflow and the water table throughout watersheds in New Mexico. The effects of beaver within the project area are primarily limited to a few historic dams. New beaver activity was possibly observed in 2006 in a small portion (single tributary) of the project area. While natural beaver recolonization would improve fish habitat and is not opposed, active beaver reintroduction does not fit within the proposed action of restoring the historic fish community to the project area.

Eliminating Bag Limits for RGCT, Allowing Catch and Release Only
All existing populations of RGCT within the project area are already managed as catch-and-release fisheries. This alternative would not address the problem with hybridization or competition with non-native fishes. This alternative would not meet project objectives for expanding the range of RGCT.

Reducing or Eliminating Stocking of Non-native Fish
Only rainbow trout are currently stocked, by NMDGF or private landowners, within the project area. Reducing or eliminating stocking of non-native rainbow trout will not address competition with non-native fish in the project area. Brown trout and brook trout, which are present in large portions of the project area, would continually displace RGCT. The practice of stocking non-native fish would cease, however, upon implementation of the preferred alternative in a project subsegment that is currently stocked.

Angler Education Regarding Illegal Transplantations
Project cooperators continually seek to educate anglers regarding the unintended effects of illegal transplantations. This alternative would not expand the range of RGCT, a primary project objective.

Natural Events that Eliminate Fish- e.g. fire and drought
Natural events are too unpredictable to be relied upon for RGCT conservation. Fire and drought are two primary concerns regarding the isolated condition of many RGCT populations. The proposed action would establish large, interconnected populations of RGCT which could undergo local extinction caused by fire or drought and be re-inhabited upon recovered conditions. Drought is simply too unpredictable to rely upon for conservation actions intended to help secure the long-term persistence of RGCT. Fire can drastically alter terrestrial and aquatic habitats (e.g. Viera et al. 2004) and recovery of the aquatic ecosystem can take many years. The actual burn pattern and severity of the fire also diminishes it as a reliable or effective alternative for meeting project needs. Where fire does remove a non-native fish population, NMDGF does repatriate native fishes upon ecosystem recovery.

Interfering with Spawning Gravels in Lakes and Reservoirs
This alternative would require identifying, disrupting, and stepping on redds of non-native fish. Such techniques would not likely destroy all redds as most lakes contain spawning tributaries and redds are not always easily accessible or observed. Missing just one redd could potentially repopulate a lake. This alternative would not address fish spawning in streams and tributaries connected to lakes. Overall, this technique would not meet project objectives.

3.0 AFFECTED ENVIRONMENT AND PREDICTED EFFECTS

In this section, the affected environment description is limited to factors pertinent to resource issues of concern and potential effects on those resources. Predicted effects are similar for all three project areas. If there are differences they are noted in the text.

3.1 Water Resources

3.1.1 Existing conditions

The flow regime in the Rio Costilla is relatively predictable, characterized by a large spring runoff from snowmelt that peaks in May and June and subsequently tapers sharply to base flow or near base flow conditions (concluded from USGS data published at web site http://water.usgs.gov). The flow on the mainstem Rio Costilla is regulated by releases from Costilla Dam administered by RCCLA. Flows are low through non-growing seasons (October – April) and increase during the irrigation season.

Cold, clear, high dissolved oxygen, and low nutrients (Smolka 1987) are characteristic of water quality in the Rio Costilla watershed. Though generally high, water quality in the Rio Costilla watershed is variable. For example, Smolka (1987) reported a high pH of 9.0 on Comanche Creek attributed to oxygen production by heavy macrophyte growth. Stream temperatures in the Comanche Creek basin do exceed thresholds for a designated use, a high quality coldwater fishery.

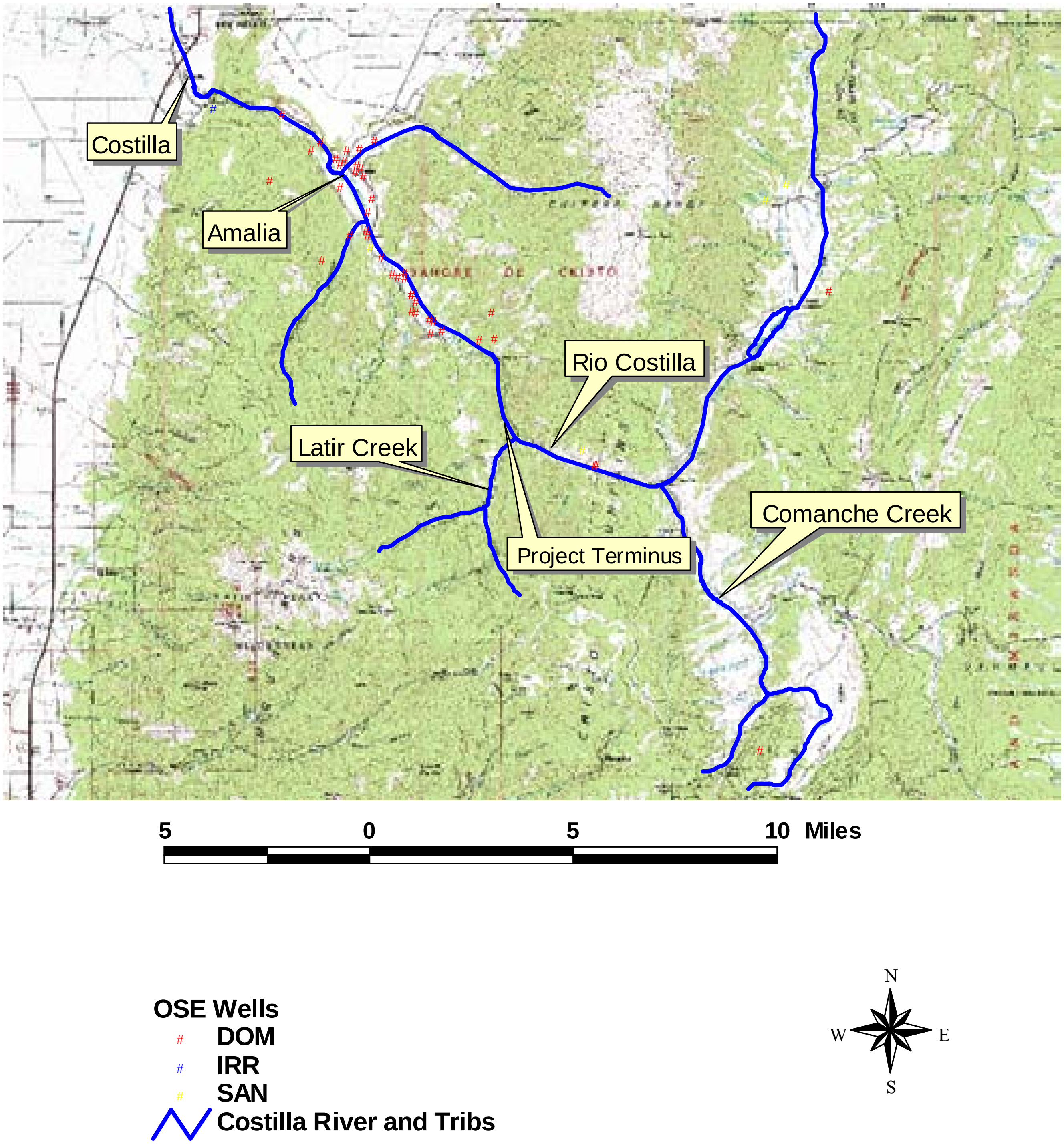
Water uses within the project area are primarily recreational (coldwater fishing, camping) and for livestock watering on RCCLA, and CNF. Agricultural irrigation and livestock watering become important uses in the lower watershed. Seven wells on record with the Office of the State Engineer are located within the project area (Figure 6); three are located on Vermejo Park Ranch and four on CNF. The first private well beyond the project area is approximately 1.5 miles downstream of the project terminus. Several wells are located upstream of the towns of Costilla and Amalia. Public drinking water wells are located near the town of Amalia, Costilla (two), and one within the project area, near Costilla Lodge. Numerous domestic wells are also present lower in the watershed.

A portion of the project area is located on the Valle Vidal Unit, Carson National Forest. The New Mexico Water Quality Control Commission has designated all waters within the Valle Vidal Unit as "Outstanding National Resource Waters" NMAC 20.6.4.8(A)(3) and 20.6.4.9(D). The project area is not included within the National Wild and Scenic River System as designated by the U.S. Congress (P.L. 90-542, as amended) though portions of the project area would be considered candidate waters (Table 3).

Table 3. Eligibility of publicly owned waters within the project area under the Federal Wild and Scenic Rivers System.

Water Name	Wild and Scenic Classification
Rio Costilla	Recreation
La Cueva Creek	Scenic
Powderhouse Creek	Wild
Chuckwagon Creek	Wild
Comanche Creek	Recreation
Foreman Creek	Wild
Gold Creek	Wild
Grassy Creek	Scenic
Holman Creek	Recreation
La Belle Creek	Recreation
Little Costilla Creek	Wild
Vidal Creek	Wild

Figure 6. Location of wells within the Rio Costilla watershed.



3.1.2 Effects on Water Resources

The effects of the alternatives on water quality and quantity within the project area and in downstream areas, specifically in regards to human, livestock, and wildlife use and health, are discussed in this section. The effects of this project on Wild and Scenic River status as well as Outstanding National Resource Water status are discussed in this section as well. The effects on aquatic habitats and biota are discussed in section 3.3.

Alternative 1 – No Action
The no action alternative would result in no changes in water quality or quantity within the Rio Costilla watershed when compared to the existing conditions.

Alternative 2 – Preferred Alternative
The proposed action would not alter water delivery, timing, or quantity within the watershed and therefore no effect is expected. Precipitation would continually dictate water quantities within the watershed.

Construction of fish barriers would require temporary diversion of water around the construction area but should not affect water quantity. Barrier(s) would be designed to impound a minimum amount of water with little to no effects on the channel morphology. Appropriate permits to construct the barrier(s), e.g. 404 and 401, would be obtained prior to construction. Most temporary barriers would utilize existing culverts which currently do not impound water. Any modification would produce no effect on water impoundment or flow but merely inhibit fish passage.

Barrier construction may affect water quality temporarily. Increased turbidity would occur during construction. Pooling of water above the barrier may cause slight increases in water temperature though design would minimize pooling. No long-term effects on water quality would occur from installing permanent or temporary barriers as turbidity increase would be ephemeral.

Water quality would be temporarily affected by increased foot traffic during mechanical removals. During electrofishing removal efforts, project staff must wade within the stream channel. Wading disturbs the stream substrate temporarily increasing turbidity. Once the crew has passed through a section, turbidity quickly returns to normal conditions.

Application of a piscicide would temporarily affect water quality. Piscicide treatment times would be scheduled during low flow periods (generally mid-June to October) to minimize the amount of piscicide required to complete the proposed action. Individual applications of piscicides would last between 4 and 8 hours. Piscicide concentrations of antimycin and rotenone needed for trout restoration projects typically range between 8-12 ppb a.i. and 50-100 ppb a.i., respectively. Actual concentrations required for the proposed action would vary depending upon onsite water quality, results of field bioassays, and target species. The actual amount of piscicide applied to a water would depend upon water volume at treatment time. Because the amount of piscicide used is volume dependent, drought would have no effect on piscicide concentration used but merely reduce the total amount applied. Potassium permanganate is typically applied at 1-4 ppm depending upon piscicide concentration and background potassium permanganate demand.

Piscicides proposed for use are Fintrol (Antimycin A), CFT Legumine (Rotenone), and Prentox Fish Toxicant Powder (Rotenone). All products considered for use within this project are registered as restricted use pesticides with the U.S. Environmental Protection Agency (USEPA) under the Federal Insecticide, Fungicide, Rodenticide Act (7 U.S.C. 136 et seq. (1996) and the New Mexico Department of Agriculture under the New Mexico Pesticide Control Act (NMSA 1973, 76-4-1 et seq.), and supporting regulations (NMAC 21.17.50). Registration as a restricted use pesticide limits pesticide use to prevent "unreasonable adverse effects on the environment." NMSA 1973, 76.4.1(R).

Antimycin is derived from naturally occurring bacteria, and has been used in fish control projects for nearly 40 years. Antimycin A interferes with oxygen transfer at the cellular level and is particularly effective on fish (Schnick 1974). The deployment of Fintrol would follow label instructions and NMDGF protocols. Antimycin rapidly decomposes in water by hydrolysis with sunlight intensity, temperature, pH (Schnick 1974), stream turbulence (Tiffan and Bergersen 1996), and stream gradient (oxidation) affecting decomposition rate.

Rotenone is commercially extracted from plants in the Legumenosae family (Finlayson et al. 2000). Rotenone is used as an insecticide by organic farmers and is found in flea and tick medications for pets. Rotenone is widely used for fish control and sampling. Rotenone inhibits oxygen transfer at the cellular level and is particularly effective on fish (Schnick 1974b). The deployment of rotenone would follow label instructions and NMDGF protocols. Rotenone readily degrades in water with hydrolysis, photolysis, temperature, organics, and pH all affecting decomposition rate (Schnick 1974b).

Any changes in water quality from the application of piscicides and potassium permanganate would be temporary. See Appendix G for more information on the effect of these chemicals and neutralizing agents on water quality including human, livestock, and wildlife consumption of treated water. Piscicides can be neutralized with potassium permanganate which hastens the degradation process. During treatment, humans, livestock, and wildlife could be exposed to piscicide treated water. Ingestion of normal quantities of water during peak treatment would have no effect on humans, livestock, or wildlife. There would be no effect on the ability to safely ingest wildlife or livestock exposed to piscicide treated waters. No contamination of groundwater is anticipated to result from this project. Piscicides degrade rapidly and bind readily to sediments which limits the ability to leach into groundwater aquifers (e.g. Dawson et al. 1991). In California, researchers did not detect rotenone or any of the other organic compounds in the formulated products in wells that were placed in aquifers adjacent to and downstream of rotenone applications (Finlayson et al. 2001).

Application methods proposed include dripping, spraying, and pumping piscicides into the treatment area. Application methods selected for a particular treatment section or lake would seek to maximize the effectiveness of the piscicide, to limit the overall number of applications required, and reduce any effects on water quality. The proposed methods (drip stations, backpack sprayers, and boat application) would minimize the possibility that the piscicide would affect non-target areas.

NMDGF must obtain approval from the New Mexico Water Quality Control Commission (NMAC 20.6.4.16) to use piscicides in this project. A hearing, pursuant to NMAC 20.6.4.16, was held in Costilla, NM on February 22, 2006. The New Mexico Water Quality Control Commission approved the petition for the proposed action at their August 8, 2006 meeting for a period of five years. Because this project is expected to extend beyond five years, additional approval from the New Mexico Water Quality Control Commission will be obtained prior to any further implementation beyond the initial five year period. Approval by the New Mexico Water Quality Control Commission indicates that the proposed action complies with NMAC 20.6.4.16 and other applicable NM water quality regulations. The proposed action would produce no long-term degradation of water quality in the portions of the project within the Valle Vidal which are designated as ONRW. Application of a piscicide to a water of the United States in accordance with FIFRA is not a pollutant under the Clean Water Act (CWA) (70 FR 5093, Fairhurst v. Hagener 422 F.3d 1146 (9th Cir. 2005)). USEPA guidance for interpreting ONRW regulations specifically permits states to allow "limited activities that result in temporary and short-term changes in the water quality of ONRW." (USEPA 1994). The application of a piscicide to remove hybrid and non-native fish is consistent with the CWA as a central purpose of this legislation is to restore the biological integrity, i.e. native fishery, of the project area (33 U.S.C. 1251 *et seq*). Time limits for such temporary degradation are not specified but EPA views temporary as "weeks and months, not years" (USEPA 1994). Piscicides rapidly degrade (antimycin ½ life of hours, rotenone ½ life of a few days, depending upon water chemistry). Degradation of piscicides is expedited by application of potassium permanganate which neutralizes piscicides with sufficient contact time. Because project subsegments must be further subdivided for implementation, piscicides would only be present on a given day within a portion of the subsegment. The use of piscicides in waters with the same legal status has been approved within the Bob Marshall Wilderness in the state of Montana.

The proposed action would not jeopardize any potential eligibility of watershed portions within the Wild and Scenic Rivers System. Waters within this national system "possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values". Inclusion of a water within the Wild and Scenic Rivers System preserves rivers in their free-flowing state defined as ". . .any river or section of a river. . . existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway. The existence, however, of low dams, diversion works, and other minor structures at the time any river is proposed for inclusion in the national wild and scenic river system shall not automatically bar its consideration for such inclusion; Provided, that this shall not be construed to authorize, intend, or encourage future construction of such structures. . ." The proposed action would enhance the recreational, fish and wildlife character of the project area by restoring the historic fish assemblage. No additional impoundment of water is included in the proposed action. The Costilla Dam is already present and no modifications in design (i.e. impoundment of additional water volume) or water delivery is proposed. Existing road culverts would be the primary method of constructing temporary migration barriers. The existing culverts do not currently impound water and thus modification would not be expected to pool additional water. The project terminus barrier (a permanent structure) would be designed to minimize pooling of water above the barrier.

Because the Rio Costilla watershed is located in the headwaters of a small portion of the Rio Grande drainage, all of the water eventually flows downstream towards municipalities and residences. The towns of Costilla and Amalia obtain their municipal water from wells. Other private drinking water wells are located below the project terminus point. One well within the project area, near Costilla Lodge, is used for drinking water. By the time project water reaches municipal or well locations, adequate dilution and degradation of piscicide (active and inert ingredients) would have occurred. Supplemental detoxification with potassium permanganate would hasten neutralization and virtually eliminate any possibility of acute or chronic exposure to humans or wildlife. Potassium permanganate is commonly used to treat drinking water at the concentrations used for piscicide neutralization.

Alternative 2 – Cumulative Effects
Project effects from this alternative would have little effect on water resources in conjunction with past, present, and reasonably foreseeable actions. Other past, present, and reasonably foreseeable actions include herbicide application for noxious weed control on CNF, past piscicide applications, barrier construction, and mechanical removals. Carson National Forest has proposed to use integrated weed management control efforts which would include hand pulling, grubbing, mowing, disking, plowing, biological controls such as controlled grazing, herbicide application, and prescribed burning (USDA 2005). No other herbicide application by other entities is expected within the project area. Within the project area on Carson National Forest, there is approximately 60 acres (0.02% total acreage) of noxious weeds that would be subject to the proposed integrated weed management efforts. Of these 60 acres, approximately 20 acres are greater than 300 feet away from any mapped streams. Only 6.4 acres (4.8 acres of Canada thistle 1.6 acres of musk thistle) are mapped within 25 feet of streams. Herbicides could be applied to riparian, roadside, and upland areas though other treatments, such as mowing and hand-pulling, will be employed prior to herbicide application. Piscicides would be applied directly to the stream or lake. Considering the chemical nature of the piscicides (rapid degradation, small concentrations, neutralization with potassium permanganate), any cumulative effects on water quality resulting from the proposed action with herbicide application is unlikely. An exact schedule for herbicide application, and whether it will ever occur within the project area, is unknown at this time.

Recent piscicide applications within the project area include Powderhouse Creek (1997) and upper Costilla Creek (2002). A piscicide was apparently applied to Costilla reservoir during the 1950s though the chemical used is unknown. Water quality testing from the 2002 upper Costilla Creek observed small concentrations of inert ingredients within 48 hours post-treatment, acetone and diethyl phthalate (Appendix G). Given the small concentrations of acetone and diethyl phthalate detected (ppb) and their ability to biodegrade, these chemicals are likely no longer present within the project area. The piscicides used would rapidly degrade and thus present negligible effects on water quality in conjunction with past piscicide applications.

Barrier construction would occur well before any mechanical removal efforts or piscicide application. Turbidity resulting from barrier construction should return to baseline levels long before mechanical removal or piscicide application. Electrofishing and angling would temporarily increase turbidity. These activities would cease weeks before piscicide application. Increased turbidity resulting from electrofishing or angling should return to baseline levels long before piscicides are applied. Increased sediment loading from barrier construction and mechanical removals would be negligible in conjunction with existing land-use practices.

Alternative 3
Mechanical removals (liberalized harvest, electrofishing, and netting) would require several years if not decades to have any probability of success within a project subsegment. At least two electrofishing passes per season, possibly more, would increase riparian foot traffic within and around the riparian area over several years. Turbidity would temporarily increase during electrofishing passes but quickly return to baseline levels once field crews vacate an area. Repeated walking within the same riparian areas over several years could increase bank disturbance and loss of vegetation and result in increased sediment loading within a project subsegment.

Effects of temporary and permanent barrier construction would be the same as described under Alternative 2.

Effects of temporary and permanent barrier construction on Wild and Scenic River eligibility would be the same as described under Alternative 2.

Alternative 3 – Cumulative Effects
Barrier construction would increase turbidity in negligible amounts in conjunction with existing land-use practices. Barrier construction would occur well before any mechanical removal efforts. Turbidity resulting from barrier construction should return to baseline levels long before mechanical removal. Repeated walking in the riparian area to conduct electrofishing removals over several years could add to bank instability and sediment loading resulting from existing grazing within portions of the project area.

3.2 Air Quality

3.2.1 Existing Conditions

Air quality in the Rio Costilla watershed is characteristic of mountainous regions of the intermountain west and New Mexico. In general, air quality parameters do not exceed any USEPA quality criteria (USEPA, http://www.epa.gov/air/data/geosel.html). In some cases, acidic deposition is a concern in precipitation (Anderholn et al. 1994)

3.2.2 Effects on Air Quality

Alternative 1
There would be no change in the existing air quality.

Alternative 2 – Preferred Alternative
Implementation of the mechanical removal and piscicide treatment would increase human presence and thus vehicle traffic in the project area. The restoration efforts would be limited to a subsegment in a given year and thus vehicle traffic would also be limited to only a portion of the project area. Overall, increased vehicle traffic would have negligible effect on air quality in the project area.

The smell of the acetone in Fintrol or the constituents of rotenone products are predicted to be minimal due to the remote location of the treatment area. High use areas may be closed during treatment to minimize exposure to odors. The odor of decaying fish may also be present for a short time following the treatments; however, crews would collect and bury fish, which would minimize this effect.

Some rotenone products possess a characteristic “pesticide odor”, primarily due to the formulations containing naphthalene and benzene. The two formulations selected for the proposed action contain either no (powder) or <1% naphthalene and benzene and therefore the “pesticide odor” would be negligible. Signs would be posted at entry points to the project area to notify the individuals regarding use of the chemicals. Such signage would provide notice to individuals, especially those with heightened sensitivity to chemicals, to avoid the area during treatment and minimize possibility of exposure. Rotenone dust would be limited to a small area where mixing actually occurs and therefore would have no effect on air quality in the project area. For any piscicide application, staff conducting the application would wear appropriate protective gear to protect against exposure to dust or fumes in accordance with the product label.

Alternative 2 – Cumulative Effects
No cumulative effects are expected under this alternative.

Alternative 3
Increased human activity in the area would require more frequent human presence in the project area. Motor vehicle transport in the area would increase and thus motor vehicle emissions would increase.

Alternative 3 – Cumulative Effects
No cumulative effects are expected under this alternative.

3.3 Wetlands, Riparian and Aquatic Habitat and Biota

In this section, the existing conditions of wetlands, riparian and aquatic habitat and biota are described. Amphibians are included within this section.

3.3.1 Existing conditions

Costilla Creek is formed in a meadow below the mixed conifer forest on VPR. The unnamed tributary that originates from the Glacier Lake complex also enters a meadow before flowing into Costilla #1 Creek. Downstream of the confluence of the unnamed tributary, Costilla #1 Creek becomes a lower gradient stream with complex meanders that continue all the way to Costilla Reservoir. Casias Creek (AKA Costilla #2 creek) forms below #2 Lake at 11,700 ft. and forms a fairly high gradient stream flowing through heavily wooded areas. The upper portion of Casias Creek incorporates several high gradient tributaries. Below Beaver Lake the gradient decreases as the stream flows into a large meadow. At this point Long Canyon Creek and the Seven Lakes complex enters the stream. The confluence of the two forks of the Rio Costilla (#1 and #2) is below the high water level in the reservoir. Other systems that flow into the reservoir include Santistevan Creek, including the four Casias Lakes, and the Twin Lakes complex. The riparian vegetation is well established and is comprised mostly of sedges (*Carex*) and rushes (*Juncus*) with a few small cinquefoil (*Potentilla)* shrubs. Turner Enterprises purchased VPR from Pennzoil Corporation in 1996. After the purchase all cattle were removed from the ranch resulting in reduced grazing impacts on the streamside vegetation. Surveys conducted in 1999 indicated very little fine sediment deposition in the lower parts of the system (Otmart et al. 1999).

The Rio Costilla watershed within CNF is primarily low gradient, mountain meadow stream types with streamside vegetation dominated by rushes and sedge species. Some sections have established woody vegetation including willows and long-leaf cottonwood. Several wetlands are present within the upper Comanche Creek watershed with varying degrees of connectivity to perennial streams. Cinquefoil is present throughout the area. Past grazing and road building have impacted sections of Comanche Creek. Current projects to restore the habitat are being conducted through a 303d grant administered by the Quivira Coalition and the USFS. There are several exclosures designed to reduce ungulate grazing in the riparian corridor. Since the Valle Vidal was sold to the U.S. Forest Service in 1982, instream and riparian habitat quality has increased (D. Storch, CNF, pers. comm.). The Rio Costilla below Costilla Dam is affected by variable flows from the dam.

Waters within RCCLA are a combination of high gradient and meandering meadow reaches. The headwaters of Midnight and Latir Creeks are lakes. On RCCLA, the mainstem of the Rio Costilla is low gradient and meanders through a series of meadows. Downstream of the confluence with Latir Creek, the Rio Costilla is more confined and higher gradient as it enters the “box” canyon area. Small tributaries, including Gate Creek, flow directly into the Rio Costilla.

Several small lakes and Costilla Reservoir are located within the VPR project area (Table 4). The lakes include #2 Lake (11,700 ft.) at the head of Casias Creek. Beaver lake (10,100 ft.) is approximately halfway between the headwaters of Casias Creek and the reservoir. The Seven Lakes complex (10,200 – 9,800 ft.) is associated with the Long Canyon tributary. These lakes appear to be enhanced impoundments, possibly historic beaver ponds. At the head of Santistevan Creek are the four Casias Lakes (11,800 ft.). Costilla Reservoir impounds water that is managed by RCCLA and the Interstate Stream Commission primarily for agricultural purposes.

No lakes exist on CNF within the project area. Any cattle watering locations and beaver ponds are considered part of the stream habitat.

Within RCCLA, several lakes form Midnight Creek and Latir Creek (Table 5). Nine lakes form a lake chain known as the Latir Lakes, which forms Latir Creek. Lake Nine discharges into Lake Six with some diffuse flow into Lake Eight. Water from Lake Eight also diffusely flows into Lake Six. Lake Seven is self contained and isolated though high flow events likely discharge into lower lakes. Latir Creek is well defined between Lake Six through Lake One inflow and outflow. A large waterfall (>20 ft.) separates Latir Lakes 3 and 4. Little Blue Lake flows into Midnight Creek though no direct surface flow was observed from this lake.

Non-native trout stocking currently occurs in two locations within the project area: the lower Rio Costilla (NMDGF) and the Latir Lakes (RCCLA). Frequency, numbers, and sizes of fish stocked varies by year. Since January of 2000, NMDGF has stocked approximately 20,000 catchable size rainbow trout in a section of the Rio Costilla below the Valle Vidal boundary, approximately 5 miles downstream of any pure RGCT.

NMDGF and CNF have collected several years of fisheries data from the Rio Costilla watershed on CNF and publicly leased portions of the Rio Costilla on RCCLA. VPR and NMDGF also conducted surveys on several tributaries of the Rio Costilla on VPR. Species collected in surveys include brook trout, brown trout, rainbow trout, cutthroat trout hybrids, white sucker, longnose sucker, and longnose dace (Table 6). Three populations of pure RGCT exist within the project area: upper Costilla Creek and tributaries, Powderhouse Creek, and the upper Comanche Creek system.

Fish present within RCCLA include cutthroat trout, rainbow trout, cutbows, longnose sucker, and white sucker (Table 6). Past surveys have documented high trout production in the Latir Lakes and Little Blue Lake. Fry stocked into Latir Lake Nine averaged seven inches of growth in one year (Harrison 1962). The state record cutthroat, 10 lbs. 2 oz. was taken from Latir Lake Nine in 1981. Surveys in 2004 documented fish only in Little Blue Lake, and Latir Lakes One through Five (Table 5). Based upon connectivity between the lakes, it is likely that fish exist in Lake 6.

Most of the small lakes within VPR contain trout populations (Table 4). #2 Lake was once occupied by cutthroat trout and brook trout but currently appears fishless. Beaver Lake contains brook trout. The Seven Lakes complex, within the Long Canyon tributary, contains brook trout populations. The four Casias Lakes contain populations of brook trout and cutthroat trout.

Brook trout, brown trout, rainbow trout, and hybrid cutthroat trout inhabit Costilla Reservoir.

Table 4. Summary of lake morphometry and fish presence in Vermejo Park Ranch lakes. Fish presence was assessed during the summers of 2004 and 2005.

Lake Name	Area (acres)	Max. Depth (m)	Mean Depth (m)	Volume (AF)	Fish Species Present
Seven Lakes Lake 1	1.0	3.0	1.5	5.1	Yes
Seven Lakes Lake 2	1.9	4.7	3.1	19.3	Brook trout
Seven Lakes Lake 3	1.0	2.2	0.9	3.0	Brook trout
Seven Lakes Lake 4	Not currently fish habitat				No
Seven Lakes Lake 5	4.0	8.5	5.0	65.6	Brook trout
Seven Lakes Lake 6	0.8	3.7	2.1	5.5	Brook trout
Seven Lakes Lake 7	3.5	2.7	2.0	22.6	Brook trout
Twin Lakes #1	Not currently fish habitat				No
Twin Lakes #2	Not currently fish habitat				No
Beaver Lake		Not Available	Not Available	Not Available	Brook trout
Lake #2	2.3	5.2	3.2	24.1	No
Casias Lake 1	2.7	2.8	1.8	16.0	Brook trout, cutthroat trout
Casias Lake 2	1.1	2.3	1.8	6.5	Brook trout, cutthroat trout
Casias Lake 3	1.0	1.2	1.1	3.6	Brook trout
Casias Lake 4	1.5	5.8	2.7	13.3	Brook trout

Table 5. Summary of lake morphometry and fish presence in RCCLA lakes. Fish presence was assessed during the summer of 2004.

Lake Name	Area (acres)	Max Depth (m)	Mean Depth (m)	Volume (AF)	Fish Species Present
Lake 1	4.0	1.2	0.7	6.9	Cutthroat trout, sucker sp.
Lake 2	0.7	0.9	0.5	1.1	Cutthroat trout, sucker sp.
Lake 3	13.1	11.2	4.2	180.6	Cutthroat trout, sucker sp.
Lake 4	4.6	3.3	2.1	31.8	Cutthroat trout
Lake 5	4.1	6.0	3.6	48.1	Sucker sp.
Lake 6	1.6	1.4	1.0	5.4	No
Lake 7	2.0	2.4	1.5	9.9	No
Lake 8	3.1	3.3	1.7	17.2	No
Lake 9	10.8	12.8	8.2	291.3	No
Little Blue Lake	2.8	10.8	6.6	60.2	Rainbow trout

Table 6. Rio Costilla watershed fishery inventory. ONVI = Rio Grande cutthroat trout, ONMY = rainbow trout, ONCX = cutthroat trout x rainbow trout hybrid, SAFO = brook trout, SATR = brown trout, CACO = white sucker, CACA = longnose sucker, RHCA = longnose dace.

Water Name	Site Description	Date of Survey	Survey Type	Adult Trout/100 m	Species Found
		Vermejo Park Ranch			
Costilla Creek	Site 1	Jun-04	Multiple Pass Depletion	51	ONVI, ONMY, SAFO, SATR
Costilla Creek	Site 2	Jun-04	Multiple Pass Depletion	17	ONVI
Costilla Creek	Site 3	Jun-04	Multiple Pass Depletion	13	ONVI
Costilla Creek	Site 4	Jun-04	Multiple Pass Depletion	21	ONVI
Costilla Creek	Site 5	Jun-04	Multiple Pass Depletion	11	ONVI
Casias Creek	1/4 mile above costilla lodge road	Jul-03	Multiple Pass Depletion	15	SAFO, ONMY
Casias Creek	Just Below 7 Lakes Culvert	Jul-03	Multiple Pass Depletion	53	SAFO, ONMY, SATR
Casias Creek	Above culvert in middle meadow	Jul-03	Multiple Pass Depletion	17	SAFO
Casias Creek	Just below upper trib	Jul-03	Multiple Pass Depletion	11	SAFO
Allen Creek	Entire System	Jul-05	Spot Check	NA	SAFO
Santistevan Creek		Jul-03	Spot Check	NA	SAFO
Long Canyon Creek	Near Seven Lakes	Jul-05	Spot Check	NA	SAFO

Table 6 continued.

Carson National Forest					
Lower Comanche Creek	Below Vidal Creek Confluence	Aug-05	Multiple Pass Depletion	13	ONVI, CACO, CACA, RHCA
Lower Comanche Creek	Below Chuck Wagon Canyon	Aug-05	Multiple Pass Depletion	19	ONVI, ONCX, CACO, CACA, RHCA
Lower Comanche Creek	Below Little Costilla	Aug-05	Multiple Pass Depletion	33	ONVI, ONCX, CACO, CACA, RHCA
Lower Comanche Creek	Above Little Costilla	Aug-05	Multiple Pass Depletion	16	ONVI, CACO, CACA, RHCA
Upper Comanche Creek	Above Vidal Creek Confluence	Aug-05	Multiple Pass Depletion	2	ONVI, CACO, RHCA
Upper Comanche Creek	Upper Meadows	Aug-05	Multiple Pass Depletion	2	ONVI, CACO
Little Costilla Creek	Site 1	Aug-05	Multiple Pass Depletion	5	ONVI, ONMY, CACO
Little Costilla Creek	Site 2	Aug-05	Multiple Pass Depletion	5	ONVI, ONMY, CACO
Gold Creek	Site 1	Aug-05	Multiple Pass Depletion	2	ONVI
Vidal Creek	Clayton Camp	Aug-05	Multiple Pass Depletion	1	ONVI, CACO
Vidal Creek	Upper Meadow	Aug-05	Multiple Pass Depletion	3	ONVI, CACO
Powderhouse Creek	Above Barrier	Jul-04	Multiple Pass Depletion	16	ONVI
Powderhouse Creek	Site 2- below barrier	Jul-04	Multiple Pass Depletion	12	ONVI, SAFO
Costilla River	Valle Vidal Boundary	Sep-03	Multiple Pass Depletion	19	ONCX, ONMY, CACO, CACA, RHCA
Costilla River	Upper Site	Sep-03	Multiple Pass Depletion	63	ONCX, ONMY, SATR, RHCA, CACO
Costilla River	La Cueva	Sep-03	Multiple Pass Depletion	63	ONCX, ONMY, SATR, RHCA, CACO
Foreman Creek	Entire system	Aug-05	Spot Check	NA	ONVI, CACO
Holman Creek	Entire system	Aug-05	Spot Check	NA	ONVI, CACO
Labelle Creek	Entire system	Aug-05	Spot Check	NA	ONVI, RHCA, CACO
Grassy Creek	Entire system	Aug-05	Spot Check	NA	ONVI
Rio Costilla Cooperative Livestock Association					
Costilla River	Above Latir Confluence	Sep-03	Multiple Pass Depletion	2	ONCX, CACO
Latir Creek		1999-2000	Spot Check	NA	ONCX

There are six amphibian species that may occur in the project area (Table 7). Of these six species, three were documented within or near the project area in 2004 (Christman 2004).

Tiger salamander are common throughout the project area and have been observed in several lakes and ponds during project planning surveys. Western chorus frog was collected in the upper Comanche Creek watershed in May 2006. Northern leopard frog was not collected in the upper Comanche Creek watershed during the same time period. All of the species are considered secure within the species range in New Mexico (BISON version 1/04) though northern leopard frog is considered a sensitive species.

Table 7. List of potential amphibians within the proposed project area.

Potential Species	Range (Elevation ft.)	Present	Special Status
Tiger Salamander *Ambystoma tigrinum*	Varied with water nearby (2,950-11,000 ft.)	Yes (2004)	No
Western Chorus Frog *Pseudacris triseriata*	Mountain lakes, wet meadows, ditches, shortgrass prairie, playa lakes (4000-9600 ft)	Yes (2006)	No
Northern Leopard Frogs (*Rana pipiens*)	Streams, lakes, and rivers (<9,600 ft.)	Yes (2004)	Yes
Canyon Tree Frog (*Hyla arenicolor*)	Rock outcrops along woody streams, talus slopes with sufficient moisture (4,000 – 8,200 ft.)	Historic specimen collected in Taos County	No
Woodhouse's Toad (*Bufo woodhousii*)	Mesic areas in the vicinity of streams and river valleys (3,000 – 8,000 ft.)	Historic specimen collected in Taos County	No
New Mexico Spadefoot (*Spea multiplicata*)	Grasslands, sagebrush flats, semi-arid shrublands, river valleys (3,000 – 8,500 ft.)	Historic specimen collected in Taos County	No

Macroinvertebrate density varies considerably among streams and years. Numerous taxa of benthic macroinvertebrates are present within the Rio Costilla watershed (Appendix H). Communities are dominated by Diptera (true flies), Ephemeroptera (mayflies), Coleoptera (beetles), and Trichoptera (caddisflies) (Vinson 2002, 2003, and 2004). Previous macroinvertebrate surveys in Costilla Creek documented densities exceeding 7,000 organisms/m^2. Harrison (1962) found an abundance of Amphipods, Cladocerans, as well as trichoptera and diptera larvae in Latir Lake Nine. Lang (1998) observed low densities of aquatic invertebrates in Latir Lakes One, Two, and Three. The knobbed-lip fairy shrimp (*Eubranchipus bundyi*) is located within the watershed.

3.3.2 Effects on Wetland, Riparian, and Aquatic Habitat and Biota

Alternative 1 - No Action

Wetland and aquatic habitat would be unaffected as would amphibians and invertebrates. Populations of RGCT in the Rio Costilla watershed may decline in number, size, and/or security. Hybridization of RGCT is expected to continue if no action is taken to remove non-native (i.e. rainbow) or hybridized fish. No progress would be made towards securing large populations of RGCT. If the decline of RGCT is significant throughout its range, federal listing as a threatened or endangered species would be likely. Though federal listing under ESA would increase protection for RGCT, and possibly prohibit ongoing land-use practices in critical habitat, any decision that RGCT need federal protection would likely result from the local extinction of secure and un-secure populations. Such losses would further reduce the genetic diversity available for future restoration efforts and be detrimental to the subspecies overall recovery. RGS and RGC populations may continue to decline.

Alternative 2 – Preferred Alternative

The proposed action would not result in any long-term effects on aquatic, wetland, or riparian habitat. No woody vegetation would be altered to implement the preferred alternative. Riparian grasses may be trampled as field staff traverses through the riparian area for mechanical removals and piscicide applications. In addition, burial pits for piscicide exposed fish would be located beyond the high water mark on the floodplain and away from jurisdictional wetlands. Equipment would disturb vegetation during barrier construction but would be short-term and limited to immediate areas around the barrier site. In many instances, barriers would be established culverts and activities limited to established roads. The permanent migration barrier would be located within the "box" canyon below the Latir Creek confluence with the Rio Costilla. A road travels next to the stream at this point with limited vegetation present. Temporary barriers previously constructed within the project area have affected less than 0.1 acre of vegetation. Similar effects would be expected for non-culvert temporary barriers.

Target fish species typically do not inhabit wetland habitats and thus mechanical removals and piscicide applications would not be necessary in most wetlands. Where wetlands are adjacent to an area inhabited by fish, mechanical removal and piscicide application may be necessary. Such activities would not alter wetland hydrology or vegetation.

Mechanical removals would reduce the abundance of resident fishes. Application of piscicides in the project area should result in mortality of all remaining fish not removed during mechanical removal efforts. Piscicides are readily transferred across the gill membrane and into the bloodstream of gill breathing organisms, making them ideal for use as a fish removal tool. Small species (such as dace and minnows) have survived multiple applications of antimycin in some instances or have been completely removed in others (Rinne and Turner 1991, Stefferud et al. 1992). Native longnose dace would be collected, stocked in unaffected waters or held offsite during the piscicide applications. Pure RGCT present in the subsegment would be collected and held offsite during the piscicide applications.

Salvage of native fish and holding them in live cars, lakes, or hatcheries does produce some risk to individual fish but the effects should be minimal. Fish are commonly held in live cars during field work and negligible mortality is expected. RGCT have been held in live cars for approximately one week without any noticeable problems in the past. Transferring salvaged RGCT to lakes within the project area would provide a long-term holding facility where the fish are provided food, cover (i.e. depth), and could be recovered when needed. Any lake selected for such an operation would be hydrologically stable and exhibit water quality characteristics required by RGCT. It is likely that not all fish would be recaptured though sufficient numbers would be salvaged and stocked to make even a partial recovery successful (e.g. ~500 RGCT). Injection with PIT tags to facilitate salvaged RGCT identification is common with low mortality and a high rate of tag retention (Dare 2003). Fin clips for genetic analysis are non-lethal and quickly heal. Several size classes would be salvaged to speed population establishment upon repatriation into the restored water. A field spawn, independent of the proposed action, was conducted in June 2006 to establish broodstock from the local populations of RGCT. Upon successful restoration, these fish and their progeny would be available to stock the project waters with an original lineage present in the project area. Transferring RGCT to a hatchery poses some risk as wild fish do not easily acclimate to hatchery conditions (e.g. hatchery feed, higher fish density, homogeneous surroundings). If moved to a hatchery, live feed could be captured during warm months and fed to captive fish. During cooler months when terrestrial insects are not available, several retailers sell live insects such as crickets which could be purchased if necessary. Fish density in the hatchery would be minimized. There could be several unforeseen events that could occur and jeopardize repatriation of the local RGCT populations. However, field spawns of RGCT populations in the project area and salvaging and restocking pure RGCT from within the project area is redundant and would maximize the probability of maintaining sources for RGCT.

Any concerns with spreading whirling disease would be minimized by testing for the parasite prior to taking fish from the donor water and fish health testing prior to stocking fish out of the hatchery. The Rio Costilla watershed has tested negative for whirling disease, as well as other major pathogens, on two separate occasions (NMDGF unpublished data) and thus whirling disease is not a concern at this time. The Seven Springs Hatchery, source hatchery for captive reared RGCT, is tested for whirling disease, as well as other pathogens, on an annual basis to ensure disease absence.

Immediately after restoration activities in a project subsegment, that water would be fishless. To expedite the fishery recovery process, native species could be stocked on multiple occasions and with multiple size classes. Restocking could occur within the same field season though may take place the following field season. A post-restoration population of RGCT within the Rio Costilla watershed (upper Rio Costilla) reached pre-treatment trout abundance just three years post-restoration (C. Kruse, pers. comm.) despite low water years during population expansion. Reproduction by stocked RGCT was noted just two years after restoration.

To date, there are >45 known Core Conservation Populations of RGCT within the Rio Grande drainage in New Mexico that could be used as donor populations for repatriation. Assessments of genetic purity for most of these populations have included multiple techniques including allozymes or mitochondrial DNA, and most recently, microsatellites (Pritchard and Cowley 2005).

Mechanical removals would disrupt, and in some cases kill, individual macroinvertebrates but should have no effect on the overall community. Public areas within the project area are common fishery destinations with anglers commonly wading in the stream. Despite higher angler use in the area, macroinvertebrate populations still exhibit high densities. Several segments are too small to effectively fish and no disruption of the aquatic macroinvertebrates in these areas is expected. When walking in the stream to electrofish, staff walks on only a portion of the stream substrate equating to minor disruption.

Reduction in the abundance of certain groups of aquatic macroinvertebrates is likely following piscicide treatments. Because of their short life cycles (Anderson and Wallace 1984), good dispersal ability (Pennak 1989) and generally high reproductive potential, aquatic invertebrates are capable of rapid recovery from disturbance (Jacobi and Degan 1977; Boulton et al. 1992; Johnson and Vaughn 1995; Matthaei et al. 1996; Nelson and Roline 1996). Most studies have found that at proposed levels, antimycin minimally affects most aquatic invertebrates found in streams and standing waters though this varies depending upon taxa considered (Walker et al. 1964; Herr et al. 1967; Schnick 1974; Houf and Campbell 1977). A study in a Wisconsin trout stream did find temporary reductions in aquatic invertebrates including certain caddisflies, craneflies, mayflies and amphipods (Jacobi and Degan 1977). However, concentrations of antimycin in the study stream reached as high as 44 ppb, about 4 times greater than concentrations likely needed for this project. Certain invertebrates are sensitive to the proposed treatment levels of antimycin, including *Cladocera* and *Copepoda* (zooplankton), *Amphipoda* (scuds), and some species of mayflies and caddisflies (Schnick 1974). However, populations of these taxa have been found to be only temporarily diminished following treatment (Schnick 1974; Jacobi and Deegan 1977).

Effects of antimycin on benthic macroinvertebrates were monitored for previous treatments in Costilla Creek and Powderhouse Creek within the Rio Costilla watershed. The data indicates a temporary reduction in macroinvertebrate density post-treatment (Figures 7 and 8). Post-treatment density recovered to pre-treatment levels within one year of the piscicide treatment. Number of taxa and EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa richness remained similar for pre, post, and subsequent years of sampling. Such recovery occurred during a low water year for the 2002 Costilla Creek project indicating rapid macroinvertebrate recovery even during drought periods.

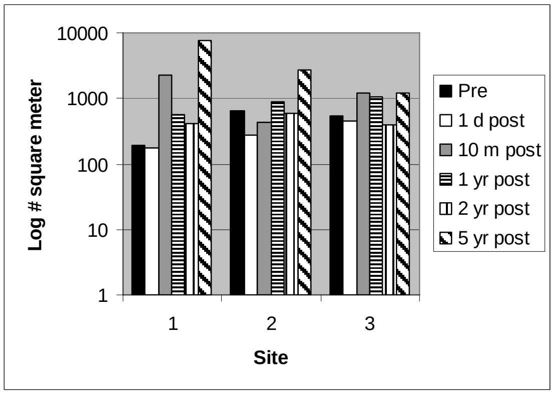
The effects of rotenone on macroinvertebrates depends upon the taxa considered (Engstrom-Heg et al.1978). Binns (1967 cited in Schnick 1974b) observed recovery of caddisflies, mayflies, and dipterans to pretreatment levels in the Green River, Wyoming two years after rotenone application. Three years after rotenone application to Manning Creek, Utah, the macroinvertebrate community had recovered to pretreatment levels (Whelan 2002). There were some taxa that were not found in the post treatment samples but due to their low abundance prior to treatment, the investigator believed that the absence was likely due to sample variability (Whelan 2002). Houf and Campbell (1977) observed no reduced density or diversity after application of rotenone to ponds. Aquatic invertebrate toxicity to rotenone ranges from 28 ppb (24 hr. LC50 *Daphnia pulex*) to 47.2 ppm (24 hr. LC50 *Orconectes immunis*) respectively (Farringer 1972 cited in Schnick 1974b, Chandler and Marking 1982, CDFG 1994). Anderson (1970) reported that a rotenone treatment had little effect on the zooplankton community with most variations in species composition and abundance caused by factors other than rotenone application. Cook and Moore (1969) reported that the application of rotenone has little lasting effect on the non-target insect community of a stream. Kiser et al. (1963) reported that none of the 42 cladoceran or copepod species were permanently removed as a result of rotenone application. Both Anderson (1970) and Kiser et al. (1963) proposed that most plankton species withstand a rotenone treatment via their highly resilient egg structures.

Knobbed-lip fairy shrimp inhabit small temporary waters including ditches, vernal pools, and ponds (B. Lang, pers. comm.). Eggs are laid when water is present, become torpid, and then hatch once the waterbody fills again. They do not, however, inhabit flowing waters and are typically absent in habitats where target fish species are present. Thus, the potential for effects on this species of fairy shrimp is negligible as the habitat of the fish target species does not overlap.

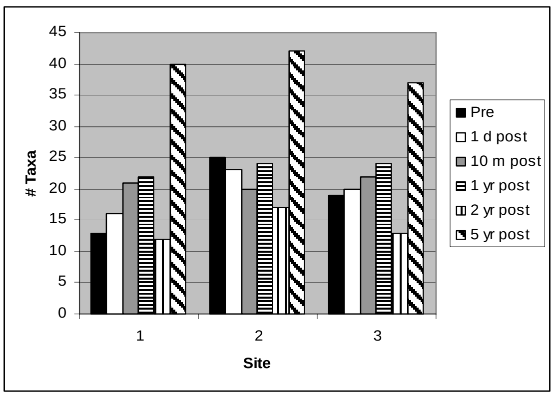
Based upon data collected from previous restorations within the Rio Costilla watershed and existing literature, application of a piscicide would have no long-term effect on aquatic macroinvertebrate density or diversity. Environmental differences between literature study areas and the project area could create subtle differences in results. Results from previous restoration projects within the project area indicate macroinvertebrate community recovery within one year. The proposed action would be implemented in segments, and therefore limit piscicide effects to only a portion of the project area in a single year. Piscicide application in other subsegments would not occur until the next field season. As a result, macroinvertebrate communities would be recovered or in the process of recovery by the time a piscicide is applied in another project subsegment. Macroinvertebrate recolonization is also possible from upstream and downstream portions of the watershed. Some macroinvertebrates may also be unaffected given their habitation within the hyporrheic zone and resistant eggs.

Some segments of stream are perennial but do not contain sufficient fish habitat and thus piscicide application is unlikely. Known segments that are perennial yet contain or partially do not contain unwanted fish species include upper Little Costilla Creek, Grassy Creek, one unnamed tributary to Comanche Creek, one unnamed tributary to Casias Creek, and one unnamed tributary to Costilla Creek. It is not expected that restoration is needed in these waters (~8.5 miles) and thus the macroinvertebrate community in these headwater habitats would be unaffected by the proposed action. In addition, several lakes do not currently contain fish (Tables 4 and 5). These areas are included within the project area as they are adjacent to fish inhabited waters. Should conditions change to a point where non-native fish reinvade these habitats, treatment may be necessary. These lakes and stream segments would serve as additional sources for macroinvertebrate recolonization.

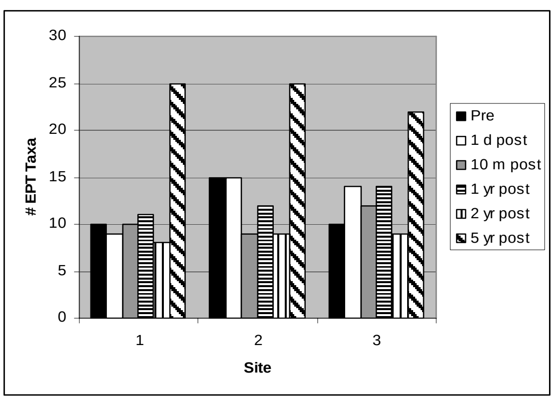
Figure 7. Macroinvertebrate density pre and post-deployment of antimycin in Powderhouse Creek, 1997



Macroinvertebrate Density

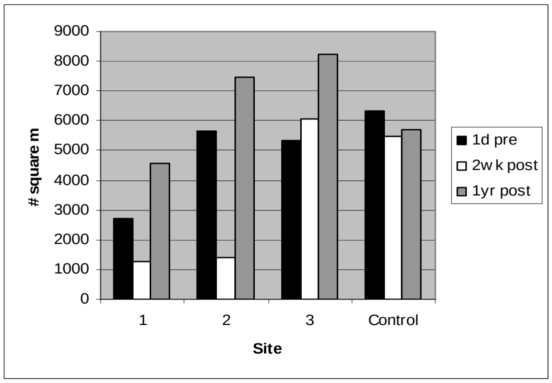


Number of Taxa

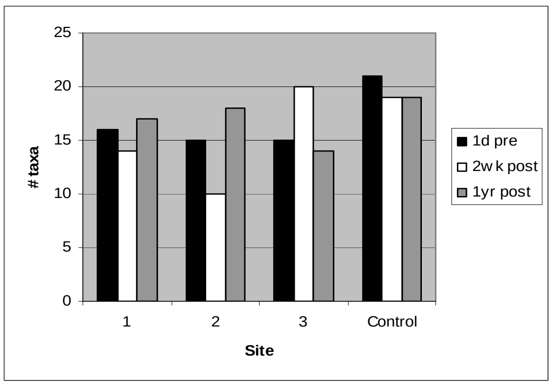


EPT Taxa Richness

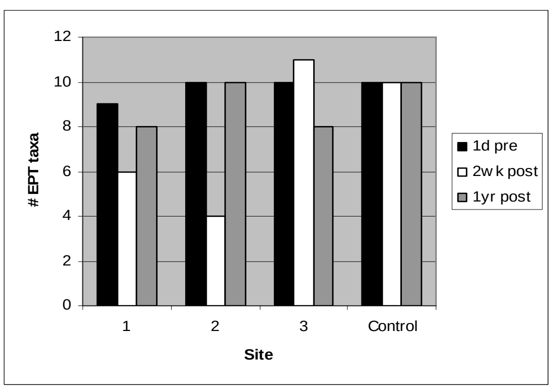
Figure 8. Macroinvertebrate density pre and post-deployment of antimycin in Costilla Creek, 2002.



Macroinvertebrate Density



Number of Taxa



EPT Taxa Richness

Adult and juvenile amphibians may be exposed to electric current or caught in nets during mechanical removals. Exposure to electric current should be limited as amphibians are mobile and can flee an affected area as staff approach. If amphibians are observed in an area, juvenile or adult, the electric current can be turned off and minimize adverse effects. Removal efforts would be limited to areas inhabited by fish and thus not all habitats would be affected.

Adult and juvenile amphibians would likely be present during some piscicide applications. Restoration efforts would be limited to fish inhabited waters, and thus not all aquatic amphibian habitat would be affected. Early life-stages of amphibians are gill breathing. Mortality of individual animals is possible due to piscicide toxicity. However, population effects would be minimal. Rotenone toxicity ranges from 5.8 ppm (96 hr. LC_{50}) to 24.0 ppm (24 hr. LC_{50}) for the leopard frog (Farringer 1972). Leopard frog larvae are more sensitive with a 24 hr. LC_{50} of 0.580 ppm established in static water testing (Chandler and Marking 1982). For antimycin, tiger salamanders survived exposure at 80 ppb for 96 hours, while bullfrog tadpoles survived 20 ppb, but perished when exposed to 40 ppb for 24 hours (Walker 1964). The LC_{50} for leopard frogs exposed to antimycin ranged from 48 to 59 ppb (Lesser 1972). Recent research on amphibian exposure to chronic, small concentrations of multiple chemicals can induce developmental problems in frogs (Hayes et al. 2006). The chemicals used in this research, however, are not present in any piscicide proposed for use. In addition, the exposure period was several weeks to months during amphibian development and metamorphosis (two days post-hatch to Gosner stage 46), in essence chronic exposure. This research is not comparable to exposure resulting from the proposed action (chronic exposure to chemicals). Chronic exposure of amphibians to rotenone or antimycin, or any of the product constituents, is unlikely due to the short-term persistence of these chemicals in the environment (Appendix G).

Alternative 2 – Cumulative Effects

Previous piscicide applications in Powderhouse Creek and upper Rio Costilla removed non-native trout and repatriated RGCT. Aquatic macroinvertebrates were monitored in both of these projects and data indicate that communities recovered within a year of application. Self-sustaining populations of RGCT are present in both streams. Three amphibian species were observed on VPR after the 2002 piscicide application. The proposed action would cumulatively add to removal of non-native fish by removing more non-native fish. Cumulative effects of past projects within the project area would not be expected given the temporary effects of piscicides on macroinvertebrates and resident fish.

As discussed in section 3.1.2, CNF has proposed an integrated weed management effort to control noxious weeds within the project area. Less than seven acres of noxious weeds were mapped within 25 feet of any stream that could have an herbicide applied under the proposal. Other methods of noxious weed control will likely be employed prior to herbicide application. Herbicide application will occur within the riparian, roadside, and upland areas. It is possible that some herbicide could enter a stream but any amount would be negligible. Piscicides are applied to streams and lakes. If juvenile amphibians are observed within a project subsegment, they would be collected and held off-site to limit piscicide exposure. Any cumulative effects on macroinvertebrates or amphibians resulting from the proposed action and herbicide application is unlikely.

Alternative 3

Several years of electrofishing, netting, and angling would continually suppress the resident fish populations at low numbers (Appendix F). Initially, excessive angling and harvest would be successful at reducing adult trout abundance. Angling would likely have little effect on non-native sucker populations as they are not as easily caught when angling. The abundance of non-native fish would be reduced through subsequent electrofishing removals. Quantifying any success rate or percent reduction is difficult as efficiency would depend upon habitat complexity, water chemistry, crew experience, among others. Expected removal efficiency would range from 50-75% of the non-native fish population within two removal efforts. On each successive pass, removal efficiency would likely decline. Fish missed during removal efforts will likely spawn and increase the number fish to remove the next year. Native fish would continually be exposed to electric current on at least two occasions in a given year for an indefinite number of years. Temporarily holding native fish, as described in Alternative 2, is not feasible due to the extended timeline for implementation in a project subsegment. If RGCT are not present within a project subsegment, no repatriation would occur until all non-natives are removed.

To conduct electrofishing removals, project personnel must walk throughout the riparian area within a project subsegment at least twice, possibly more, in a given year. Such removals would take place at similar intervals for an indefinite number of years. This would lead to annual trampling of riparian vegetation and potential streambank degradation. Extensive use of gill nets could increase both the juvenile and adult amphibian mortality as gill nets are not species selective. Negative effects associated with Alternative 3 could be long-term due to continuous removal efforts over an indefinite time period.

Effects from barrier construction would be the same as discussed under Alternative 2.

Alternative 3 – Cumulative Effects

No cumulative effects are expected under this alternative.

3.4 Terrestrial Habitat and Wildlife

In this section, the existing conditions of terrestrial habitat and wildlife are presented. Effects of the alternatives are discussed. Special status species are discussed in following sections though effects in this section may also be applicable.

3.4.1 Existing conditions. The upper reaches of Rio Costilla watershed include steep-sided canyons alternating with wider meadowed valleys. The upper forested drainage exhibits spruce-fir (Engelmann spruce, limber pine, and aspen) and mixed conifer (Douglas fir, blue spruce, scrub oak, limber pine, white fir, ponderosa pine, aspen) complexes. Understory species are dominated by *Cardamine* and *Senecio* near saturated areas with *Arctostaphulos* dominating dryer areas (Omart et al. 1999). Current land use includes cattle grazing, timber harvest, mineral extraction, hunting, wildlife viewing, and various outdoor recreation activities. Cattle grazing occurs only on CNF and RCCLA. Timber harvest potentially occurs on all three tracts of land.

The landscape supports a variety of large mammals including bear, mountain lion, elk, Rocky Mountain bighorn sheep, coyote, and deer. A list of wildlife species known or expected to occur within the project is provided in Appendix I. This list does not include wildife with special status (State or Forest Sensitive, or Federal protection) as they are discussed in a following section.

3.4.2 Effects on terrestrial habitat and wildlife

Alternative 1 - No Action
There would be no change in quantity or quality of terrestrial vegetation or wildlife in the project area under the no action alternative.

Alternative 2 – Preferred Alternative
The proposed action would not result in any changes in the quantity or quality of terrestrial vegetation or wildlife and their habitat, as most activity would be confined to the stream corridor. Project implementation may require the transportation of equipment and personnel over areas where no established roads or trails exist, though these activities would be limited. Foot and horse travel would be the primary mode of transportation off of established roads. Temporary and permanent fish migration barriers would disturb the ground in immediate areas surrounding the barrier and have a minimal effect on terrestrial habitat throughout the project area. Dead fish pits would be small and insignificant across the landscape as a whole.

During mechanical removals, increased human presence may disrupt movement and habitat use of some terrestrial animals. Once humans leave the area, terrestrial wildlife should resume natural patterns. Electrofishing may expose individual small mammals to electric current. This occurrence is not common and, when it does occur, staff would quickly turn off the electrofishing unit. Gill nets are set below the surface of the waterbody and thus pose little risk to waterfowl or fish-eating birds.

There would be localized absence of fish biomass available for some animals to prey upon. Likewise, aquatic macroinvertebrate abundance would be locally reduced within a project subsegment. Such temporary reductions may affect prey availability and prey search time. Macroinvertebrate data collected from past restoration projects within the project area indicate that macroinvertebrates are reduced in density, not entirely lost (See Section 3.3). Aquatic macroinvertebrate prey would still be available after the restoration efforts within a subsegment. Any reduction in prey availability would be short term and limited to a small portion of the entire project area. American Dipper (*Cinclus mexicanus*), which feeds primarily on aquatic macroinvertebrates, is mobile and could seek prey elsewhere. Species that feed on fish or aquatic macroinvertebrates are normally quite mobile and would be able to find prey in other portions of the project area that have not been treated or have already been reestablished. In addition, terrestrial invertebrates, sources of prey for insectivores such as flycatchers, warblers, bluebirds, and bats, among others, would be unaffected by the proposed activity. Terrestrial wildlife such as mice, voles, rats, and rabbits would be unaffected by the proposed action and thus available as prey sources for raptors and other predators.

Mobile terrestrial wildlife could potentially be exposed to treated water, consume treated water, or consume piscicide-killed fish. Because of human presence during treatment of each segment, it is unlikely that large numbers of animals would enter the treatment area and consume either fish or water. Exposure to treated water (e.g. walking in the water) poses little risk to terrestrial wildlife. The piscicides selected in the proposed action are not considered carcinogenic, teratogenic, fetotoxic, or mutagenic. In the event terrestrial wildlife did drink piscicide treated water (Appendix G), the quantities needed to ingest a potentially harmful dose are physically impossible to reach. Consumption of piscicide-exposed fish would also produce no effect upon terrestrial wildlife populations given the large mass of fish that must be consumed to obtain a harmful dose. Collection and disposal of piscicide-killed fish would limit the potential for wildlife to consume fish.

Alternative 2 – Cumulative Effects
There would be no effects on terrestrial wildlife habitat or species from the proposed action, and therefore, no contribution to cumulative effects on these species.

Alternative 3
The effects of Alternative 3 on terrestrial habitat and wildlife would be similar to Alternative 2 except for exposure to piscicides. Presence of humans within the project, which may alter wildlife activities, would continue over several years. During implementation, the entire fish population in a subsegment would be suppressed at a low level. Any effect of reduced fish biomass on food availability and search time for fish-eating birds and mammals in a project subsegment would be long-term. Complete removal of unwanted fish is unlikely. Reduced biomass throughout the project area would continue for several years if not decades. Fish-eating birds are normally quite mobile and able to find prey in other portions of the project area though a greater area of the project would be affected by mechanical removals.

Alternative 3 – Cumulative Effects
No cumulative effects are expected under this alternative.

3.5 Special Status Species

Special status species are protected under the federal Migratory Bird Treaty Act (16 U.S.C. 703 *et seq.*), Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*) or two state laws, the Wildlife Conservation Act (17-2-37 NMSA) or the New Mexico Endangered Plant Species Act (9-10-10 NMSA), as well as those considered to be sensitive species by CNF, USFS Region 3, or NMDGF. Sensitive species are those for which substantial declines in range and abundance have been documented, but legal protection is not yet warranted or insufficient information exists to fully quantify status. The ESA prohibits killing, harming, or harassing listed species and prohibits the adverse modification of their designated critical habitat. If listed species could potentially be affected through implementation of the proposed action, the USFWS must be consulted to make an assessment of the risk to the species. A threatened of endangered species consultation with USFWS required by Section 7 of the ESA will be completed in conjunction with this EA.

3.5.1 Existing conditions. Based on information from USFWS, USFS, and NMDGF, 35 species with special status could be found in the project area or potentially affected by the proposed action (Table 8). Additional birds protected under the Migratory Bird Treaty Act are listed in Appendix J.

Table 8. Special status species potentially in project area.

Common Name	Scientific name	Status
Mammals		
Myotis little occult brown bat	*Myotis lucifugus occultus*	R3 Forest, State – sensitive
Townsend's pale big-eared bat	*Plecotus townsendii pallescens*	R3 Forest, State – sensitive
New Mexican jumping mouse	*Zapus hudsonius luteus*	R3 and CNF Forest – sensitive, State – sensitive
Ringtail	*Bassariscus astutus*	R3, State – sensitive
American marten	*Martes americana origenes*	R3 Forest – sensitive, State – threatened
Rocky mountain bighorn sheep	*Ovis canadensis canadensis*	R3 Forest - sensitive
Birds		
Baird's sparrow	*Ammodramus bairdii*	State – threatened
White-faced ibis	*Plegadis chihi*	R3 Forest – sensitive
Bald eagle	*Haliaeetus leucocephalus*	Federal, State – threatened
Northern goshawk	*Accipiter gentilis*	R3 and CNF Forest - sensitive
Swainson's hawk	*Buteo swainsoni*	R3 Forest – sensitive
Ferruginous hawk	*Buteo regalis*	R3 Forest – sensitive
American peregrine falcon	*Falco peregrinus anatum*	R3 and CNF Forest – sensitive
White-tailed ptarmigan	*Lagopus leucurus altipetens*	R3 and CNF Forest – sensitive, State - threatened
Mountain plover	*Charadrius montanus*	R3 Forest – sensitive State - sensitive
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	R3 Forest – sensitive, State – sensitive, Federal-Candidate
Flammulated owl	*Otus flammeolus*	R3 Forest – sensitive
Mexican spotted owl	*Stris occidentalis lucida*	Federal – threatened
Boreal owl	*Aegolius funereus*	R3 and CNF Forest – sensitive, State – threatened
White-eared hummingbird	*Hylocharis leucotis borealis*	R3 Forest – sensitive, State - threatened
SW willow flycatcher	*Empidonas traillii extimus*	Federal – endangered, State – endangered
Loggerhead shrike	*Lanius ludovicianus*	State – sensitive
Gray Vireo	*Vireo vicinior*	R3 Forest – sensitive, State – sensitive
Amphibians		
Northern leopard frog	*Rana pipiens*	R3 and CNF Forest - sensitive
Fishes		

Rio Grande cutthroat trout	*Oncorhynchus clarki virginalis*	R3 and CNF Forest, State – sensitive
Rio Grande sucker	*Catostomus plebeius*	R3 Forest – sensitive
Rio Grande chub	*Gila Pandora*	CNF Forest, State – sensitive
Invertebrates		
Snails		
Cockerell's striate disk snail	*Discus shimeki cockerilli*	State – sensitive
Linnaeus' ramshorn snail	*Gyraulus crista*	CNF Forest - sensitive
Wrinkled marshsnail	*Stagnicola caperatus*	R3 Forest – sensitive, State - endangered
Clams		
Sangre de Cristo peaclam	*Pisidium sanguinichristi*	State – threatened R3 and CNF Forest – sensitive
Plants		
Ripley milk-vetch	*Astragalus ripleyi*	CNF Forest – sensitive
Hairless fleabane (AKA Pecos Fleabane)	*Erigeron sublager*	CNF Forest – sensitive
Small-head golden-weed	*Haplopappus microcephalus*	CNF Forest – sensitive
Arizona Willow	*Salix arizonica*	CNF Forest – sensitive
Sierra Blanca kitten-tail	*Besseya oblongifolia*	CNF Forest - sensitive

3.5.2 Effects on special status species

Alternative 1 - No Action

The no action alternative would maintain the baseline conditions for any special status species in the project area though continued decline of RGCT in the watershed is expected. The expanded range of RGCT, RGS, and RGC, all considered sensitive species, would not occur.

Alternative 2

Fish

During recent surveys, staff have not found RGS or RGC in the project area. RGCT populations are well documented. Pure RGCT populations that currently exist in the Rio Costilla drainage would be protected and expanded by the proposed action. Genetically introgressed cutthroat populations, which produce a significant threat to pure RGCT due to ongoing hybridization, would be removed from the project area. The goal of the proposed action is repatriation of a viable population of genetically pure RGCT, RGS and RGC after removal of the extant non-native fishes in the project area. These species would be stocked into the stream or lake following confirmation that all non-native fish are removed.

Invertebrates

Sangre de Cristo peaclams (*Pisidium sanguinichristi*) have only been documented in the Middle Fork Lake near Red River, a lake beyond the project area. No populations of Cockerell's striate disk snail (*Discus shimeki cockerelli*) have been documented in the Rio

Costilla drainage though this snail is land-based and thus would not be affected by aquatic application of a piscicide. Recent invertebrate surveys documented the presence of wrinkled marshsnail (*Stagnicola caperatus*) in high-elevation woodland pools within VPR (B. Lang, pers. comm.) and they do not inhabit perennial waters that would be affected by the proposed action. Linnaeus' ramshorn snail (*Gyraulus crista*) was collected within CNF though beyond the project area. Exposure to 10-40 ppb antimycin produced no effect on snails (Berger 1965, Degan 1973 cited in Schnick 1974). Clams and mussels exhibit a 96 hr. LC_{50} for antimycin ranging from 50 ppb to 5 ppm (Schnick 1974). A 96 hr. LC_{50} was calculated at 4.0, 1.75, and 7.95 ppm for *Physa*, *Oxytrema*, and *Heliosoma* snails, respectively (Chandler and Marking 1982). Hart et al. (2001) noted no post-treatment effects of rotenone on mussels in the Knife Lake system, Minnesota. Considering the proposed piscicide concentrations and short-term exposure period (4-8 hours) as well as no habitat overlap, no effects are expected on special status invertebrate populations within the project area.

Amphibians
Northern leopard frogs (*Rana pipiens*) inhabit the project area (Christman 2004). Northern leopard frogs generally inhabit streams, lakes, marshes and irrigation ditches (Degenhardt et al. 1996). High elevation populations breed later in the summer than low elevation populations. Hahn (1968) observed metamorphosing leopard frogs in August at 3200m (10,200 ft) in southern Colorado. The proposed action should produce minimal effect on northern leopard frog populations as discussed in 3.3.2. Northern leopard frogs inhabit a variety of habitats within the project area that would be unaffected by the proposed action. If juvenile northern leopard frogs are observed in a project subsegment, they would be collected and relocated to unaffected locations.

Mammals
The potential effects of the proposed action for mammals are discussed below. One mechanism for exposure to piscicides is common to all mammals within the project area; consumption of piscicide treated water. These effects are discussed in Appendix G. Unique indirect effects for a particular mammal are discussed for a particular species. Effects of mechanical removals are limited to potentially shocking small mammals within the stream during electrofishing. Effects on special status mammals from mechanical removals would be the same as discussed in section 3.4

The New Mexico jumping mouse (*Zapus hudsonius luteus*) is generally associated with montane meadow systems with perennial streams and dense vegetation (Finch 1992, Zwank 1994). The diet of the jumping mice includes both vegetal (e.g., seeds and fruits) and animal (e.g., insects) components (Burt and Grossenheider 1976). The New Mexico jumping mouse is extant within the Jemez and Sacramento Mountains as well as the Rio Grande valley at Bosque del Apache and Isleta (J. Stuart, pers. comm.). One confirmed record of New Mexico meadow jumping mouse in the Sangre de Cristo mountains is from the Williams Lake area, beyond the project area. The New Mexico jumping mouse feed on seeds, fruits, and insects that would be unaffected during project implementation. No effects on the New Mexico meadow jumping mouse are expected as a result of the proposed action.

Ringtail (*Bassariscus astutus*) are found primarily in montane habitats with rocky canyon walls (Frey and Yates 1996). Ringtail feed on small mammals as well as birds, lizards, insects, cactus fruits and other plants, and carrion (Taylor 1954). Given the omnivorous diet of ringtail, alternate sources of food would be available. There would be little if any effect upon potential ringtail cat populations in the project area by the proposed action.

Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) were transplanted into the Latir Peak Wilderness in 2002 and are known to be transient in the portions of the Culebra Range in New Mexico. Bighorns inhabit rugged cliffs and other rocky areas adjacent to suitable feeding sites, which include grass as well as browse plants (Findley 1975). Human presence in areas near bighorn sheep populations would occur during project implementation. Increased frequency of humans in high elevation areas (>11,000 ft.) should produce no permanent effect on the bighorn sheep populations in the project area.

American marten (*Martes americana origenes*) inhabit forests of spruce, fir, and associated trees in northern New Mexico (Bailey 1932, Findley et al. 1975). Their summer diet is varied and includes mammals, birds and their eggs, fish, insects, and carrion. Though part of the American marten diet may be decreased during the temporary removal of fish from a portion of the project area, their omnivorous diet would provide other prey sources during project implementation. The proposed action would have no affect on American marten populations in the project area.

Myotis little brown occult bat (*Myotis lucifugus occultus*) occurs in the vicinity of large permanent water sources, such as streams, drainage ditches, or lakes (Findley et al. 1975). Invertebrates, including aquatic species, are an important food source for the little brown occult bat (Barbour and Davis 1967, Fenton and Barclay 1980, and Chung-MacCoubrey 1995). As discussed in section 3.3.2, aquatic invertebrates would not be completely removed and reduced populations quickly recover. Terrestrial invertebrates would be unaffected by the proposed action and would continually provide sources of prey. In addition, these bats are mobile and can seek alternative feeding sites within the project area during site specific project implementation. No long-term effects should be observed on the myotis little brown occult bat as a result of the proposed action.

Townsend's pale big-eared bat (*Plecotus townsendii pallescens*) is a western species inhabiting semidesert shrublands, pinon-juniper woodlands, and open montane forests (Hoffmeister 1986). Their distribution tends to be strongly correlated with the availability of caves or cave-like roosting habitat (e.g., old mines). One study in the southwest found that 38 of 40 stomachs contained only lepidopterans, averaging 6-12 mm in length. Small quantities of other insects have been detected, including coleopteran, diptera, hemiptera, hymenoptera, homoptera, neuroptera, trichoptera, and plecoptera. The proposed action should produce no effect on local lepidoptera populations. Temporary reduction of secondary food sources, airborne aquatic macroinvertebrates, may occur. Aquatic macroinvertebrates would be unaffected in other subsegments during implementation of the proposed action in a project subsegment and thus can serve as sources of secondary prey. Other than a temporary reduction of a secondary food source, the proposed action would produce no effect on Townsend's pale big-eared bat.

Birds

The potential effects of the proposed action for birds are discussed below. Exposure to piscicides for all birds potentially with in the project area is discussed in Appendix G. Unique effects are discussed for a particular species.

Southwestern willow flycatcher (*Empidonax traillii*) is an obligate riparian species known to occur in Taos County. Distribution is limited to lower elevation riparian habitats (internet - USFWS data sheet, S. Williams pers. comm. 6/22/01). The southwestern willow flycatcher is generally found in riparian woodlands in close association with dense vegetation. Preferred habitat includes willows (*Salix* sp.) but also arrowweed (*Pluchea sericea*) and tamarisk (*Tamarix ramosissima*) typically with a scattered overstory of cottonwood (*Populus deltoides*). These riparian areas provide nesting and foraging habitat. Southwestern willow flycatchers may encounter temporarily reduced invertebrates but are mobile and can seek food in alternative areas. In addition, terrestrial insect prey would be unaffected by the proposed action. Suitable habitat would not be affected, as woody vegetation would be unaltered. No effects are likely to result from the proposed action.

White-tailed ptarmigan (*Lagopus leucurus altipetens*) have been recorded on Costilla Peak and Latir Peak. White-tailed ptarmigan feed primarily on buds, leaves, flowers, and when available, insects and other arthropods (Johnsgard 1983). Increased frequency of humans in riparian areas during project implementation is likely including areas near Costilla Peak and Latir Peak. Any effect of humans in the area would be short-term and would not affect white-tailed ptarmigan populations.

Bald eagles are present in the Rio Costilla watershed. Migratory and juvenile eagles are commonly seen near Costilla Reservoir in the spring and summer months. Bald eagles are water oriented, but can be found in various habitat types from mid-elevational montane forests to pinon-juniper and lower elevational shrublands. They prefer large trees near a ready supply of fish (majority of diet), but commonly take small mammals, birds (waterfowl), or eat carrion. It is unlikely that bald eagles use the creek as a primary food source; however it is probable that if a substantial number of fish carcasses were relatively accessible they would opportunistically feed upon on them. The availability of piscicide exposed fish would be reduced by collection and burial, and as described previously, the quantity of dead fish that would have to be consumed to produce toxic effects is enormous (3.4.2). The proposed action is not likely to have any effect on bald eagles.

The Mexican spotted owl (*Strix occidentalis lucida*) is most common in mature, old-growth forests throughout its range (Ganey 1992), and preferred habitat characteristics include multi-layered (uneven-aged) stands, snags, and downed woody debris (Block et al. 1995). Spotted owls can be found in many types of forested ecosystems (e.g., Douglas fir, redwood, ponderosa pine, fir-spruce, etc.) if suitable habitat components are present. Critical habitat for Mexican spotted owl is not included in or near the project area (69 FR 53182). They typically inhabit mature coniferous habitat, often in association with riparian areas. They are usually resident to fixed territories year around. Little old growth forest exists within the project area; much of the drainage has been logged in the last century. Prey ranges from large invertebrates (beetles and moths) to small mammals (Ganey 1992). Migration is seasonal; they move upslope in the spring and down in the fall. Nesting occurs, in tree cavities, in the tree canopy, or on cliff ledges at 1,825-2,500 m (6,000+ ft) elevation. Young, 1-3 per clutch, are fully independent by early October. The proposed action is unlikely to affect Mexican spotted owls as (1) they do not inhabit the riparian area where the bulk of project activities would occur, (2) foraging activity is nocturnal a time when project activities would be limited, and (3) the owl or the owl's primary prey are not dependent on aquatic biota for food.

The mountain plover (*Charadrius montanus*) is associated with lower grassland habitats (Sager 1996) and are unlikely to occur in elevations as high as the treatment area.

The white-faced ibis (*Plegadis chihi*) may be transient in the Rio Costilla watershed. Ibis feed opportunistically on crayfish, frogs, grasshoppers, and other invertebrates (Finch and August 1992). Localized, short-term reductions in insect populations should not affect the highly mobile ibis.

The peregrine falcon (*Falco peregrinus anatum*) is found locally across New Mexico and can be resident or migratory. This species feeds almost exclusively on flighted prey and nests on cliff ledges or other tall, sheer natural or man-made structures (Hubbard 1985). Nesting generally begins in April with young fledged within 75 days (late-July). Considering life history characteristics, feeding behavior, and timing of the proposed action, there should be no effect on peregrine falcons in the project area.

The boreal owl (*Aegolius funereus*) is resident to the Sangre de Cristo mountains of northern New Mexico and occurs mainly above 2,900 m (9,500 ft.) in climax spruce-fir forests (Ryder et al. 1987). Boreal owl feed primarily on rodents but opportunistically feed on birds as well. Increased human presence in the project area may temporarily disrupt boreal owl behavior. No effects on boreal owl populations are likely to result from the proposed action.

White-eared hummingbird (*Hylocharis leucotis borealis*) is classified as an irregular migrant (fewer than 10 reports) in New Mexico. This species typically occurs in montane habitats including evergreens and riparian woodlands at middle elevations (1,500 – 2,300 m) (Hubbard 1978). It is likely that white-eared hummingbirds do not even exist within the project area. If they do exist, they rely upon nectar from flower plants which would be unaffected by the proposed action. As a result, the proposed action would have no effect on white-eared hummingbird.

Gray vireo (*Vireo vicinior*) is associated with open woodlands/shrublands (Hubbard 1985). Juniper (*Juniperus* spp.) and pinon dominates most areas inhabited by gray vireo in New Mexico, although oak (*Quercus* spp.) is also present in southern ranges. The gray vireo is an insectivore and inhabits New Mexico from April to September (NMDGF 1988). The close association with pinon-juniper complexes and limited range beyond 2,200 m in elevation make the presence of gray vireo within the project area unlikely. If present, a temporary reduction in insect density would have little effect on gray vireo.

Baird’s sparrow (*Ammodramus bairdii*) breed in shortgrass prairies. In New Mexico, this sparrow has been found in a variety of habitats, ranging from desert grasslands in the south to prairies in the northeast and mountain meadows in the Sangre de Cristo mountains--to an elevation of 3600 m (Hubbard 1985). They feed on insects, spiders, grass, and grass seeds. Localized, short-term reduction of aquatic invertebrate populations should not affect the Baird’s sparrow as alternative forage would be available and terrestrial insects unaffected.

Northern goshawk (*Accipiter gentilis*) is a year round inhabitant of New Mexico. Goshawks typically prefer mature stands in varying forest types, with ponderosa pine, mixed species, and spruce-fir commonly used in the southwestern US. Prey items are primarily small to mid-size mammals and birds. Nests are found in the canopy of large trees usually within 0.5 km (1650 ft) of perennial water. Breeding occurs throughout summer. If present in the watershed, northern goshawks should not be affected by the proposed action as fish are not a prey source for northern goshawk. Increased human presence could disrupt daily activity as nesting is proximal to perennial water though this effect would be negligible.

Swainson's hawk (*Buteo swainsoni*) occur in grasslands, shrublands and riparian woodlands from lower to middle elevations (850-2,300 m) and rarely occur at higher elevations (2,300 – 4,000 m) (Hubbard 1978). Primary food sources for Swainson's hawks includes squirrels, amphibians, and large insects. Considering this range, it is unlikely that Swainson's hawk is present within the project area. If present, it is unlikely that populations of Swainson's hawks would be affected by the proposed alternatives as prey sources would not be affected by the proposed action.

Ferruginous hawk (*Buteo regalis*) are associated with sagebrush valleys and rolling grasslands. Prey items consist mainly of small mammals and large insects. It is unlikely that Ferrigunous hawk are found in the treatment area and would be affected by the proposed project.

Yellow-billed cuckoo (*Coccyzus americanus occidentalis*) are not known to occur within the project area. They are normally associated with lowland deciduous woodlands but are occasionally found in riparian willow communities at lower (900 to 1,700 m) to middle (1,500 to 2,300 m) elevations (Hubbard 1978). Caterpillars are a main prey source, with cicadas, grasshoppers, beetles, ants, wasps, frogs, lizards, and small fruit being consumed in smaller amounts (Howe 1986). If present in the project area, the proposed action should not affect yellow-billed cuckoo prey availability and therefore should produce no effects.

Flammulated owls (*Otus flammeolus*) summer in the Sangre de Cristo mountains and migrate statewide. Forage for flammulated owls includes areas of mature open stands of pine, douglas-fir, quaking aspen, blue spruce, oaks, and various others. Though largely insectivorous, the flammulated owl may occasionally capture small mammals and birds. Reduced aquatic macroinvertebrate abundance would not affect flammulated owls as alternative sources of prey would be available.

The loggerhead shrike (*Lanius ludovicianus*) ranges from agricultural lands on the prairies to montane meadows, nesting in sagebrush areas, desert scrub, pinyon-juniper woodlands, and woodland edges (Johnsgard 1986). Diet consists of large insects and small mammals (Finch 1992). Reduced aquatic invertebrate abundance could affect prey availability though alternative food sources would be available.

Birds Protected under the Migratory Bird Treaty Act and Executive Order 13186
Species of birds protected by the MBTA would not be affected by the proposed action. Electric current is effective over a small area (2-3 feet) within the stream and thus would not contact migratory birds as they would likely flee an area due to human presence. Gillnets are set below the water surface and thus would pose no risk to birds in flight or near lentic water bodies. Effects of ingestion of piscicide treated water and piscicide-killed fish are discussed

in Appendix G. Birds that are herbivorous would have no reduction in forage. Insectivores may experience reduced abundance of aquatic macroinvertebrates though terrestrial macroinvertebrates would be unaffected. Given their migratory nature, birds would be able to find prey in surrounding areas.

Plants

Ripley's milkvetch (*Astragalus ripleyi*), small-headed goldenweed (*Ericameria microcephala*), Pecos fleabane (*Erigeron subglaber*), Arizona willow (*Salix arizonica*), and Sierra Blanca kittentails (*Besseya oblongifolia*) are considered sensitive by CNF. Small-headed goldenweed is not likely found within the project area as documented populations are located in the Tres Piedras area only (http://nmrareplants.unm.edu). Pecos fleabane inhabits high ridges beyond the areas affected by the proposed action. Other species could potentially be affected by excavation of fish burial pits. All pits would be located to avoid any effects on these plants. Permanent disruption of any vegetation is unlikely as most off-road activity would involve foot and horse travel. Only Arizona willow is potentially found within the riparian area of lower project sections. Barrier construction would be limited to small portions of the project area and should produce no effect on special status species. Application of piscicides would produce no effect on special status plant species in the project area. Antimycin has been used in Japan as an extremely effective fungicide on rice plants (Harada et al. 1959, Dunshee et al. 1949). Based on the fact that it is used to control fungus on living rice plants without apparent damage and that the concentrations used to kill fish are very low, it is unlikely that there would be any effects on vegetation in the project area. Schnick (1974b) cited several researchers who reported rotenone having no affect on either algae or rooted aquatic vegetation. Rotenone is commonly used as the active ingredient for insect control in organic and non-organic farming with no adverse effects noted.

Alternative 2 – Cumulative Effects

The analysis area for cumulative effects on special status species is the area in and immediately adjacent to the project area. Direct and indirect effects estimated to occur from this project include temporary reduction in the number of RGCT (overall expansion of the range of RGCT, RGC, and RGS), temporary increase in turbidity during barrier construction and mechanical removal of non-native fish, and short-term existence of piscicides and potassium permanganate within waters in a subsegment. Increased turbidity from the proposed action would be a fraction of the overall natural and human caused sediment loading. The proposed action would expand the range of three sensitive species of native fish in New Mexico. Piscicide treatments would be limited spatially, within a particular waterbody, and temporally, short-term lethal concentrations and rapid degradation. Because piscicides and potassium permanganate degrade rapidly, do not bioaccumulate, and are applied at low concentrations, they do not add cumulatively to past, present, or reasonably foreseeable future actions such as fuel management projects, herbicide applications, or recreational activities that could affect special status species.

Alternative 3

Effects of mechanical removal only would be similar to that described under Alternative 2 with the exception of piscicide effects. Exposure of existing RGCT, where they are sympatric with non-native fishes, to electric current during electrofishing removals would occur over an indefinite number of years.

3.6 Cultural and Historic Resources

3.6.1 Existing conditions.

Humans inhabited areas within the project area for over 10,000 years. Early remains of humans were discovered in nearby Folsom, NM. Pueblo cultures developed in the area approximately 1,100 year ago. Large tracts of the project area were originally part of the Maxwell and Sangre de Cristo Land Grants. VPR was purchased by Turner Enterprises, Inc. in 1996. The Valle Vidal portion of the project area (Segment B) was donated to CNF from Pennzoil Corporation in 1982.

A search of the ARMS database for the region surrounding the proposed project areas was completed on March 10, 2005. This search was a Class I literature search to identify the number and types of historic properties previously found in the region. This search could also indicate if any historic properties were located in the areas of proposed ground disturbance (barrier construction) and would provide an estimate of the types and frequencies of properties that might be anticipated in the proposed project area. Results of this search indicate the presence of 81 previously recorded historic properties in the immediate region surrounding the proposed project areas. Of these sites, the majority are historic structures and historic mines (n = 60) and the remainder include historic trash dumps, a stage stop, the Costilla Dam construction camp, prehistoric structures, and prehistoric lithic artifact scatters.

3.6.2 Effects on Cultural and Historical Resources

Alternative 1 - No Action
Monitoring of the existing fish populations would continue in the Rio Costilla watershed and, there would be no effects on cultural or historical resources under this alternative.

Alternatives 2 and 3
As described previously, most of the proposed activities are not invasive or physically destructive in nature. Anthropogenic disturbances within the project area include vegetation disturbance from increased foot and vehicle traffic, increased noise, and vegetation disturbance during barrier construction. These activities should have no effect on any known or as yet undiscovered culturally or archeologically important sites. Most traffic would occur on established roads and trails, with some trampling of vegetation when personnel are working in or along the wetted stream corridor. Digging fish burial pits would disturb the ground within the floodplain, thus unlikely to disturb any site of historical significance. In the event that objects or sites with potential to be historically or culturally important are discovered during project activities, care would be taken to avoid any or further disturbance of the site until notification of the proper authorities. Additionally, because sites of historic significance in the Rio Costilla drainage are generally located away from the stream corridor (e.g., in upland or terraces adjacent to the stream) and the proposed action would be temporary and non-invasive, cultural and historical resources would not be affected by the treatment activities.

Fish barrier construction would require archeological clearance from the State Historic Preservation Office. Prior to construction, an archaeologist would conduct a Class III intensive pedestrian inventory (survey) to identify or re-document any historic properties in the areas of the proposed ground disturbance. Such properties, if found, would be evaluated for their potential to be included in the National Register of Historic Properties. If a historic or archaeological site is found within the proposed barrier site, the barrier would be relocated to avoid adverse effects.

3.7 Socioeconomic Factors

3.7.1 Existing conditions.

The entire project area is located within Taos County, NM. A 2003 census of Taos County recorded 31,269 residents. Taos County is sparsely populated with Taos and Questa being the largest towns. The closest incorporated town is Amalia, NM. Amalia, population 100 citizens, and Costilla, population 250 citizens, are located approximately 8 and 13 miles northwest of the proposed project terminus, respectively.

Ethnic composition of Taos county is primarily hispanic or latino (57.9%) and white, not hispanic, (33.8%). Median household income was $26,762 in 1999.

There are no primary residences located within the project area and land use along the riparian corridor and surrounding uplands is primarily recreational with some livestock usage. Downstream from the project area, water from the Rio Costilla is used for irrigation and livestock watering and users rely on its availability for their livelihood. Access varies within the proposed project areas.

Project Area A: The upper Rio Costilla drainage starts on VPR property. There is no public access to the project area on the VPR, only ranch guests with a state license are permitted to fish or hunt.

Project Area B: These portions of the Rio Costilla drainage are on USFS property. Public access exists to this section of the project. Public angling is allowed on all streams from July 1 to December 31with "Catch and Release" regulations for all waters except for the Shuree Ponds, which is not included in the project area. Several angling guides bring clients to the Rio Costilla. Hunting is allowed with a special hunt permit obtained through a draw system administered by NMDGF.

Section C: These portions are on RCCLA property. Public angling access on the mainstem Rio Costilla is leased by NMDGF. Fishing in the Latir Lakes and Latir Creek drainage is available for a nominal daily fee. Camping within RCCLA is also available for a daily fee. Hunting permits are obtained through RCCLA.

There are several organic farms located near Costilla, NM downstream of the project area which irrigate from the Rio Costilla (B. Baker, pers. comm.).

3.7.2 Effects on Socioeconomic Factors

Alternative 1 - No Action

Socioeconomic factors would be affected by this alternative. If the no action alternative is selected, project cooperators would incur no costs for project implementation. The local economy would not realize economic benefits of anglers visiting this area to fish for a unique southwestern trout. Local economies may be affected if RGCT were listed as threatened or endangered under ESA. If RGCT is listed, ongoing grazing within Section B may be limited or halted. Timber harvest may also be affected. Angler satisfaction within Section B and C may decrease as white sucker populations continually expand. Angler satisfaction within Section C may decrease as sucker would continually dominate fish biomass and reduce macroinvertebrate abundance in the Latir Lakes.

Alternative 2
The proposed action would be implemented in segments to minimize the loss of angling opportunities in Sections A, B and C. The project would be conducted to tier removal efforts so a fishery would be established (or in the process) in part of each section prior to beginning another. All project area streams that lie on the Valle Vidal portion of CNF are designated "catch and release". To enable harvest via angling, the NM Game Commission would have to alter the state fishing regulations. Regulations for part of the NMDGF lease portion of the Rio Costilla on RCCLA property permit some harvest. VPR contractually limits harvest and tackle used by their guests though general state fishing regulations otherwise apply. Angling opportunities would be reduced as RGCT populations establish over a period of 2-3 years, and harvest would likely be restricted for a subsequent period of time through decreased bag limits or catch and release regulations. Local angling organizations, New Mexico Trout and Trout Unlimited, have indicated support for the proposed action. It is likely that angling effort would temporarily shift to other local trout streams in the area, and any negative effects on the local economy (tackle shops, guides) would be negligible; therefore, there should be no disproportionately high or adverse effects to minority or low-income populations.

Conversely, the proposed action may benefit the local economy. Once RGCT are established in the Rio Costilla watershed, more anglers may frequent the area for the opportunity to catch this subspecies of cutthroat trout. This could benefit local guides as well as lodges, restaurants, and other service providers needed by anglers.

Costs associated with this alternative would include the purchase of piscicide, agency and private entity salaries, and equipment. Costs for manpower and equipment would be absorbed jointly by VPR, RCCLA, and NMDGF with support from the federal Sport Fish Restoration Act and other private sources. Costs associated with piscicides would be paid for by private landowners on private land and NMDGF on public land.

Local organic farmers would not be affected by the proposed action. Organic farms are located well below the project terminus point. Rapid degradation, neutralization, and spatial distance from the project terminus would ensure that piscicides and their constituents do not jeopardize the farms organic status. NMDGF has corresponded with the NM Organic Commodity Commission regarding the location of these farms. Under their direction, NMDGF would provide personal notification to these farms regarding the piscicide treatment dates to provide the opportunity to avoid irrigating on these dates or use alternative water sources (i.e. groundwater).

Alternative 2 – Cumulative Effects
There would be no cumulative effects under this alternative.

Alternative 3
Continuous mechanical removals to suppress non-native fish populations would continuously affect recreational fishing opportunities within the watershed. As fishing opportunity declines, angler satisfaction and visitation would likely decline producing a direct effect on local fishing guide services, lodging, restaurants, and other services required by independent anglers.

Alternative 3 – Cumulative Effects
There would be no cumulative effects under this alternative.

3.8 Wilderness, Recreation, and Scenery

3.8.1 Existing conditions.

No portion of the project area is classified as wilderness. The Latir Peak wilderness is adjacent to the Latir Lakes area of Section B. The entire project area has a high scenic quality. Common scenes include rugged cliffs, snow-capped peaks, conifer-forested slopes, open meadows, and shaded riparian areas. Hiking, picnicking, camping, wildlife watching, hunting and angling are the main recreational uses in the project area. Hunting opportunities include elk, deer, turkey, and bear. Angling opportunities include brook trout, brown trout, cutbows, rainbow trout, and remnant populations of RGCT.

3.8.2 Effects on Wilderness, Recreation, and Scenery

Alternative 1 - No Action
This alternative could affect current recreational opportunities or scenic qualities of the project area. If no conservation measures to restore RGCT occur, listing as a threatened or endangered species could occur. Such a designation would prohibit angling for existing RGCT and limit angling in critical habitat areas. Lack of action would diminish the current opportunity to reestablish the historic fish community and provide a unique angling experience.

Alternatives 2
The proposed actions would have no significant effects on scenery in the project area. A project terminus barrier would look artificial though the proposed location is next to an existing road. Considering the size of the project watershed, the presence of a barrier affecting less than one acre of land is not a substantial effect on scenery. Barriers would be designed so that they are as natural as possible, considering cost and function, and attempt to blend in with the natural landscape. Post-construction vegetation growth would minimize any effects to scenic values.

Piscicide application would result in short-term change in water quality. Though access to the project area would not be affected, use of water within the subsegment for drinking or other purposes would be lost short-term. Though effects to water quality are minimal (3.1), notices of piscicide application would be posted at project subsegment entry points. Adjacent sources of water (springs, untreated seasonal tributaries) would be available for those who wish to use the project area during or immediately after treatment. Hiking or horseback riding may decline within public areas during project implementation in those areas.

A temporary (2-3 years) decline is angling opportunities in portions of the project area is expected. However, RGCT would be restocked into the stream as soon as an area is confirmed to be free of non-native trout. Though fish abundance would be reduced during project implementation, restocking may occur within 2-10 months after the final piscicide application. Much of this time may occur during winter when the area is not accessible to anglers. As discussed in section 3.7.2, staff would tier the removal efforts to continually provide angling opportunities to the public. Multiple size classes of fish would be restocked within the project area to accelerate population establishment. NMDGF would seek restrictive catch and release regulations for the entire stream after renovation to minimize harvest from the population. Once the population is self-sustaining, NMDGF would reconsider limited harvest in appropriate portions of the project area. NMDGF would seek to continue to manage the Valle Vidal portions of the project area as catch-and-release fisheries subject to NM Game Commission approval. Cooperating biologists would monitor populations to evaluate population growth, distribution, and recruitment, as well as individual age, growth, and condition.

The project area is part of NMDGF hunt units including the Valle Vidal (CNF) and Unit 55 (VPR, RCCLA). Mechanical removal and piscicide applications would be scheduled from early summer to early fall. Most of these seasons are beyond the legal hunting season though there could be some overlap with early bow hunting seasons.

Alternative 2 – Cumulative Effects
No cumulative effects are expected under this alternative.

Alternative 3
Barrier presence and construction would be the same as under Alternative 2. Reduced angling opportunities would occur long-term as mechanical removals are conducted. Human presence in the area would increase to conduct the removals.

4.0 Agencies and Persons Consulted

List of Preparers

Yvette Paroz, NM Department of Game and Fish, Aquatic Researcher
Harold Namminga, U.S. Fish and Wildlife Service, Fisheries Biologist
Kirk Patten, NM Department of Game and Fish, Fisheries Biologist
Robert Dello-Russo, NM Department of Game and Fish, Archaeologist

Other Contributors

Donna Storch, Carson National Forest, Aquatic Resources Program Manager
Amy Unthank, U.S. Forest Service, Region 3 Fisheries Biologist
Audrey Kuykendall, Carson National Forest, Forest Planner
Catherine Sykes, NM Department of Game and Fish, Assistant Chief of Fisheries
Carter Kruse, Turner Enterprises, Inc., Aquatic Ecologist
Juan Martinez, Carson National Forest, Fisheries Biologist
Eric Frey, NM Department of Game and Fish, Fisheries Biologist

List of Agencies, Individuals, Tribes, and Organizations Contacted

Peggy Abbott
Martha Abernaily
Joan Adams
Jaki Allen
Eric Ames
Demian Anderson
Alex Archer
Jospeh Armbuster
David Arntzek
Kayleigh Avery
Carol Bada
Janice Bailey
Linda Barbour
Richard Becker
Blaire Bennet
Bessy Berman
Robert Bernstein
Elizabeth Bessin
David Best
Suzanne Betz
Ann Bier
Diane and Jean Bixler
Joyce Blalock
Stephen and Wendy Blumberg
Richerd and Clyda Bohannon
Bruce Bolander
Lloyd Bolander
Imogene Bolls
Susan Bolon
Bonnie Bonneau
Theresa Bradley
M Brenden
Laura Brookins
Irene Brown
Ruth Bryant
Joan Bullington
Jane Burns
Jim Caffrey
Ellen and David Caldwell
Larry Candill

Rosemarie Cano
Jacqueline Canzone
Nancy Cella
Laura Center
Judy Chaddick
Lori and Lared Chatteley
Cheryl Christopher
Marilyn Colony
Dexter Coolidge
Max Cordova
Tony Cowan
Sally Currie
Valerie Davis
Ray and Jane Dehner
David R. Delling
Kevin Doyle
Isabella Draper
Paula Eastwood
Elizabeth Riedel
Julie and Steve Ellison
Emma Evangelos
Nancy Even
Linda Federico DeGeest
Larry Felton
Michael Fitzgerald
Andrew Flack
Jock Fleming
Tom and Nancy Florsheim
Sharon Flying Up
Judy Follmar
Crystal Ford
Joanne Forman
Audra Genduso
Bill & Beth Gibson, Jr.
Kerby Goforth
Sue Goldberg
Michael Goodrich
Mary Gourd
Conrad Green
Anthony Griego
Mary Haig
Sarah Hamilton
Gabriel Hanson
Wendell Harris
Charles Hathcock
Dennis Heffner
T Graham Hereford
Sonja Hershorn
Richard Hertz
Mike Hill
John Hillyard
Tom Himrod
Kathleen Holian
Jim and Margie Hubert
Anthony Ingle
Iiah Jones
Richard Jones
William Joseph
Art Judd
Michael Kaufman
Tim Keller
Dorothy Kelly
Jarie Kovac
Edward Krasilovsky
Patricia Laidlaw
Kirsten Lear
Lee and Ginger Levin
Melia Lewis
Paul & Susan Lisko
Douglas Loescher
Katherine Loge
Robert Long

Donna Luehrmann
Peter Lyne
Michael Maestas
Theresa and Whitney Martin
Richard McCurdy
Barbara Mcintyre
Althea McLuskie
Penelope McMullen
Shirley McNall
Doris Meyer
Michael Miller
Celeste Miller
Karen Milstein
Ty G and Gael Minton
Shelley Morey
Sara Morgan
Mr. & Mrs. Eliseo
Julianne Murphy
Bette Myerson
Sam Navarro
Karen Nichols
Kate Nilssen
Vivian Olsen
Richard and Judith Opsahl
Thomas A. Parkhill
Christine Pederson
Santa Pefer
Jason Pfeifer
James Podesta
Christine Ponko
Alan Powell
June Price
David Quintana
Julie Rapp
Janet Rees
Emily Reese
Kevin Reilly
Myron Rightman
Wanda Roach
Jane and Jerry Robinson
Stephen & Nancy Rose
Stephen J. Rose
Carlota Roth
Mildred Sain
C Salomon
Joann & Fen Sartorius
Elida Saucedo
Suan and Martin Schauer
Dorothy Schoech
Elizabeth Schweinitz
Mary Shaffer
Russ Shinn
Marian Shirin
David Shoemaker
Tim Sierra
Ron Simmons
Martha Simonson
Susan Small
Terry Smith
Thomas Solomon
Jeffrey Stebbins
George Steigerwald
Louise Stiver
Jean Stokes
Susan Strebe
Larry Sullivan
Carol Szpakowski
Aaron Thode
Donald Thomas
Inga Thompson
Richard Truett
Penny Truitt

Deb Ungar
April Urban
Gie Van de Pol
John Vogol
Sydney Walter
Roderick & Jean Watts
Paula White
Joseph Whiteman
Mary Whitman
Sarah Wilder
Joan Wilkes
David Witt
Elizabeth Witte
Keith Woloshun
Nancy Woodward
David Wunker
Marianne Yancey
Mary Ybarra
Linda Young
Ed Adams
Jan Crawford
Wayne Gallegos
Alfonso Gonzalez
Graham Hereford
Dan Howe
Steven Johnson
John Lapin
Anne McCampbell
Marcus Miller
Robert Mundy
Mary Jane Reed
Erasto Rivera
Taylor Streit
Arthur Firstenberg
Jerilou Hammett
Margaret Chapman
Patricia Lenhan
Carolyn Beste
Abiquiu Elementary School
Acequia de Atalaya
Acequia Madre Ditch Association
Advisory Council on Historic Preservation
Albuquerque City Councilor, Distric 6
Albuquerque Journal
Alcalde Elementary - Espanola Public Schools
Amalia Ventero Neighborhood Association
American Rivers
Amigos Bravos/Coalition for the Valle Vidal
Angel Fire Chamber of Commerce
Angostura Homeowner's Assoc.
Apache - Sitgraves National Forest
Assoc. of Rio Embudo Acequia Users
Atalaya Acequia Association
Atalaya Ditch Commission
BIA - Northern Pueblos Agency
Big Willow Farm
Black Mesa Winery
BLM - Taos Field Office
Bureau of Reclamation
Camino Real Ranger District-USDA
Camp Summerlife
Canjilon Ranger District-USDA
Carson Forest Watch
Carson National Forest-USDA
Center for Biological Diversity
CHEC-Forest Watch
Chimayo Elementary School
Cibola National Forest-USDA
Cimarron Chamber of Commerce
Cimarron Inn & RV Park
Cimarron Watershed Alliance
Coalition for the Valle Vidal

Coconino National Forest-USDA
Colfax County
Colfax County Manager
Comanche Tribe of Oklahoma
Coronado National Forest-USDA
Costilla County
Costilla County Soil and Water Conservation
Costilla Neighborhood Association
Department of Defense
Dixon Elementary School
Documents Dept. The Libraries, CSU
Dos Amigos Anglers
Dulce Independent Schools
Eight Northern Pueblos
El Rito Elementary School
El Rito Ranger District-USDA
Office of Chief of Navy Operations, Environmental Protection Division
Espanola Ranger District-USDA
Federal Energy Regulatory Commission
Federal Highway Admin, Midwest Rgn
Forest Guardians
Forest Guild
Forest Products Association
Gila National Forest-USDA
Hidden Lake Property Owners Assoc.
High Country Anglers
High Desert Angler
High Mountain Angler
Highlands University
Holy Cross School
Housing and Urban Development
Interstate Stream Commission
Jaraso Mutual Ditch Co.
Jerry T. Duran Custom Knives
Jicarilla Apache Nation
Jicarilla Ranger District-USDA
Kaibab National Forest-USDA
KTAO Radio
Lincoln National Forest-USDA
Los Rios Anglers
Luna Vocational-Technical Institute
McCurdy School
Mora Land & Water Protective Assoc.
Mora Public Schools
Native Forest Network, SW Rep.
New Mexico Department of Agriculture
New Mexico State Library
NM Acequia Assoc.
NM Acequia Commission
NM Cattlegrowers Assoc.
NM Director of Tourism
NM Economic Development & Tourism
NM Energy, Minerals and Natural Resources Dept
NM Enviroment Department
NM Environmental Law Center
NM State Forestry
NM Tourism & Travel Division
NM Wilderness Alliance
NM Wildlife Federation
NMSU Cooperative Service
NOAA Office of Policy & Strategic Planning
Northern New Mexico Stockman's Assoc.
Northern NM Community College
Office of Cultural Affairs, HPO
Office of Senator Pete Domenici
Ortega & Associates
Pacific Legal Foundation
Penasco Independent School District
Philmont Scout Ranch
Pojoaque Elementary School
Pojoaque High School
Prescott National Forest-USDA

Public Service Company of NM
Pueblo of Jemez
Pueblo of Nambe
Pueblo of Picuris
Pueblo of Pojoaque
Pueblo of San Ildefonso
Pueblo of San Juan
Pueblo of Santa Clara
Pueblo of Taos
Pueblo of Tesuque
Pueblo of Zuni
Raton Chamber & Economic Development Council
Rio Arriba County Commissioners
Rio Arriba County Planning Office
Rio Costilla Cattle and Livestock Association
Rio Pueblo/Rio Embudo WPC
Robertson High & Mem. Middle Schools
San Francisco de Asisi Elem. School
San Miguel Chamber of Commerce
Sangre de Cristo Chronicle
Santa Fe Containment Coalition
Santa Fe National Forest-USDA
Santa Fe New Mexican
Santa Fe Trail National Scenic Byway Alliance
Scenic New Mexico
Sierra Club - Santa Fe Group
Sipapu Ski Area
Sonoran Bioregional Diversity
Southwest Archeology
Sunshine Water Users
Taos Archeological Society
Taos Christian Academy
Taos County
Taos County Chamber of Commerce
Taos County Commission
Taos County Economic Dev. Corp.
Taos County Planning Department
Taos Economic Department
Taos Environmental Assoc.
Taos Nature Society
Taos News
Taos Saddle Club
Taos Soil & Water CD
Tesuque Day School
The Hopi Tribe
The Navajo Nation
The Raton Range
The Reel Life
The Southern Ute Tribe
The Taos News
The Ute Mountain Ute Tribe
Tonto National Forest-USDA
Town of Questa
Town of Red River
Town of Taos
Tres Piedras Ranger District-USDA
Trout Unlimited
Trout Unlimited, Truchas Chapter
Turner Enterprises Inc.
Twining Sanitation Dist
United Church of Santa Fe
US Army Engineer, SW Division
Natural Resources Conservation Service-USDA
Bureau of Land Management-USDI
US Fish and Wildlife Service, Ecological Services-USDI
US Fish and Wildlife Service, Fishery Resources-USDI
US National Park Service-USDI
Velarde Elementary School
Vermejo Park Ranch
Village of Taos Ski Valley
Wagon Mound Public Schools
Walton's Mountain

Watermaster
Western Environmental Law Center
Western Land Exchange Project
Western Network
White Mountain Apache Tribe
Wild River Tours
Wild Watershed
Wilderness Society
World College

5.0 LITERATURE CITED

Anderholn, S. K., R. G. Roybal, D. Risser, and G. Somers. 1994. Analysis of meteorological data and water chemistry of Latir Lakes, Taos County, New Mexico, 1985-88. U.S.G.S. Water-Resources Investigations Report 93-4113.

Anderson, N. H. and J. B. Wallace.1984. Habitat, life history, and behavioral adapatations of aquatic insects. Pages 38-58 *in* R. W. Merritt and K. W. Cummins, editors, An Introduction to Aquatic Insects of North America. Kendall Hunt Publishing Company. Dubuque, Iowa.

Archer, D. L. 2001. Rotenone neutralization methods. Pages 5-8 *in* Cailteux, R. L., L. DeMong, B. J. Finlayson, W. Horton, W. McClay, R. A. Schnick, and C. Thompson, editors.. Rotenone in Fisheries: Are the Rewards Worth the Risks? American Fisheries Society, Bethesda, Maryland.

Bailey, F. M. 1928. Birds of New Mexico. New Mexico Department of Game and Fish, in Cooperation with the State Game Protective Association and the Bureau of Biological Survey.

Bailey, V. 1932. Mammals of New Mexico. North American Fauna 53.

Barbour, R. W. and W. H. Davis. 1967. Bats of America. University Press. Lexington, Kentucky.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. Bethesda, Maryland.

Berger, B. L. 1965. Rough fish removal with antimycin in Coe and Sidie Hollow Creeks, Vernon County, Wisconsin, on August 13, 1965. U. S. Fish and Wildlife Service, Fish Control Laboratory, La Crosse, Wisconsin

Berger, B. L., P. A. Gilderhus, and R. E. Lennon. 1967. Attempted reclamation of Whitewater Lake, Valentine National Refuge, Nebraska. U.S. Fish and Wildlife Service Fish Control Laboratory, LaCrosse, Wisconsin.

Binns, N. A. 1967. Effects of rotenone treatment on the fauna of the Green River, Wyoming. Fisheries Research Bulletin 1:1-114, Wyoming Game and Fish Commission, Cheyenne, Wyoming.

Block, W. M. and thirteen others. 1995. Recovery plan for the Mexican Spotted Owl (*Strix occidentalis lucida*). U.S Department of Interior, Fish and Wildlife Service.

Boulton, A. J., C. G. Peterson, N. B. Grimm, and S. G. Fisher. 1992. Stability of an aquatic macroinvertebrate community in a multiyear hydrologic disturbance regime. Ecology 73: 2192-2207.

Burt, W. H. and R. P. Grossenheider. 1976. A field guide to the mammals. Houghton Mifflin Co., Boston, Massachusetts.

Calamusso, B. and J. N. Rinne. 1999. Native montane fishes of the middle Rio Grande ecosystem: status, threats, and conservation. Pages 231-237 *in* Finch, D.M, et al. (Technical Coordinators), Rio Grande Ecosystems: Linking land, water, and people: toward a sustainable future for the Middle Rio Grande Basin. 1998 June 2-5; Albuquerque, NM. Proceedings RMRS-P-7. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station..

Calamusso, B., J.N. Rinne, and P.R. Turner. 2002. Distribution and Abundance of the Rio Grande sucker, *Catostomus plebeius*, in the Carson and Santa Fe national Forest, New Mexico. Southwestern Naturalist 47:182-186.

California Department of Fish and Game. 1994. Final programmatic environmental impact report (subsequent): rotenone use for fisheries management.

Chandler, J. L. and L. L. Marking. 1982. Toxicity of rotenone to selected aquatic invertebrates and frog larvae. Progressive Fish Culturist 44(2): 78-80.

Christman, B. L. 2004. Amphibian and Reptile Surveys in Costilla Creek Drainage, Vermejo Park Ranch, Taos and Colfax Counties, New Mexico.

Chung-MacCoubrey, A. 1995. Species composition and roost requirements of bats using water sources in pinyon-juniper woodlands. Unpublished.

Conservation agreement for the range-wide preservation and management of the Rio Grande cutthroat trout *(Oncorhynchus clarki virginalis*) 2003.

Cook, S. F. and R. L. Moore. 1969. The effect of a rotenone treatment on the insect fauna of a California stream. Transactions of the American Fisheries Society 3:539-544.

Dare, M. R. 2003. Mortality and long-term retention of passive integrated transponder tags by spring chinook salmon. North American Journal of Fisheries Management 23: 1015-1019.

Davies, W. D. and W. L. Shelton. 1983. Sampling with toxicants. *In* Nielsen, L. A. and D. L. Johnson, editors.. Fisheries Techniques. American Fisheries Society. Bethesda, Maryland.

Dawson, V. K. 1986. Absorption/desorption of rotenone by bottom sediments. U.S. Fish and Wildlife Service, National Fisheries Research Laboratory, La Crosse, Wisconsin.

Dawson, V. K., W. H. Gingerich, R. A. Davis, and P. A. Gilderhus. 1991. Rotenone persistence in freshwater ponds: effects of temperature and sediment adsorption. North American Journal of Fisheries Management 11: 226-231.

Degan, D. J. 1973. Observations on aquatic macroinvertebrates in a trout stream before, during, and after treatment with antimycin. M.S. Thesis, University of Wisconsin-Stevens Point, November 1973.

Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and reptiles of New Mexico. University of New Mexico Press. Albuquerque, New Mexico.

Duff, D. A. 1996. Conservation assessment for inland cutthroat trout- Introduction. United States Department of Agriculture – Forest Service.

Dunshee, B. R., C. Leben, G. W. Keitt, and F. M. Strong. 1949. The isolation properties of antimycin A. Journal of the American Chemical Society, 71:2436-2437.

Engstrom-Heg, R., R. T. Colesante, and E. Silco. 1978. Rotenone tolerances of stream-bottom insects. New York Fish and Game Journal. 25(1):31-41.

Farringer, J. E. 1972. The determination of the acute toxicity of rotenone and Bayer 73 to selected aquatic organisms. Master's Thesis. University of Wisconsin, Madison, Wisconsin.

Fenton, M. B. and R. M. R. Barclay. 1980. *Myotis lucifugus*. Mammalian Species 142:1-8.

Finch, D. and M. August 1992. Threatened, endangered, and vulnerable species of terrestrial vertebrates in the Rocky Mountain Region. USDA Forest Service General Technical Report RM-215.

Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. xxii + 360 pp.

Finlayson, B. J., R. A. Schnick, R. L. Cailteux, L. DeMong, W. D. Horton, W. McClay, C. W. Thompson, and G. J. Tichacek. 2000. Rotenone use in fisheries management, administrative and technical guidelines manual. American Fisheries Society. Bethesda, Maryland.

Finlayson, B. J., S. Siepmann, and J. Trumbo. 2001. Chemical residues in surface and ground waters following rotenone application to California lakes and streams. Pages 37-54 *in* R.L. Cailteux, L. DeMong, B. J. Finlayson, W. Horton, W. McClay, R. A. Schnick, and C. Thompson, editors. Rotenone in fisheries: are the rewards worth the risks? American Fisheries Society, Trends in Fisheries Science and Management 1, Bethesda, Maryland.

Frey, Jennifer K. and Terry L. Yates. 1996. Mammalian diversity in New Mexico. New Mexico Journal of Science. 36:4-37.

Ganey, J. L. 1992. Food habits of Mexican spotted owls in Arizona. The Wilson Bulletin 104: 321-326.

Griffith, J. S. 1988. Review of competition between cutthroat trout and other salmonids. American Fisheries Society Symposium. 4:53-60.

Hahn, D. E. 1968. A biogeographic analysis of the herpetofauna of the San Luis Valley, Colorado. Master's Thesis. Louisiana State University, Baton Rouge, Louisiana.

Harada, Y., K. Nakayama, and F. Okamoto. 1959. Antimycin A, an antibiotic substance useful for prevention and treatment of imochibyo, a disease of rice. Chemical Abstracts, vol. 53 19286-19287.

Harrison, F. A. 1962. Basic Survey of Upper Latir Lake. Federal Aid Project F-22-R-3. Santa Fe, New Mexico.

Hart, R. A., T. Brastrup, D. E. Kelner, and M. Davis. 2001. The freshwater mussel fauna (Bivalvia: Unionidae) of the Knife River, Minnesota, following a rotenone treatment. Journal of Freshwater Ecology 16:487-492.

Hayes, T. B., P. Case, S. Chui, D. Chung, C. Haeffele, K. Haston, M. Lee, V. P. Mai, Y. Marjuoa, J. Parker, and M. Tsui. Pesticide mixtures, endocrine disruptors, and amphibian declines: are we underestimating the impact? Environmental Health Perspectives 114:40-50.

Herr, F., E. Greslin and C. Chappel. 1967. Toxicology studies of antimycin, a fish eradicant. Transactions of the American Fisheries Society. 96:320-326.

Houf, L. J. and R. S. Campbell. 1977. Effects of antimycin A and rotenone on macrobenthos in ponds. Investigations in Fish Control, USDI Fish and Wildlife Service, Washington, D.C.

Hoffmeister, D. F. 1986. Mammals of Arizona. The University of Arizona Press and the Arizona Game and Fish Department.

Howe, W. H. 1986. Status of the Yellow-Billed Cuckoo (*Coccyzus americanus*) in New Mexico. New Mexico Department of Game and Fish.

Hubbard, J. P. 1978. Revised checklist of the birds of New Mexico. New Mexico Ornithological Society Publication No. 6.

Hubbard, J. P. 1985. Peregrine falcon (*Falco peregrinus*). New Mexico Department of Game and Fish, Handbook Endangered Species in New Mexico: BIRD/FA/FA/PE:1-2.

Jacobi, G. Z. and D. J. Degan. 1977. Aquatic macroinvertebrates in a small Wisconsin trout stream before, during, and two years after treatment with the fish toxicant antimycin. Investigations in Fish Control, USDI Fish and Wildlife Service, Washington D.C.

Johnson, S. L. and C. C. Vaughn. 1955. A hierarchical study of macroinvertebrate recolonization of disturbed patches along a longitudinal gradient in a prairie river. Freshwater Biology 34:531-540.

Johnsgard, P. A. 1979. Birds of the Great Plains: Breeding species and their distribution. University of Nebraska Press, Lincoln, Nebraska.

Johnsgard, P. 1983. The grouse of the world. University of Nebraska Press, Lincoln, Nebraska.

Kiser, R. W., J. R. Donaldson, and P. R. Olson. 1963. The effect of rotenone on zooplankton populations in freshwater lakes. Transactions of the American Fisheries Society 92:17-24.

Lawrence, J. M. 1956. Preliminary results on the use of potassium permanganate to counteract the effects of rotenone on fish. The Progressive Fish-Culturist 18:15-21.

Lang, B. K. 1998. A macroinvertebrate (mollusca and crustacea) survey of Latir Lakes 1-3, Rio Costilla Park, Taos County, NM. New Mexico Department of Game and Fish.

Lesser, B. R. 1972. The acute toxicities of antimycin A and juglone to selected aquatic organisms. Master's Thesis, University of Wisconsin-La Crosse, La Crosse, Wisconsin.

Marking, L. L. and V. K. Dawson. 1972. The half-life of biological activity of antimycin determined by fish bioassay. Transactions of the American Fisheries Society. 101:100-105.

Marking, L. L. and T. D. Bills. 1975. Toxicity of potassium permanganate to fish and its effectiveness for detoxifying antimycin. Transactions of the American Fisheries Society 104:579-583.

Matthaei, C. D., U. Uehlinger, E. Meyer, and A. Frutiger. 1996. Recolonization by benthic invertebrates after experimental disturbance in a Swiss prealpine river. Freshwater Biology 35:233-248.

McPhee, M. and T. Turner. 2004. No genetic evidence for hybridization between Rio Grande sucker, *Catostomus Plebeius*, and the introduced white sucker, *Catostomus commersoni*, in the Rio Grande. Environmental Biology of Fishes 71: 85-93.

Nelson, S. M. and R. A. Roline. 1996. Recovery of a stream macroinvertebrate community from mine drainage discharge. Hydrobiologia 339:73-84.

New Mexico Department of Game and Fish. 2002. Long range plan for the management of Rio Grande cutthroat trout in New Mexico. Santa Fe, New Mexico.

New Mexico Department of Game and Fish. 2006. Comprehensive Wildlife Conservation Strategy for New Mexico. New Mexico Department of Game and Fish. Santa Fe, New Mexico.

Otmart, R. D., M. A. Fonstad and D. Long. 1999. Geomorphic, hydrologic and vegetational appraisal of Costilla Creek Basin streams, Vermejo Park Ranch, Colorado – New Mexico.

Pennak, R. W. 1989. Fresh-water invertebrates of the United States. John Wiley and Sons, Inc. New York.

Pritchard, V. L. and D. E. Cowley. 2005. Investigation of population genetic structure and levels of introgression in Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) using microsatellite markers. Final Report.

Rees, D. E. and W. J. Miller. 2005. Rio Grande sucker (*Catostomus plebeius*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region.

Rinne, J. N. and P. R. Turner. 1991. Reclamation and alteration as management techniques, and a review of methodology in stream restoration. Pages 219-244 *in* W.L Minckley and J. L Deacon, editors. Battle against extinction, native fish management in the American West. The University of Arizona Press, Tuscon, Arizona.

Ryder, R. A., D. A. Palmer, and J. J. Rawinski. Distribution and status of the boreal owl in Colorado. *In* Biology and Conservation of Northern Forest Owls. Symposium Proceedings. February 1987. USDA Forest Service General Technical Report RM-142.

Sager, L. A. Jr. March, 1996. P.O.Box 203, Cerrillos, NM, 87010. Review of Species Account and Report: A 1995 Survey of Mountain Plovers (*Charadrius montanus*) in New Mexico. New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Schnick, R. A. 1974. A review of the literature on the use of antimycin A in fisheries. USDI Fish and Wildlife Service, La Crosse, Wisconsin.

Schnick, R. A. 1974b. A review of the literature on the use of rotenone in fisheries. USDI Fish and Wildlife Service, Springfield, Virginia.

Smolka, L. R. 1987. Intensive water quality survey of Costilla Creek and its tributaries, Taos County, New Mexico. Surface Water Quality Bureau, EID/SWQ-87/3, Santa Fe, New Mexico.

Stefferud, J. A., D. L. Probst, and G. L. Burton. 1992. Use of antimycin to remove rainbow trout from White Creek, New Mexico. *In* D. A. Hendrickson, editor. Proceedings of the Desert Fishes Council, Volume 22-23. Bishop California.

Stumpff, W. K. and J. Cooper. 1996. Rio Grande cutthroat trout, *Oncorhynchus clarki virginalis*. *In*: D. E. Duff, editor. Conservation Assessment for Inland Cutthroat Trout. U.S. Department of Agriculture, Forest Service, Intermountain Region, Ogden, Utah.

Swift-Miller, S. M., B. M. Johnson, R. T. Muth, and D. Langlois. 1999. Distribution, abundance, and habitat use of Rio Grande sucker, *Catostomus plebeius*, in Hot Creek, Colorado. Southwestern Naturalist 44:42-48.

Sublette, J. E., M. D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico.

Taylor, W. P. 1954. Food habits and notes on life history of the ring-tailed cat in Texas. Journal of Mammalogy 35(1):55-63.

Tiffan, K. F. and E. P.Bergerson. 1996. Performance of antimycin in high-gradient streams. North American Journal of Fisheries Management 16:465-468.

USEPA (U.S. Environmental Protection Agency). 1981. Completion of pre-RPAR review of Rotenone. USEPA Office of Toxic Substances, Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 1989. Guidance for the reregistration of pesticide products containing rotenone and associated resins as the active ingredient. USEPA Report 540/RS-89-039. Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 1994. Water Quality Standards Handbook, 2nd edition. USEPA Office of Water Quality, Washington D.C.

USDA. 1982. Multiple Use Area Guide- Valle Vidal Management Unit. Carson National Forest, Taos, New Mexico.

USDA Forest Service. 1995. Final Environmental Impact Statement for the Invasive Plant Control Project. Southwestern Region, Albuquerque, New Mexico.

Vieira, N. K. M., W. H. Clements, L. S. Guevara, and B. F. Jacobs. 2004. Resistence and resilience of stream insect communities to repeated hydrologic disturbances after a wildfire. Freshwater Biology 49:1243-1259.

Vinson, M. 2002. Aquatic Invertebrate Monitoring Report. Report for Carson National Forest. National Aquatic Monitoring Center, Utah State University, Logan, Utah.

Vinson, M. 2003. Aquatic Invertebrate Monitoring Report. Report for Carson National Forest. National Aquatic Monitoring Center, Utah State University, Logan, Utah.

Vinson, M. 2004. Aquatic Invertebrate Monitoring Report. Report for Carson National Forest. National Aquatic Monitoring Center, Utah State University, Logan, Utah.

Walker, C. R., R. E. Lennon, and B. L. Berger. 1964. Preliminary observations on the toxicity of antimycin A to fish and other aquatic animals. Bureau of Sport Fisheries and Wildlife. Circular 1986, Washington, D.C.

Whelan, J. E. 2002. Aquatic Macroinvertebrate Monitoring Results of the 1995 and 1996 Rotenone Treatments of Manning Creek, Utah. Utah Department of Natural Resources Publication Number 02-04.

Zwank, Phillip J., et al. 1994. Habitat use and population status of the meadow jumping mouse at Bosque Del Apache National Wildlife Refuge. *In* Abstracts From Presentations at Arizona/New Mexico Chapters of the Wildlife Society, Sierra Vista, AZ. February 4 and 5, 1994.

6.0 Appendices

Appendix A. Project Scoping Letter

GOVERNOR
Bill Richardson

DIRECTOR AND SECRETARY
TO THE COMMISSION
Bruce C. Thompson

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH

One Wildlife Way
Post Office Box 25112
Santa Fe, NM 87504
Phone: (505) 476-8055
Fax: (505) 476-8131

Visit our website at www.wildlife.state.nm.us
For basic information or to order free publications: 1-800-862-9310.

January 23, 2006

Re: A Proposal to Restore Rio Grande Cutthroat Trout in the Rio Costilla Watershed

Dear Interested Party:

The New Mexico Department of Game and Fish and the U.S. Fish and Wildlife Service are committed to the conservation and restoration of native fish species of New Mexico. The Rio Grande cutthroat trout is currently reduced to less than 10% of its historic range. Factors contributing to this decline include habitat degradation, hydrologic modification, competition, and hybridization with non-native trout species. Most existing populations of Rio Grande cutthroat trout are limited to small headwater streams, creating concerns about long-term population viability.

1.1.1 <u>Purpose and Need</u>

To help assure its long-term persistence, there is a need for establishing a genetically pure population of Rio Grande cutthroat trout into a watershed large enough to support populations with a low probability of extinction. Concurrent with restoring Rio Grande cutthroat trout, there is also a need for re-establishing the historic coldwater fish community in which Rio Grande cutthroat trout evolved that includes Rio Grande sucker, Rio Grande chub, and longnose dace. Coordinating restoration for Rio Grande cutthroat trout and other members of the native fish community, namely Rio Grande sucker and Rio Grande chub, will proactively address potential endangered species concerns that may arise in the future, including possible listing under the Endangered Species Act.

1.1.2 <u>Proposed Action</u>

The New Mexico Department of Game and Fish, in cooperation with Vermejo Park Ranch, Rio Costilla Cooperative Livestock Association, U.S. Fish and Wildlife Service, and U.S. Forest Service, proposes to restore Rio Grande cutthroat trout and other members of the native fish community in the Rio Costilla watershed (see attached sheet). The proposed project area includes three major sections of the Rio Costilla watershed: 1) the Rio Costilla, including Costilla Reservoir; 2) the Comanche Creek watershed; and 3) the Latir Creek watershed (see map). This area was selected due to the quality of the habitat, ongoing projects by other conservation groups, and connectivity among multiple drainages.

The proposed action includes approximately 150 stream miles, over 25 lakes ranging in size from 1.5 acres to 12 acres, and Costilla Reservoir. Currently, the game fishery consists of Rio Grande cutthroat trout, brook trout, brown trout, rainbow trout, and cutthroat trout hybrids. Brook trout and brown trout displace Rio Grande cutthroat trout through competition. Rio Grande cutthroat trout readily hybridize with rainbow trout and other subspecies of cutthroat trout. White sucker and longnose sucker, both non-native fish, are also present in the drainage.

To secure Rio Grande cutthroat trout and the native fish assemblage within the Rio Costilla, all non-native and hybridized fish would need to be removed from the project area. Such removal would include a variety of fishery management techniques most appropriate for meeting project goals. Upon successful removal of unwanted fish from a project subsegment, Rio Grande cutthroat trout and, where suitable habitat exists, members of the native fish community would be restocked into the subsegment. To prevent non-native fish from reentering the project area, a permanent fish migration barrier would be constructed on the Rio Costilla below the confluence of Latir Creek on Rio Costilla Cooperative Livestock Association property. Temporary fish migration barriers would be constructed to isolate portions of the watershed and prevent non-native fish from reentering subsegments of the project area during implementation.

1.1.3 Responsible Official

The proposed action would be funded by the U.S. Fish and Wildlife Service through the Sportfish Restoration Act and implemented by New Mexico Department of Game and Fish. Pursuant to the National Environmental Policy Act (NEPA) and its implementing regulations (40 CFR 1500), this letter initiates the public "scoping" process, whereby public comment is requested, significant issues identified, and project alternatives are developed. The environmental effects of the alternatives will be described and evaluated in a NEPA document, most likely an Environmental Assessment.

Upon completion of the Environmental Assessment (sometime in the spring/early summer 2006), the Regional Director, Region 2, U.S. Fish and Wildlife Service (Responsible Official) will decide whether to select the proposed action, an alternative, or to take no action. If an action alternative is selected, the Responsible Official must determine if the project would create significant environmental impacts. If significant impacts are expected to occur, an environmental impact statement must be prepared. If the selected alternative has no significant impacts, then a Finding of No Significant Impact will be prepared and the project could be implemented as early as late summer/fall 2006.

1.1.4 Request for Comments

We would like to hear from you. Your ideas, concerns, and suggestions will be helpful in designing a project to secure the long-term existence of Rio Grande cutthroat trout for future generations. Written comments will be most effective if received by February 27, 2006. Please send your comments to:

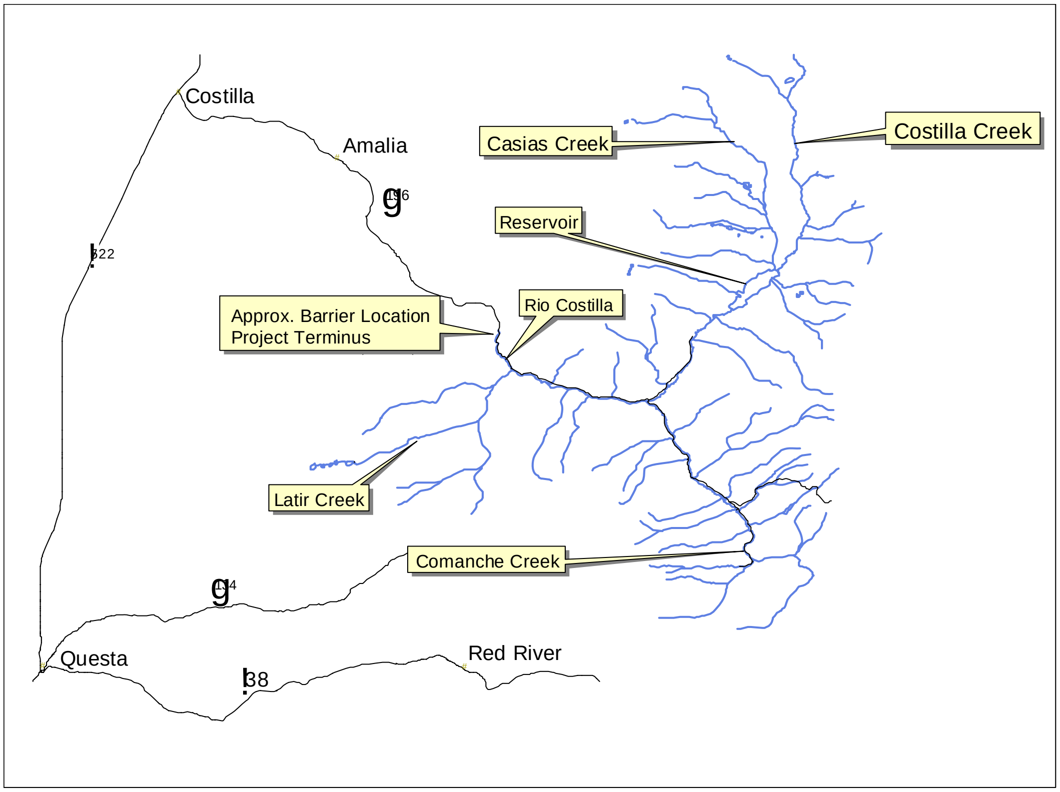
New Mexico Department of Game and Fish
Attn: Kirk Patten
P.O. Box 25112
Santa Fe, NM 87504

If you would like a paper or digital copy of the NEPA document once it is available, please make this request in your written comments. Additionally, we will be sponsoring a public forum where you can learn more about the project and visit with project biologists on February 18, 2006, from 2:00 p.m. to 4:00 p.m., at the Rio Costilla Cooperative Livestock Association, Highway 196 House # 72, Costilla, New Mexico. For further information, please contact Kirk Patten, Fisheries Biologist, at 505-476-8055.

Thank you for your time and interest in Rio Grande cutthroat trout management projects.

Sincerely,

Michael B. Sloane
Chief of Fisheries


Costilla
Amalia
Casias Creek
Costilla Creek
Reservoir
Approx. Barrier Location
Project Terminus
Rio Costilla
Latir Creek
Comanche Creek
Questa
Red River
522
38

Prospective Actions that could be Components of Efforts to Restore the Native Fish Community to the Rio Costilla Watershed

Fish Migration Barriers

- Construct temporary barriers to inhibit upstream movement including:
  - -Road culvert modifications
  - -Gabion barriers
  - -Concrete barriers
- Construct permanent barrier on the Rio Costilla composed of reinforced concrete

Fish Removal

- Fishing regulation amendments to permit increased angler harvest limits
- Mechanical removal by electrofishing and nets:
  - -Non-trout and non-native species
  - -Non-native trout transferred to non-project waters for angling opportunities
- Fish Salvage Order by New Mexico Department of Game and Fish Director
- Chemical application and neutralization

Native Fish Confinement (temporary)

- Native fish species collected and held for restocking upon successful restoration
  - -Held on-site in holding pens or other means
  - -Tagged and moved to alternative waters for recapture
  - -Held in hatchery facilities
- Potential genetic testing of Rio Grande cutthroat trout

Fish Transport

- Fish health certification will be obtained prior to transport of salvaged fish beyond the Rio Costilla watershed
- Transport of salvaged fish will include:
  - -Human transport with buckets
  - -Horseback with panniers
  - -All Terrain Vehicles using existing roads
  - -Hatchery trucks using existing roads

Fish Stocking

- Stock pure Rio Grande cutthroat trout within a project subsegment upon successful restoration
- Stock members of the native fish community within suitable habitat upon successful restoration

Appendix B. Initial Public Scoping Comments.

Northwest
1216 Lincoln Street
Eugene, Oregon 97401
541 485-2471
fax 485-2457
eugene@westernlaw.org

Southwest
P.O. Box 1507
Taos, New Mexico 87571
505 751-0351
fax 751-1775
taos@westernlaw.org

Rocky Mountains
679 E. 2nd Avenue, Suite 11B
Durango, Colorado 81301
970 385-6941
fax 385-6804
durango@westernlaw.org

www.westernlaw.org

Western Environmental Law Center

February 24, 2005

New Mexico Department of Game & Fish
Attn: Kirk Patten
P.O. Box 25112
Santa Fe, New Mexico 87504

Re: ***Coalition for the Valle Vidal Comments Concerning the Proposal to Restore Rio Grande Cutthroat Trout in the Rio Costilla Watershed***

Dear Mr. Patten:

As you are well aware, the Valle Vidal is a spectacular wildlands landscape. Accordingly, and in no small part due to the efforts of the Water Quality Control Commission ("WQCC") and the Department of Game & Fish ("DGF"), its waters were designated an Outstanding National Resource Water ("ONRW"), the highest level of protection under the Clean Water Act ("CWA").

Notably, the Coalition for the Valle Vidal takes no position either for or against the proposal to use piscicides in the Rio Costilla watershed as a tool to restore Rio Grande Cutthroat Trout. The Coalition's mission centers on a discrete mission: the permanent protection of the Valle Vidal from the threat of coalbed methane development. Application of piscicides to the Valle Vidal's waters, as a policy matter, is therefore not directly cogent to the Coalition's mission.

Nonetheless, the WQCC and DGF must ensure full and fair compliance with the enhanced protections afforded these waters by ONRW designation. This is critical to demonstrate, from the start, that the State of New Mexico is serious about not merely *designating* ONRW in New Mexico, but also *implementing* its protections. Setting an example early on that ONRW protections will be complied with fully and fairly is important if ONRW designation can be effectively wielded to ensure that if coalbed methane development on the Valle Vidal occurs, such development will fully comport with ONRW protections. The WQCC and DGF must therefore ensure that antidegradation review is conducted for the proposal to restore Rio Grande Cutthroat Trout, and, accordingly, ensure that any impacts to the watershed are necessary to meet the Clean Water Act's objective (33 U.S.C. § 1251) and will only cause temporary and short-term impacts.

If you have any questions concerning the Coalition's position, please do not hesitate to contact me at eriksg@westernlaw.org or 505.751.0351. Notably, this letter conveys only the Coalition's position; it may not convey the individual positions of all organizations and parties who comprise the Coalition's membership. Thank you for your time and consideration.

Sincerely,

Erik Schlenker-Goodrich
Counsel, Coalition for the Valle Vidal

Attorney, Southwest Office
Western Environmental Law Center

cc: New Mexico Water Quality Control Commission, c/o Sally Worthington, 1190 St. Francis Drive, N-2150 P.O. Box 26110, Santa Fe, New Mexico 87502

New Mexico Council of Trout Unlimited
P.O. Box 32952
Santa Fe, NM 87594-2952

February 25, 2006

Kirk Patten
New Mexico Department of Game and Fish
P.O. Box 25112
Santa Fe, NM 87504

Re: Proposal to Restore Rio Grande Cutthroat Trout to the Rio Costilla Watershed

Dear Mr. Patten:

Trout Unlimited if is a national organization of about 130,000 anglers and conservationists interested in the restoration and conservation of our nation's coldwater resources. In New Mexico, Trout Unlimited has over 1,200 members with a keen interest in our fisheries and our native trout.

We feel that projects like the Rio Costilla project offer the best opportunity to secure the future of our imperiled state fish, the Rio Grande cutthroat trout. While many of the past restoration efforts have focused on small, remote headwater segments, a large inter-connected system like the Rio Costilla offers a better opportunity for genetic stability and protection from catastrophic events.

Trout Unlimited has been a participant in past projects in this watershed, and will participate in this project to the extent that it is helpful in completing and maintaining the project. We are dedicated to do what we can to keep restoration of the Rio Grande cutthroat moving forward, and in seeing that the necessary work is done to avoid an embarrassing Endangered Species Act listing of our state fish.

In our research on native fish projects throughout the country, we have found much good data to support the use of piscicides like Fintrol and Rotenone when necessary. If chemical treatments are necessary on this project, we would like to see a continued collection of important data, especially as it relates to macro-invertebrates and amphibians. While there are good studies to indicate that these agents are safe and effective when used as directed, and have no impacts on human health or long-term impacts on the watershed, we feel it important to continue to build a body of factual evidence whether positive or negative.

Sincerely,

William Schudlich
Chairman
New Mexico Council of Trout Unlimited

Cc: Joe McGurrin, TU Resource Director
Kevin Reilly, TU National Leadership Coucil

Truchas Chapter
TROUT UNLIMITED

February 16, 2006

New Mexico Department of Game & Fish
Attn: Kirk Patten
P.O. Box 25112
Santa Fe, NM 87504

Re: Comments on RGCT Restoration in Rio Costilla Watershed.

Dear Mr. Patten:

The Truchas Chapter of Trout Unlimited strongly supports the Department of Game & Fish's Proposal to Restore Rio Grande Cutthroat Trout (RGCT) to the Rio Costilla watershed.

The Truchas Chapter, based in northern New Mexico, has over 600 members. The chapter was formed, in large part, to work for the restoration of RGCT in its native range. Like all Trout Unlimited chapters, the Truchas Chapter's mission is to conserve, protect and restore North America's trout and salmon fisheries and their watersheds.

The RGCT, New Mexico's state fish, has been reduced to less than 10% of its historic range. Where it does exist, it faces a number of threats from habitat degradation to hybridization with, and competition from, non-native fish. The continued existence of RGCT cannot be assured unless genetically pure populations of RGCT are reestablished in large, complex drainages where they will not be geographically and genetically isolated and where they will not be subject to extirpation from catastrophic events, such as drought and fire. For the same reasons, we support your department's efforts to restore the historic coldwater fish community with which the RGCT evolved.

It is vitally important that the RGCT be restored to more of its native range. It is the trout that evolved in the streams of northern New Mexico, and it is more able than exotic trout to survive periods of drought, fire and other natural catastrophes. Because it evolved in this environment with other native aquatic species, it is more compatible than exotic trout with those other species.

TROUT UNLIMITED
P.O. Box 31671
Santa Fe, New Mexico 87594-1671
www.truchas-tu.org

Perhaps more importantly, it is the stated policy of the United States, as expressed in the Endangered Species Act, that our native species be preserved and protected. That Act accepts the principle that native species have significant value in themselves and for all of us.

If its current condition deteriorates further, the RGCT will be listed as endangered under the Endangered Species Act. Such a listing would create great economic dislocations in New Mexico and southern Colorado. It would adversely affect fishing, logging, farming, grazing, irrigation, and urban water uses.

We are familiar with the techniques for removing non-native fish outlined in your department's January 23 letter, including the use of chemicals, and we support the use of those techniques. We know that the restoration of RGCT cannot be accomplished without the removal of all non-native fish which interbreed with RGCT or which compete with them, and so the removal of all of those non-native fish is essential the success of this project. Many of our members have spent considerable time reviewing the literature concerning the piscicides antimycin and rotenone, and we are convinced that, at the amounts and time of exposure used in native fish restoration projects, they are safe for people and air-breathing animals and will have only minimal, short-term impacts on non-target aquatic species.

The reestablishment of RGCT to the drainage of the Rio Costilla will go a long way to assuring the preservation and recovery of the RGCT, and we support your department's efforts on this project.

Please send a digital copy of the NEPA document once it is available to me at roboconnor@aol.com and to Kevin Reilly of our board at kevinvreilly@gmail.com.

Sincerely,

Robert O'Connor
President

Date: February 27, 2006

To: New Mexico Department of Game and Fish
Attn: Kirk Patten
P.O. Box 25112
Santa Fe, NM 87504
(505) 476-8055
(505) 476-8131 fax
kirk.patten@state.nm.us

From: Ann McCampbell, MD
11 Esquila Rd
Santa Fe, NM 87508
(505) 466-3622
DrAnnMcC@aol.com

Re: Proposal to Restore Rio Grande Cutthroat Trout in the Rio Costilla Watershed

SCOPING COMMENTS

A joint environmental impact statement (EIS) should be prepared by the New Mexico Department of Game and Fish (NMDGF), Carson National Forest, and U.S. Fish and Wildlife Service (FWS).

An EIS is required because, among other things:

1) Federally threatened or endangered species (e.g., bald eagle & Mexican spotted owl) are present in the project area;

2) The project area contains water bodies eligible for designation under the Wild & Scenic Rivers Act;

3) The Valle Vidal contains ecologically critical wetlands;

4) Migratory waterfowl use critical wetlands and marshes;

5) The environmental impacts of deploying piscicides is uncertain, especially impacts to macroinvertebrates and amphibians;

6) There is controversy among experts whether there are long-term impacts to macroinvertebrates and amphibians;

7) The proposed use of piscicide is in conflict with state water standards that permit "no degradation" of water quality in waters, such as those of the Valle Vidal, designated as Outstanding Natural Resource Waters (ONRWs).

The Carson National Forest is obligated to cooperate in the preparation of an EIS with NMDGF and FWS or prepare its own EIS because part of the project will occur on forest service property. In addition, Carson National Forest has taken, or will be taking, a connected action of creating a fish barrier on its property and possibly will supply staff to aid in the implementation of the project.

Issues that need to be documented and/or analyzed in the EIS:

1) The impact of stocking non-native fish, both in the past, currently, and proposed as part of this project, on the Rio Grande Cutthroat Trout (RGCT), other native fish, amphibians, and other species;

2) Establishing a need to restore Rio Grande chub, Rio Grande sucker, and longnose dace along with RGCT in the project area;

3) Documenting and quantifying adverse impact to RGCT of the presence of white suckers;

4) Benefit to RGCT's survival of being listed as threatened or endangered under the federal Endangered Species Act;

5) A description of the project area, including the exact number of stream miles and lakes proposed for restoration activities, that clarifies whether fishless lakes and ephemeral streams will be poisoned;

6) Analysis of short- and long-term impacts of piscicide use (analyzed separately for Fintrol, CFT Legumine, and Prentox Rotenone Fish Toxicant Powder) on fish, amphibians, reptiles, birds, macroinvertebrates, micro-organisms, and plants in, near, and downstream of the project area. Particular attention should be paid to possible impacts to rare or unique macroinvertebrate species.

   Impacts should be analyzed for morbidity, such potential for impaired reproduction and/or development, altered behavior, and increases in mutations and cancer, as well as mortality.

   Indirect effects of piscicide use should also be analyzed, such as loss of insects and fish from the food chain for an indefinite period, including impacts to migratory waterfowl that rely on invertebrate food resources for their survival and reproductive condition;

7) Analysis of short- and long-term impacts of electrofishing on all species listed above, as well as the predicted number of times electrofishing will occur in each stream segment and lakes in the project area;

8) A complete list state or federally threatened, endangered, and sensitive species, as well as rare and unique species (such as the knobbedlip fairy shrimp), present in the project area should be compiled, along with detailed maps showing where they are located. Macroinvertebrates need to be identified at the species level.

   The presence and location of brewers black birds, cliff swallows, house wren, solitary sandpiper, and the common snipe should also be documented. When data is missing, the gaps should be clearly identified and plans proposed for obtaining the missing data;

9) An assessment of whether beavers were or are present in the project area and if so analyze the impacts of restoring beavers as a member of the native aquatic community;

10) Analysis of the predicted effects of global warming on all existing RGCT populations, and its anticipated effects on the habitat and survival of RGCT in the project area;

11) Analysis of potential impacts of piscicide use on certification of downstream organic growers and ranchers;

12) Identity of all private wells and uses of surface water for drinking from the headwaters in the project area to the town of Costilla;

13) Analysis of potential impacts to humans of drinking or swimming in water containing piscicide chemicals or breathing piscicide fumes. Impacts should be considered for pisicicide applicators and other staff as well as vulnerable populations like children, pregnant women, the elderly, and those with heightened sensitivities or allergies to chemicals;

14) A chemical analysis listing and quantifying all ingredients present in the products proposed for application. These products include Fintrol, CFT Legumine, Prentox Rotenone Fish Toxicant Powder, potassium permanganate, and any dyes or other products proposed for use;

15) Impacts to humans, wildlife, and the environment should be made for all proposed methods of piscicide application including aerial, boat, backpack, and instream deployment stations;

16) A method should be identified that allows applicators to determine during deployment whether excessive doses of antimycin or rotenone are being applied;

17) The need for restoration of Rio Grande chub and Rio Grande suckers should be analyzed, and if restoration is deemed necessary, a long-range restoration plan should be created;

18) A detailed description of the project and its timeline should be provided. This should include the order of stream restoration activities, the methods and products to be employed, and the approximate dates for completion;

19) Details of the plan to remove pure RGCT trout from certain stream segments, hold them for a period of time, and reintroduce them into the stream should be provided. This plan should include the identity of the streams from which RGCT are to be removed, the manner they will be removed, the location, manner, and length of time they will be kept. The relative risks and benefits of the "no action" alternative and removing and returning fish in this manner should be analyzed. In particular, the risks of injecting fish with electronic tags should be analyzed, as well as risks for introducing whirling disease, potential harm from handling and anesthetizing fish, and the potential for and possible impacts from accidents and other unanticipated events.

Alternatives that should be analyzed in detail:

1) Netting
2) Angling
3) Dewatering (especially Costilla Reservoir)
4) Genetic swamping, i.e., stocking RGCT and other native species
5) Decreasing genetic purity standard of RGCT, e.g., possibly 90%
6) Interfering with spawning gravel in lakes and reservoirs
7) Taking advantage of natural events that eliminate fish
8) Angler education and other precautions to reduce illegal transplantations
9) Reducing or eliminating stocking of non-native fish
10) Habitat improvement
11) Eliminating bag limits for RGCT, allowing catch-and-release only

Cumulative impacts that should be analyzed in detail:

1) Identification of what, where, and when chemicals have been used to kill fish in the project area, including the possible use of an organochlorine pesticide in Costilla reservoir in the 1950's;

2) Identification of what, where, and when other pesticides or toxic chemicals have been introduced, drifted, or run into project waters in the last 50 years, along with future plans for use of chemicals in or near the project area, such as the use of herbicides on salt cedar and other riparian plants;

3) The predicted number of times piscicide will be applied to each stream segment in the project area and the cumulative impacts of doing so;

4) The cumulative impact of exposure to the combined ingredients in piscicides, i.e., the analysis needs to be of the whole product formulation and not the individual ingredients. Impacts from combinations of piscicides and/or combination of piscicides with potassium permanganate and dyes should also be analyzed;

5) The cumulative exposure of humans and wildlife to endocrine disruptors, including those in products proposed for use in this project, should be analyzed;

6) Cumulative impacts on amphibians should be analyzed that includes impacts from global warming, ultraviolet light, introduced predators, and toxic exposures, including the proposed use of piscicides, as well as impacts of electrofishing.

   The analysis should take into account the growing evidence that combinations of chemicals can produce adverse effects in frogs even when individual chemicals have no noticeable impact, and that these adverse effects can occur at concentrations as low as .1 ppb (part per billion). See "Pesticide mixtures, endocrine disruption, and amphibian declines: Are we underestimating the impact?" by TB Hayes, et al., Environmental Health Perspectives, in press, www.ehponline.org/members/2006/8051/8051.pdf.

Thank you for allowing me to comment on this proposed project. Please send me an electronic and paper copy of the NEPA document when it becomes available.

Respectfully submitted,

Ann McCampbell MD

Ann McCampbell, MD

WILD WATERSHED
P.O. Box 1943
Santa Fe, N.M. 87504
sam@wildwatershed.org
505-438-1057

February 27, 2006

New Mexico Department of Game and Fish
Attention: Kirk Patten
P.O. Box 25112
Santa Fe, New Mexico 87504

Delivery via fax 476-8131

Re: Restoration of Native Trout in the Rio Costilla Watershed

Dear Mr. Patten:

The following are preliminary comments by WILD WATERSHED to the January 23, 2006 scoping letter, which proposes to Restore Rio Grande Cutthroat Trout in the Rio Costilla Watershed of northern New Mexico ("Project"). We support the basin-wide restoration of native trout but do not support the use of broad-spectrum poisons and electro-shocking in high quality streams, lakes and wetlands or, in most cases, the construction of temporary and permanent stream barriers as a means of restoration. Detailed comments are found below:

1. <u>NEPA requires that the Forest Service participate to the fullest extent possible as a cooperating agency in Project planning and implementation.</u>

The regulations implementing the National Environmental Policy Act ("NEPA") strongly urges that federal agencies "cooperate with State and local agencies to the fullest extent possible . . . such cooperation shall to the fullest extent possible include joint environmental impact statements." 40 C.F.R. Section 1506.2(b) and (c).

The Forest Service is not a cooperating agency in this Project despite that fact that: 1) at least 82 miles of high quality streams on public lands managed by the Forest Service, including the entire Comanche Creek watershed, will be impacted by the Project and; 2) the Northern Leopard Frog (*Rana pipens*), a Forest Service designated "sensitive species" will be impacted by the project. In addition, there is no mention in the scoping letter of potential conflicts with the Forest Service Conservation Strategy for the Northern Leopard Frog, an administrative requirement designed to preclude Endangered Species Act listing (Forest Service Manuel 2621.2). Any NEPA analysis must acknowledge and describe the extent of such conflicts. 46 Fed. Reg. 18026, March 23, 1981.

Under the National Forest Management Act ("NFMA") the Forest Service must provide for the diversity of plant and animal communities. 16 U.S.C. § 1604(g)(3). To achieve this goal, the regulations implementing NFMA specify that the agency ensure viable populations of native animals are maintained by monitoring the population trends of management indicator species ("MIS") at both project and forest levels. 36 C.F.R. § 219.19 (a)(6). In this case, macro invertebrates and "resident" trout are both MIS on the Carson National Forest.

The Project is designed to kill thousands of MIS resident trout. It will also significantly change the composition of invertebrate communities and possibly eliminate rare and endemic invertebrates (personal communication, Dr. Nancy Erman). Dr. Carter Kruse has done field trials on the effects of antimycin A to invertebrates at deployment rates in the Project area. His preliminary findings, as presented to Water Quality Control Commission on February 22, found lower post-deployment populations of invertebrates in seven out of twenty-two sample sites. These results clearly suggest a significant impact to MIS populations on the Carson National Forest, arguing for substantive participation by the Forest Service to ensure compliance with NFMA's diversity mandate.

The construction of fish barriers on public lands managed by the Forest Service is within the scope of this Project. Such construction is a closely related connected action that requires analysis in the same impact statement. 40 C.F.R. Section 1508.25(a)(1). As in past trout restoration projects, the impacts of fish barrier construction on downstream water quality and quantity must be evaluated together with the impacts of fish poisons and electro-fishing. This can only be accomplished if the Forest Service actively participates in the analysis and implementation of this Project.

2. <u>An Environmental Impact Statement must be prepared because the Project may result in significant effects to the human environment.</u>

NEPA requires preparation of Environmental Impact Statement ("EIS") if significant impact to the human environment may occur. "A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial." 40 C.F.R. 1508.27(b)(1). An EIS must be prepared in this case because significant effects are likely to occur. The criteria which trigger the preparation of an EIS include:

1) The application of the fish poisons antimycin A, rotenone and their inert ingredients may affect the communities of Costilla and Amalia that rely on streams originating in the Costilla watershed for drinking and irrigation water. Antimycin A is not registered in California because its toxicity is unknown and the negative environmental effects of rotenone can persist for at least several years (Anderson 1970). The degree to which these poisons affect the public health and safety must be analyzed in an EIS. 40 C.F.R. 1508.27(b)(2).
2) An EIS must be prepared to analyze Project effects to the unique characteristics of Valle Vidal, an ecologically critical management area of the Carson National Forest. 40 C.F.R. 1508.27(b)(3). The streams in the Valle Vidal are designated Outstanding National Resource Waters, the most protective classification under the Clean Water Act. The Rio Grande Cutthroat Trout population in the Valle

Vidal is one of only two Core Conservation Populations that contain multiple tributaries. These unique characteristics require preparation of an EIS to document impacts.

3) The use of fish poisons in trout restoration projects is highly controversial and therefore requires analysis in an EIS. 40 C.F.R. 1508.27(b)(4). Controversy is established when experts degree. Dr. Nancy Erman and Dr. Ann McCampbell are qualified experts who have evaluated the relevant information and concluded that fish poisons have a high probability of causing significant, long-term impacts on non-target species and human health.
4) The possible environmental effects of antimycin A and certain inert ingredients is highly uncertain because the studies required to determine their effects on human health have not been completed. Therefore, the use of these materials in streams on public lands involve unknown risks that must be analyzed in an EIS. 40 C.F.R. 1508.27(b)(5).
5) This large and complex Project may result in cumulatively significant impacts to amphibians, invertebrates, sensitive and indicator species and a host of birds and mammals that prey on these species. Past fish poisoning projects, especially those that occurred during the 1950s, may have result in toxic and persistent residues that may still be having significant effect on wildlife and human health. An EIS must be prepared to address all the past, present and reasonably foreseeable future cumulative impacts of this Project. 40 C.F.R. 1508.27(b)(7).
6) An EIS must be prepared because the Project threatens to violate the Clean Water Act. 40 C.F.R. 1508.27(b)(10). As noted above, the streams in the Project area have been designated as Outstanding National Resource Waters ("ONRW"). New Mexico's water quality standards state: "No degradation shall be allowed in high quality waters designated by the commission as ONRW." This simple and clear requirement is based upon the anti-degradation standard of the Clean Water Act. Application of fish poisons is a significant degradation and would violate the Clean Water Act. At a minimum, the Project "threatens" to violate a federal law imposed for the protection of the environment and an EIS is therefore required. 40 C.F.R. 1508.27(b)(10).

Miscellaneous Comments:

- Please provide a description and location of all NMGFD non-native fish stocking within the Costilla watershed.
- Please provide a detailed analysis of the impacts and threats posed by livestock grazing, off-road vehicles and other habitat destroying activities within the Project area.
- Please provide a history of fish poisoning projects in New Mexico, including failures of fish barriers and management errors.
- Please provide information on what chemicals were used in the 1950s in Costilla Reservoir to kill fish. Collect and analyze sediment samples if persistent chemicals were used.
- Please identify all the secondary, indirect effects of eliminating invertebrates and amphibians to non-target birds and mammals.

- Please identify all rare and endemic invertebrate species in the Project area.
- Please provide peer reviewed studies documenting the adverse effect of White Suckers on Rio Grande Cutthroat Trout.
- Please evaluate the effectiveness of using gill netting to eliminate non-native trout in lakes in the Project area (Knapp and Matthews 1998).
- Please document the extent and history of stocking non-native trout in Latir Lakes within the Project area.

Please send me the final EIS when completed.

Respectfully submitted,

Sam Hitt, Founder
Wild Watershed

References

Anderson, R.S. 1970. Effects of rotenone on zooplankton communities and a study of their recovery patterns in two mountain lakes in Alberta. Journal of the Fisheries Research Board of Canada 27:1335-1356.

Knapp, R.A. and K.R. Matthews. 1998. Eradication of non-native fish by gill netting from a small mountain lake in California. Restoration Ecology, Vol. 6, No. pp. 207-213.

February 27th, 2006

To. Kirk Patten
I'm writing in concern for the Ville Vidal eradication of trout species other than native cutthroat - My concerns are that if the process begins - what happens to the whole Ville Vidal? Does this help the fight in not to drill the Ville Vidal for natural gas? If so, than great! If it does not help, than what does it do? Another thought how do you keep the other trout species from eventualey getting together again in the streams - The planting of non-native trout in alot of the mountain lakes - it's almost certain they will blend again?

Let's save ~~our~~ our natural and native homeland, New Mexico is a gem lets shine it up and ~~offer~~ offer a unique tourist destination.
Viva Nuevo Mexico! Thank you
"Benito Trujillo"

FOREST GUARDIANS

Mr. Kirk Patten
New Mexico Department of Game & Fish
PO Box 25112
Santa Fe, NM 87504

February 27, 2006

Dear Mr. Patten,

Thank you for the opportunity to comment on the New Mexico Department of Game & Fish's proposal to restore Rio Grande Cutthroat Trout in the Rio Costilla watershed. I also appreciate you taking the time two weeks ago to meet with myself and others to inform us about various aspects of the proposal. We are supportive of the Department's broad goal of restoring native fish and providing them with larger watersheds and connected river miles in which they can survive and flourish. At the same time, we have some significant concerns about the scope of this project, and the risks involved to aquatic life, clean water and public health.

Before providing some initial comments on the issues as we currently view them, we'd like to provide an alternative perspective on the problem of native trout recovery in the Southwest. First of all, we believe the most important action that needs to be taken is an immediate prohibition on the stocking of non-native trout in high quality cold water streams. There are real, cumulative and ongoing impacts of the past, present and likely future efforts to stock streams in the vicinity of this project with non-native trout. We would like to see the Department conduct a thorough environmental analysis of the effects of these programs on native trout and other sensitive and state and federally protected trout, amphibians and other aquatic or semi-aquatic species.

Second, we believe that no treatments of any kind should occur until all of the project's fish barriers have been approved, funded and constructed. To analyze a project on this scale with so many uncertainties surrounding the ability to secure streams with fish barriers seems to be putting the proverbial cart before the horse. We recognize that some fish barriers are easier to approve and construct and maintain than others, but if the project does not have a realistic ability to deliver on barriers than it should not be proposed on such a large scale.

Third, native trout do best in streams that are in excellent habitat condition. Though restoration work has improved the quality of habitat in the streams on the Valle Vidal, the streams in the Valle Vidal are all violating state water quality standards, largely due to historic and ongoing cattle grazing. We believe the restoration of native woody vegetation and the recolonization or reintroduction of beaver should be an even higher priority and can result in far greater native trout populations than the removal of non-native suckers and chubs.

National Environmental Policy Act

The National Environmental Policy Act requires federal agencies to prepare an Environmental Impact Statement (EIS) for any proposed action "significantly affecting the quality of the human environment. Because most agencies do not wish to undergo the more

MAIN OFFICE:
312 Montezuma Avenue ▼ Santa Fe, NM 87501 ▼ 505-988-9126 ▼ Fax 505-989-8623 ▼ www.fguardians.org ▼ swwild@fguardians.org
DENVER OFFICE: 1536 Wynkoop Street, Suite 300 ▼ Denver, CO 80202 ▼ 303-780-9939 ▼ lmccain@fguardians.org

comprehensive analysis required by an EIS most agencies simply prepare Environmental Assessments (EA). This is true even in cases where the "significance" criteria used to determine whether or not to do an EIS show that an EIS is more appropriate. We believe that an EIS is appropriate in this case, though we will patiently await the outcome of your draft EA.

We believe that the proposed action meets many, though perhaps not all of the significance criteria as defined by NEPA. I will not list the significance criteria but rather discuss the ways in which the project meets individual criteria.

First of all, there is significant scientific controversy. The California Department of Pesticide Regulation has recently rejected the registration of Fintrol because of extensive data gaps regarding its toxicity and environmental fate. It is my understanding that California is the only state in the nation that makes its own assessment of the safety and effectiveness of pesticides before registering them. Given that and the current dismal state of affairs in pesticide registration and oversight at the federal Environmental Protection Agency (EPA) we believe that there is ample evidence that significant scientific controversy exists. From our perspective the EPA abandoned its public trust responsibility in terms of its obligations to ensure the safe registration of pesticides during the 1980s under President Ronald Reagan. We believe this controversy over the use and registration of a toxin in freshwater streams is quite significant. We would like to see this controversy addressed thoroughly.

Second, though the use of piscicides is not precedential at this point, the use of piscicides in "Outstanding National Resource Waters" is unquestionably precedential not only in New Mexico but possibly on a national scale as well. We would like the EA to analyze whether or not piscicides have been used in any other ONRW in the United States.

Third, and as noted above, this action is "related to other actions that may have individual insignificant impacts but cumulatively significant effects." The issue as we see and as noted above is the continued release of non-native trout in New Mexico's trout streams annually and the effects of those releases on native trout restoration—which is the purpose and need of this project. We would like to see a thorough analysis of the location, extent, timing and duration of release of non-native trout in the waters proposed for restoration.

Fourth, the waters of the Valle Vidal are eligible for inclusion in the National wild and scenic river system and are also designated as ONRW's largely because of the ecologically critical values these waters sustain. These "unique characteristics" are potentially at risk as a result of the proposed action. A thorough analysis of these values and the risks to them is warranted.

By no means is the above discussion of significance criteria intended to be comprehensive. It is merely a brief discussion of some of the reasons that we believe caution and a comprehensive analysis are in order.

<u>Clean Water Act</u>

We believe there are two significant Clean Water Act issues that need to be addressed in the analysis and in the Department's decision about the use of piscicides. The most significant issue is compliance with the state's anti-degradation policies, particularly as they relate to Outstanding National Resource Waters (ONRW). We do not currently see that there is any legal way in which the application of piscicides as proposed can comply with New Mexico Water Quality Standards.

As you well know the New Mexico Water Quality Control Commission recently designated every stream in the Valle Vidal as an ONRW. The New Mexico anti-degradation policy clearly states that, "no degradation shall be allowed in high quality waters designated by the commission as outstanding national resource waters." There is some consensus that at least some degradation will occur to these ONRWs as a result of the proposed action. Though the degree and significance of that degradation is at issue for certain, there is nevertheless no wiggle room in the current state of New Mexico anti-degradation regulation.

Though it is true that the federal regulations implementing the anti-degradation provisions of the CWA allow for some level of degradation, that level of degradation must be short-term and insignificant and must benefit the purposes for which the ONRW was designated. We agree that the beneficial purposes are quite significant. However we also believe the deleterious effects of this project are potentially significant as well. Finally, the state's anti-degradation policy quite clearly states that these "temporary and short-term changes in water quality…do not impair existing uses." We do not see how this project can proceed without impairment to existing uses. The EIS should address this issue in detail.

The second anti-degradation issue that is critical is the actual anti-degradation review process which is required anytime a Tier 3 or ONRW is potentially degraded. The New Mexico Environment Department has done few if any of these reviews. While we recognize that the anti-degradation review is a state responsibility, the obligation falls on the Department to ensure that the EIS and record address economic costs and benefits of the proposal and weigh those against risks associated.

The second significant Clean Water Act requirement relates to the National Pollution Discharge Elimination System (NPDES). The CWA prohibits "discharge" of "any pollutant" into "navigable waters" without a permit issued by the United States Environmental Protection Agency (EPA) under the NPDES system or under a federally approved state permit system. NPDES permits offer important additional protection (beyond FIFRA requirements) for the nation's waterways. We believe that piscicides are a pollutant as defined under the CWA and that the Department should comply with the CWA by obtaining a permit. We are aware of two separate federal circuits (9^{th} and the 2^{nd}) that have found that pesticide application to a state's waterways requires an NPDES permit. Though a district court in Montana has addressed the issue in the reverse with respect to one of the piscicides at issue, the issue is by no means settled at the circuit court level. We believe that the controversy surrounding this issue is another reason an EIS is more appropriate in this instance.

<u>Wild and Scenic Rivers Act</u>

Nearly every river that is proposed for fish poisoning in this project is eligible for designation and permanent Congressional protection under the Wild and Scenic Rivers Act. Once eligible, the U.S. Forest Service is required to ensure that the "outstandingly remarkable values" (ORV's) that made the river segments eligible in the first place are protected on an interim basis. The outstandingly remarkable values of many of the streams in the Valle Vidal that the Forest Service identified include "fish" and "wildlife." Interim protection, currently incorporated into the Carson National Forest plan, requires the Forest Service to protect and, to the extent practicable, enhance outstandingly remarkable values. (NF Plan Amendment 12). This issue of protection of ORVs is unique for each river segment and must be thoroughly analyzed in the EA.

National Forest Management Act

Though funded by the U.S. Fish and Wildlife Service, the majority of the project is being carried out on Carson National Forest lands and is being coordinated with and facilitated by the U.S. Forest Service among other partners. Moreover there are connected actions, as noted above, that the Forest Service is carrying out that inextricably linked to this project. Given the linked nature of these actions we believe the EIS should comply with the National Forest Management Act's central mandate: "to ensure the viability of all native wildlife."

The viability mandate is especially relevant to Management Indicator Species. This project should be informed by and the EIS should analyze population data that is sufficient to establish a trend as required by the Carson National Forest Land and Resource Management Plan ("Carson Forest Plan"), the National Forest Management Act ("NFMA"), (16 U.S.C. 1600 et seq.), and NFMA's implementing regulations, (36 C.F.R. Part 219)..

We would much prefer that the Department focus on prohibiting the continued stocking of non-native trout where they are likely to be a threat to native trout and other wildlife combined with a greater emphasis on habitat restoration as well as a more precautionary approach to non-native fish removal.

Thank you, again, for the opportunity to comment and please do let us know if you have any questions about the issues raised or the intent therein of our comments.

Sincerely,

John C. Horning
Executive Director
Forest Guardians

4

New Mexico Department of Game and Fish
Rio Grande Cutthroat Trout Restoration Project Public Forum
February 18, 2006 Costilla, New Mexico

Page 1 of 1

Name: Paul A Martinez Sangre de Cristo LAND GRANT Phone: (not required) (505) 586-1438
CALL ME!
Address: PO Box 69 Amalia NM 87512

e-mail address (not required):

Comments regarding the restoration project: 1) MORE TIME MUST BE ALLOTTED FOR DISCLOSURE and DISCUSSION
* All Stakeholders must be brought to the table
NOT just the Game & Fish and the Poison Peddlers
* Proof that your project has worked elsewhere
* Ted Turner, RCCLA, Carson National Forest, GAME & Fish and others are not the LAWFUL landowners, the Land, Water, Fish, Game, Forest, and Minerals Rights to most of the properties described on your posters, belong to Sangre de Cristo Land Grant and therefore the Heirs of said organization, under whose authority do you intend to trespass unto our properties with the intent of poisoning our private property - whether it be fish or water.
* Each of your employees has taken a Constitutional Oath in order to hold their position as a State Employee in NM, and there can and will be held responsible for their actions as individuals in the Violation of **our** Rights as guaranteed by the Treaty of Guadalupe Hidalgo and protected by the Constitution of the United States of America

Please mail to: New Mexico Department of Game & Fish
Attn: Kirk Patten
P.O. Box 25112, Santa Fe, NM 87504

PS
I'm the CEO of the Sangre de Cristo Land Grant and we are part of the State Registry of LG's 476-8055
DO SOME RESEARCH EARN YOUR PAY!

RECD FEB 21 2006

Mw Bar Ranch
PO Box 57
Amalia, Nm 87512
505 586-2054

February 17, 2006

Mr. Kirk Patten
NM Dept of Game & Fish
PO Box 25112
Santa Fe, NM 87504

RE: Restoration of the Cutthroat Trout in the Rio Costilla Watershed

Dear Mr. Patten:

We reside along the Rio Costilla approximately three miles east of the village of Amalia. We support the restoration of Cutthroat Trout in the watershed. We both believe that the area will be enhanced by removing the non-native species and allowing those species that belong here to become re-established.

However, we are hesitant about the use of chemicals to remove the non-native fish species without assurances that no harm will be done to other species that belong in the area and that might reside along the stream bank or drink from the river while the chemicals are present. Also, can plants uptake the chemical and pass it on to animals that eat the plants?

We would like to a copy of the NEPA document once it becomes available. A digital copy would be fine with us. Our E-mail is mwbarranch@cs.com.

Thanks for considering our comments.

Sincerely,

Mary Ann Walz

Mary Ann Walz

Lawrence Montoya

Lawrence Montoya

2-15-06

New Mexico Dept of Game + Fish
Attn: Kirk Patten
P.O. Box 25112
Santa Fe. N.M. 87504

RECD FEB 21 2006

Dear Mr. Patten:

Re: Rio Grande Cut throat Project on Rio Costilla Watershed.

assuming the project is Successful:

1. Will the fishing be open to public fishing on catch + release only and/or small limits to control fish population?.
2. If so - will private property owners charge additional fees? It is not fair to use our money to improve private property fisheries.
3. On the other hand if land owners pay their share they should still retain the rights to charge as they see fit.

Thank you for the opportunity to Comment.

Sincerely
Lloyd Bolander
P.O. Box 98
Valdez N.M. 87579

P.S. If the project goes I hope it is an unqualified success. It would be nice to catch + release native Trout again.

J

February 6, 2006

RECD FEB - 9 2006

Attn: Kirk Patten
New Mexico Department of Game and Fish
P.O. Box 25112
Santa Fe, New Mexico 87504

Dear Kirk Patten:

It is nice of you to take the time to send me an opportunity to respond to such an important (to me) subject as the proposed Rio Grande Cutthroat Trout improvements for the Costilla Creek and some of its drainages. I am aware of the struggles and difficulties necessary to complete such a document.

In the past 25-years I have been involved with the Rio Costilla drainage in various capacities, including bio-assays and water quality studies above and below the Costilla Dam; dam repairs to the Costilla Dam; dam breach analysis of Costilla Dam and drinking water system evaluations & samplings of various fishing/hunting camps on the Vermejo Ranch (including Costilla Lodge).

The concerns I have at this time are as follows:

1. One of the lakes above Costilla Lodge has many large Brook Trout. Will the destruction of all non-indigenous fish species also include these fish as these lakes are within the study area?;
2. Maintenance-For future destructions of non-indigenous fish species, would cut-off walls on each stream confluence to the main Rio Costilla channel be of benefit?;
3. I assume that the destruction of all fish species on the study streams would also mean the destruction of all micro-biota that also exists in those streams. How will the reintroduction of these micro-biota be addressed?;
4. At one time Dr. Jerry Jacobie considered the Rio Costilla reach above Costilla Dam as one of the best cutthroat-trout breeding areas in the West (not just New Mexico). How will this reach of the Rio Costilla be addressed?;
5. The remnants of the railroad that was used to build Costilla Dam is now under the waters of the Costilla Dam Reservoir. Will the destruction of non-indigenous fish species damage or increase the rate of deterioration of these artifacts?

Your letter stated that if we wished to have a copy of the NEPA document upon its completion that we should ask for one. Please send me a copy of the written NEPA document when it becomes available.

Sincerely yours;

David O. Quintana

David O. Quintana, P.E.
3715 Thaxton Av., S.E., Apt. A
Albuquerque, New Mexico 87108
Ph. 505-670-2054

GOVERNOR
Bill Richardson

DIRECTOR AND SECRETARY
TO THE COMMISSION
Bruce C. Thompson

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH

One Wildlife Way
Post Office Box 25112
Santa Fe, NM 87504
Phone: (505) 476-8055
Fax: (505) 476-8131

Visit our website at www.wildlife.state.nm.us
For basic information or to order free publications: 1-800-862-9310.

Great, no poison, please

January 23, 2006

Re: A Proposal to Restore Rio Grande Cutthroat Trout in the Rio Costilla Watershed

RON SIMMONS & ASSOCIATES
155H CALLE OJO FELIZ 470-3014
LIC 032657
SANTA FE, NM 87505

Dear Interested Party:

The New Mexico Department of Game and Fish and the U.S. Fish and Wildlife Service are committed to the conservation and restoration of native fish species of New Mexico. The Rio Grande cutthroat trout is currently reduced to less than 10% of its historic range. Factors contributing to this decline include habitat degradation, hydrologic modification, competition, and hybridization with non-native trout species. Most existing populations of Rio Grande cutthroat trout are limited to small headwater streams, creating concerns about long-term population viability.

Purpose and Need

To help assure its long-term persistence, there is a need for establishing a genetically pure population of Rio Grande cutthroat trout into a watershed large enough to support populations with a low probability of extinction. Concurrent with restoring Rio Grande cutthroat trout, there is also a need for re-establishing the historic coldwater fish community in which Rio Grande cutthroat trout evolved that includes Rio Grande sucker, Rio Grande chub, and longnose dace. Coordinating restoration for Rio Grande cutthroat trout and other members of the native fish community, namely Rio Grande sucker and Rio Grande chub, will proactively address potential endangered species concerns that may arise in the future, including possible listing under the Endangered Species Act.

Proposed Action

The New Mexico Department of Game and Fish, in cooperation with Vermejo Park Ranch, Rio Costilla Cooperative Livestock Association, U.S. Fish and Wildlife Service, and U.S. Forest Service, proposes to restore Rio Grande cutthroat trout and other members of the native fish community in the Rio Costilla watershed (see attached sheet). The proposed project area includes three major sections of the Rio Costilla watershed: 1) the Rio Costilla, including Costilla Reservoir; 2) the Comanche Creek watershed; and 3) the Latir Creek watershed (see map). This area was selected due to the quality of the habitat, ongoing projects by other conservation groups, and connectivity among multiple drainages.

Thank You Ron Simmons

Kirk: This is great news. Please, no use of poisons to eradicate fish. I do not agree with any use of herbicides or other "control poisons" on the forest area, especially in our watersheds and streams.

The proposed action includes approximately 150 stream miles, over 25 lakes ranging in size from 1.5 acres to 12 acres, and Costilla Reservoir. Currently, the game fishery consists of Rio Grande cutthroat trout, brook trout, brown trout, rainbow trout, and cutthroat trout hybrids. Brook trout and brown trout displace Rio Grande cutthroat trout through competition. Rio Grande cutthroat trout readily hybridize with rainbow trout and other subspecies of cutthroat trout. White sucker and longnose sucker, both non-native fish, are also present in the drainage.

To secure Rio Grande cutthroat trout and the native fish assemblage within the Rio Costilla, all non-native and hybridized fish would need to be removed from the project area. Such removal would include a variety of fishery management techniques most appropriate for meeting project goals. Upon successful removal of unwanted fish from a project sub-segment, Rio Grande cutthroat trout and, where suitable habitat exists, members of the native fish community would be restocked into the sub-segment. To prevent non-native fish from reentering the project area, a permanent fish migration barrier would be constructed on the Rio Costilla below the confluence of Latir Creek on Rio Costilla Cooperative Livestock Association property. Temporary fish migration barriers would be constructed to isolate portions of the watershed and prevent non-native fish from reentering sub-segments of the project area during implementation.

Responsible Official

The proposed action would be funded by the U.S. Fish and Wildlife Service through the Sportfish Restoration Act and implemented by New Mexico Department of Game and Fish. Pursuant to the National Environmental Policy Act (NEPA) and its implementing regulations (40 CFR 1500), this letter initiates the public "scoping" process, whereby public comment is requested, significant issues identified, and project alternatives are developed. The environmental effects of the alternatives will be described and evaluated in a NEPA document, most likely an Environmental Assessment.

Upon completion of the Environmental Assessment (sometime in the spring/early summer 2006), the Regional Director, Region 2, U.S. Fish and Wildlife Service (Responsible Official) will decide whether to select the proposed action, an alternative, or to take no action. If an action alternative is selected, the Responsible Official must determine if the project would create significant environmental impacts. If significant impacts are expected to occur, an environmental impact statement must be prepared. If the selected alternative has no significant impacts, then a Finding of No Significant Impact will be prepared and the project could be implemented as early as late summer/fall 2006.

Request for Comments

We would like to hear from you. Your ideas, concerns, and suggestions will be helpful in designing a project to secure the long-term existence of Rio Grande cutthroat trout for future generations. Written comments will be most effective if received by February 27, 2006. Please send your comments to:

New Mexico Department of Game and Fish
Attn: Kirk Patten
P.O. Box 25112
Santa Fe, NM 87504

If you would like a paper or digital copy of the NEPA document once it is available, please make this request in your written comments. Additionally, we will be sponsoring a public forum where you can learn more about the project and visit with project biologists on February 18, 2006, from 2:00 p.m. to 4:00 p.m., at the Rio Costilla Cooperative Livestock Association, Highway 196 House # 72, Costilla,

COMANCHE TRIBE
NAGPRA

FEB - 6

February 6, 2006

Michael Sloane, Chief of Fisheries
State of New Mexico
Department of Game & Fish
One Wildlife Way
PO Box 25112
Santa Fe, NM 87504

Re: Proposal to restore Rio Grande Cutthroat Trout in the Rio Costilla Watershed

Dear Mr. Sloane:

Thank you for your letter of January 23rd regarding the proposed restoration Rio Grande Cutthroat Trout to the Rio Grande.

At this time, the Comanche Nation has no immediate concerns or issues regarding the project; however, please keep us informed of the project progress. We also would like to receive any archaeological reports and findings for the project area.

If in the process of the project human remains or archaeological items are discovered, we request that you immediately cease the project work and notify us so that we may discuss appropriate disposition with you and the other Tribal Nations that may be affected by such discoveries.

We look forward to your reports as activities proceed.

Sincerely,

Fred Nahwooksy

Fred Nahwooksy, NAGPRA Coordinator

cc: Robert Dello-Russo

P.O. Box 908 • Lawton, Oklahoma 73502 • (580) 492-3754 • (580) 492-3733 FAX

J

NM G and F
Kirk Patten
PO Box 25112
SF NM 87504

Feb 2, 2006

Dear Kirk,

We have already spoken on the phone and I appreciate you including us in the loop on this. I think I made my apprehensions clear at Commission meeting regarding my fears about the project; namely that we already have a very good fishery there and who knows what lies ahead.

But don't get me wrong I would love to see only Rio Grandes in those waters.
I do realize that the project will probably move ahead and I hope for its success. The one suggestion that my son Nick and I have (Nick owns Taos Fly Shop and I own the Streit Fly Fishing guiding service) is that the fishery not be degraded by raising harvest limits and making salvage orders. This seems to me to be purely political gesture as I'm sure that you realize that the amount of fish that could be removed by anglers in a season would be minuscule and will decrease general fish size.

More importantly it took many years to get folks used to throwing the trout back and this would be a backward step in catch and release mentality—for very questionable results.

Thanks
Taylor Street—Streit Fly Fishing
Nick and Christina Streit—Taos Fly Shop

Taylor Streit
Nick Streit

RECD FEB - 6 2006

Jan. 27, 2006

Kirk Patten
PO Box 25112
Santa Fe, NM 87504

Mr. Patten,

I am writing in response to the proposal to restore the Rio Grande Cutthroat Trout in the Rio Costilla Watershed.

The American Outdoor Academy is extremely supportive of any effort to restore the Rio Grande Cutthroat to its former range and is glad to see the US Fish and Game and the New Mexico Dept. of Game and Fish taking a proactive role.

My only concern is that the project may be a little over ambitious. 150+ miles of stream may be too large of an area to control all the variables necessary to insure a successful reintroduction. Perhaps it may be more feasible to limit the reintroduction area to a more manageable size.

I also feel for the project to be successful there will need to be an extensive public relations campaign. It will be important to involve the public as much as possible in all aspect of the project. The more the public, especially those who live and work around the proposed area, know about the project, its purpose and goals, and are able to physically participate, the better chance the project has for success.

I appreciate this opportunity to comment. It is my hope to again see the Rio Grande Cutthroat in its native waters.

Thank you,

Jared Chatterley

Jared Chatterley
Executive Director
American Outdoor Academy

RECD FEB - 3 2006

NEW MEXICO TROUT
A NON-PROFIT ORGANIZATION

P. O. Box 3276
Albuquerque, NM 87190-3276

Feb 14, 06

Kirk Patten
Fisheries Biologist
New Mexico Dept. of Game & Fish
1 Wildlife Way
Santa Fe, N.M. 87507

Dear Mr. Patten,

New Mexico trout a statewide coldwater fisheries conservation organization with 400 -500 members supports native fish restoration in their historical waters when and where appropriate.

New Mexico Trout is very supportive of the New Mexico Game and Fish dept.'s project to restore Rio Grande Cutthroat trout to the Rio Costilla watershed, its ancestral home.

New Mexico Trout also supports the careful use of piscicides for the removal of non native fish where it is the only viable method to be successful.

During our work with New Mexico Dept. of Game & Fish on projects to restore Rio Grande Cutthroat trout such as the Rio Cebolla "Bring Back the Natives" project we have never observed long term effects of piscicides on populations of aquatic insects or amphibians and they have not posed a risk to human health or to the environment in general.

We have a retired Fish and Wildlife Service biologist with almost 40 years experience with piscicides and he has never observed a risk to humans or a long term effect on the environment where it was used.

Thank you for this opportunity to comment.

Mike Maurer
President
New Mexico Trout
P.O. Box 3276
Albuquerque, New Mexico 87190

AFFILIATED WITH THE FEDERATION OF FLY FISHERS AND TROUT UNLIMITED

Note - Kirk Patten, NMWGFT:

Sorry I was not at my computer -

REC'D FEB - 6 2006

Hope you can read my writing.

Please call me if you have any questions.

(505) 587-2848

Thanks.

Joni Beede

Also - please call me with the name of the US Fish and Wildlife Project manager for this Proposal. Thanks. (I'd like to send them a copy)

Your Community Voice in the Carson

Re: Rio Grande Cutthroat Trout -
Rio Costilla Watershed Proposal
(Jan. 23, 2006 Scoping Letter)

Page 1

Carson Forest Watch
Box 15 Llano, NM • 87543 • 505-587-248

2/2/06.

Kirk Patten -
N.M. Dept. Game & Fish
PO Box 25112
Santa Fe, N.M. 87504

RECD FEB - 6 2006

On behalf of our citizen's group in rural Taos County, the following are comments regarding the Rio Grande Cutthroat Trout Proposed Action in the Rio Costilla Watershed:

1) We have concerns regarding efforts to restore the cutthroat trout to avoid E.S.A. listing. We are a party to the law-suit to list the trout under the E.S.A., and believe that this species and its habitat merit E.S.A. listing and protection.

2) The NM Dept. of Game & Fish proposal only deals with one small watershed in this species' range - and unfortunately, does not address the reason's for the Rio Grande Cutthroat declines - except for competition from other fish species. Loss of quality habitat - esp. due to livestock grazing, was not addressed.

3) Because of our long-term drought in the Southwest - and in the Range of the Cutthroat trout - it is critical to ~~[illegible]~~ analyze how this drought is affecting trout and its habitat. Lower water
Lower water soils and loss of vegetation are all →

affecting our headwater streams and water-sheds. Fish species will have less Resilience and will be stressed under drought conditions.
4) Also - any proposed use of pisticides will have less water for dilution and will be more concentrated - thus the effects will be even more pronounced than models or past studies may show. The NM Dept. of Game & Fish must analyze how the drought will affect pisticide use and effectiveness

5) Many residents of Northern Taos County have multiple Chemical Sensitivities - any exposure to pesticides (even "EPA Approved") threatens their health & safety. Many of these folks also hike, fish, camp, birdwatch, and enjoy the Rio Costilla & Latir watersheds. This proposal poses unacceptable Risks to this population.
6) We are particularly concerned regarding the pisticide "Short-term" affect on aquatic organisms Many Insects, and birds that feed on these insects as well as pollinators such as bees, moths, & bats & butterflies could be negatively affected by pisticides
7) Especially in a drought - Insect Recovery is likely to be weakened and less able to rebound, and the NM Dept. of Game & Fish needs to address this concern. This is important -

Page 3

CARSON FOREST WATCH
P.O. Box 15
Llano, NM 87543

Rio Costilla Watershed/ cont'd.

– because many of this proposed action's determination of effects is based upon the "quick" aquatic organism Recovery Rates; we question how soon many important insects and other species will recover from pesticide use – again – esp. in a drought, when already stressed.

8) Also of concern is this pesticide proposal's effects on migratory songbirds & birds of prey; species such as SW willow flycatcher, all flycatcher species, Bluebirds, Warblers, (phoebes & many others) species, Bluebirds, Warblers, & many others – again – depend on aquatic insects & organisms. Again – a drought further reduces the quantity and quality of these insects, and threatens the viability of these birds. Pesticide use & loss of quantity and quality of aquatic insects directly affects these bird species. (& toxicity directly on birds)

9) Many studies have documented both decline in the number of insects as well as the diversity of insects (quality & variety of species) in streams after pesticide use. Any simplifying

→

Page 4)

[redacted]

← of these stream system ecologies and insect populations, esp in a drought is a negative effect upon our bird populations. (+ bats + frogs

10) The NM Dept. of Game & Fish needs data to support pisticide use during drought - as well as data showing effects of pisticides upon songbirds, esp. insect-eaters.

11) The Water Ouzel (<u>dipper</u>) is an important bird species of concern in this watershed - and directly <u>lives in</u>, nests along, and feeds in these streams. How are these species affected by pisticides? The NMDG&F needs data on this species' effects; Because this small bird feeds <u>under water</u> for aquatic organisms - the proposal's effects on the dipper need to be analyzed. A short-term loss of food for this species is a <u>significant</u> effect & threat to its viability. The health effects of pisticides on the dipper also need to be disclosed & addressed (egg success, hatch + chick survival, reproductive effects, etc.) ⟶

Page 5

CARSON FOREST WATCH
P.O. Box 15
Llano, NM 87543

In Summary - The NM Dept. of Game & Fish has not demonstrated adequate analysis of the effects of drought combined with pisticide use on this watershed.

The "short-term" loss of aquatic species and questionable Recovery of these species is of even more concern in drought years, and we believe the agency needs to Re-evaluate any use of pisticides in light of our drought.

Also - we Remain concerned regarding the effects of pisticides on our fragile migratory bird populations, & the NM Dept of Game & Fish has a mandate to insure that any projects it carries out do not threaten the viability of our bird wildlife in New Mexico.

Some of these bird species are declining and not Recovering from many factors; (loss of habitat, pollution, predation, climate change, etc etc.

Page 6

The NM Dept of Game & Fish has a responsibility to manage for the health of our bird populations - as well as fish and game species.

This proposal unfortunately threatens our Native birds and pollinators, (esp. Bats) — and frogs *
and needs to be Re-evaluated.

Please address these concerns, analyze effects on dipper, songbirds, bats, & other species, & pesticide use.

Also address drought & declines, such as and address causes of trout declines, Such as livestock grazing. Climate change (warming) also need addressing here, (warming stream temps.

Basically this proposal treats only one watershed with an unacceptable method - and does not address adequately it's effects on our New Mexico songbirds, bats, frogs, & aquatic species.

~~For further information or to comment on this paper contact:~~

~~Rita Beard~~
~~Forest and Rangeland Staff~~
~~Washington Office~~
~~USDA Forest Service~~
~~970 295-5745~~
~~rbeard@fs.fed.us~~

~~Joe Carbone~~
~~Ecosystem Management Staff~~
~~Washington Office~~
~~USDA Forest Service~~
~~202 205-0884~~
~~jcarbone@fs.fed.us~~

Copies to:
Dr. Ann McCampbell
Forest Guardians
Wild Watershed
Center for Biological

thank you,

Sincerely,
Joanie Berde
Co-ordinator for Carson Forest Watch —
Please Respond to these Concerns.

Page 7

CARSON FOREST WATCH
P.O. Box 15
Llano, NM 87543

one additional Site-Specific Concern is the building of a fish barrier downstream of the confluence of Latir Creek to the Rio Costilla.

While we generally support the use of fish barriers to block Brown & German Trout passage - we are concerned regarding protection of the unique box canyon area downstream of the Latir junction with Rio Costilla.

This Rock canyon is one of the most beautiful features of the Valle Vidal area, and contains ferns & other Rare plants.

We don't support any intrusive fish barriers here (esp. any cement work) as it would impair the integrity of this Box canyon.

It is important to locate the fish Barrier East (& upstream) of the narrows and the Rocks of this canyon, closer to Latir Creek.

It would still be effective - as the Box canyon Rock pools already offer a natural fish barrier and a Cement barrier upstream would supplement this. Rather than Cement - logs & natural materials would be preferable and keep with the surrounding ecosystem. Protection of the BoxCanyon is critical.

February 22, 2006

To: New Mexico Department of Fish and Game
Attn: Kirk Patten
P.O. Box 25112
Santa Fe, NM 87504

From: Nancy A. Erman Nancy A. Erman
43200 East Oakside Place
Davis, CA 95616
e-mail: naerman@ucdavis.edu

Re: Scoping Comments on proposal to restore Rio Grande cutthroat trout in Rio Costilla watershed by fish removal through use of poisons and electroshocking in streams/lakes and construction of temporary and permanent barriers in streams. (3 pages)

Please send to me at the above address all further environmental documents concerning this proposal to remove fish from 150 miles of stream, more than 25 lakes and Costilla Reservoir and to build permanent and temporary barriers in an attempt to restore Rio Grande cutthroat trout. Thank you.

A joint EIS should be prepared by the responsible agencies—the New Mexico Department of Fish and Game (NMDFG), the USDA Forest Service, US Fish and Wildlife Service—for the proposed poisoning of the Rio Costilla watershed. The project proposed is large and the poisoning will have a high probability of significant, long-term impacts on non-target species, of changing the composition of invertebrate communities and of eliminating species of rare and endemic invertebrates and amphibians. The stream/lake poisons used to kill fish are not species- or fish-specific. It is unclear from the scoping letter who is the lead agency on this project. The US Fish and Wildlife Service is listed as the "responsible" agency but the scoping comments are to be sent to the New Mexico Department Fish and Game.

The title of the project should have been more descriptive and honest regarding what is actually planned.

The EIS should include the following:

- A complete description of the "variety of fishery management techniques" to be used for fish removal.

- A complete description of all poisons to be used, chemical make-up of poisons and proposed locations of use, including neutralization chemicals.

- An assessment of the transfer and persistence of all chemicals in the poison formulations (including neutralization chemicals) through the food web.

- Description of methods of application of poisons.

- A list of all non-target SPECIES in the project area including invertebrates, amphibians and fish. Indicate locations within the project area where they are found. Small headwater streams have a high probability of containing rare and/or endemic species of aquatic invertebrates and amphibians in addition to rare fish.

- A review of published and unpublished agency studies showing impacts to aquatic invertebrates and amphibians from aquatic poisons to be used in this project.

- A complete list of all riparian and other terrestrial species that will be affected by losses of major food items throughout this poisoning and electroshocking project, that is, the impacts on food webs of birds, mammals, reptiles, amphibians, terrestrial invertebrates.

- A detailed map showing all water bodies to be poisoned, the chronology of the proposed poisoning, the places and dates of all barrier construction, the places and dates of all electroshocking of fish. Specify public and private land boundaries.

- Review of the history of errors and problems with chemical neutralization of rotenone and antimycin at lower project boundaries in streams and the persistence of poisons in lakes.

- Provide evidence of efficacy of barriers to fish restoration efforts.

- A complete history of all past efforts to restore the Rio Grande cutthroat trout.

- A complete history and locations of all past stream/lake poisoning projects conducted in New Mexico by the NMDFG and/or US Fish and Wildlife Service. This history is necessary to establish the cumulative impacts of use of poisons on target and non-target species.

- Genetic evidence that a pure population of Rio Grande cutthroat trout exists, where it exists and estimated size of population. Provide evidence that it can be maintained throughout the years of this project. Designate numbers of individuals tested for genetic studies, and where individuals were collected. Such evidence should be completed and submitted for review PRIOR TO restoration efforts.

- Description and assessment of all habitat degradation and hydrologic modification that has occurred in the project area.

- Dates and listing of all past NMDFG introductions of non-native fish into the project area.

- Description and locations of current NMDFG stocking of non-native fish throughout the state.

- Description of re-education program to prevent the general public and NMDFG from future introductions of non-native species into the project area.

- Detailed information on how the dead fish will be dealt with.

Appendix C. Public Meeting Legal Notices and Educational Information.

PUBLIC NOTICE

STATE OF NEW MEXICO
County of Bernalillo SS

Bill Tafoya, being duly sworn, declares and says that he is Classified Advertising Manager of **The Albuquerque Journal**, and that this newspaper is duly qualified to publish legal notices or advertisements within the meaning of Section 3, Chapter 167, Session Laws of 1937, and that payment therefore has been made of assessed as court cost; that the notice, copy of which is hereto attached, was published in said paper in the regular daily edition, for 3 times, the first publication being on the 10th day of February, 2006 and the subsequent consecutive publications on February 11th, 12th, 2006.

Sworn and subscribed to before me, a Notary Public, in and for the County of Bernalillo and State of New Mexico this 10th day of February of 2006.

PRICE $ 27.67

Statement to come at end of month.

ACCOUNT NUMBER C 80868

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF NEW MEXICO
My Commission Expires:

CLA-22-A (R-1/93)

Approved for payment

Signature Patty Medina

Date 3-15-06

RECD FEB 16 2006

THE SANTA FE
NEW MEXICAN
Founded 1849

NM DEPT GAME & FISH
PO BOX 25112
Attn: Patsy Medina
SANTA FE NM 87504

ALTERNATE ACCOUNT: 56627
AD NUMBER: 00156320 ACCOUNT: 00002159
LEGAL NO: 78404 P.O. #: 06-198-603876
46 LINES 3 TIME(S) at 66.24
AFFIDAVIT: 6.00
TAX: 5.51
TOTAL: 77.75

AFFIDAVIT OF PUBLICATION

STATE OF NEW MEXICO
COUNTY OF SANTA FE

I, R. Lara, being first duly sworn declare and say that I am Legal Advertising Representative of THE SANTA FE NEW MEXICAN, a daily newspaper published in the English language, and having a general circulation in the Counties of Santa Fe and Los Alamos, State of New Mexico and being a newspaper duly qualified to publish legal notices and advertisements under the provisions of Chapter 167 on Session Laws of 1937; that the publication # 78404 a copy of which is hereto attached was published in said newspaper 3 day(s) between 02/13/2006 and 02/15/2006 and that the notice was published in the newspaper proper and not in any supplement; the first date of publication being on the 13rd day of February, 2006 and that the undersigned has personal knowledge of the matter and things set forth in this affidavit.

Public Notice

The New Mexico Department of Game and Fish is sponsoring a public forum to discuss a proposal to restore Rio Grande cutthroat trout and members of the native fish community in the Rio Costilla watershed. Members of the public are invited to come and learn more about the project. The public forum is scheduled for February [illegible], 2006 from 2:00-4:00 p.m. at the Rio Costilla Cooperative Livestock Association, Highway 196, Mileage [illegible], Costilla, New Mexico. For additional information, contact Kirk Patten at 505-476-8055.
Legal #78404
Pub. Feb. 13, 14, 15, 2006

/S/ R Lara
LEGAL ADVERTISEMENT REPRESENTATIVE

Subscribed and sworn to before me on this 15th day of February, 2006

Notary Laura E. Harding

Commission Expires: 11/23/07

Approved for payment

Signature Patsy Medina

Date 3-2-06

OFFICIAL SEAL
Laura E. Harding
NOTARY PUBLIC
STATE OF NEW MEXICO
My Commission Expires: 11/23/07

www.santafenewmexican.com
202 East Marcy Street, Santa Fe, NM 87501-2021 • 505-983-3303 • fax: 505-984-1785 • P.O. Box 2048, Santa Fe, NM 87504-2048

Native Fish Restoration in the Rio Costilla Watershed, Taos County, New Mexico

February 18, 2006
2:00 – 4:00 p.m.
Rio Costilla Cooperative Livestock Association
Costilla, New Mexico

The purpose of this meeting is to inform the public of a proposed restoration of the native fish community in the Rio Costilla watershed. The Rio Grande cutthroat trout is a management priority for New Mexico Department of Game and Fish as this sub-species of cutthroat trout inhabits less than 10% of its original range in New Mexico. The New Mexico Department of Game and Fish, in cooperation with the U.S. Fish and Wildlife Service, Vermejo Park Ranch, Rio Costilla Cooperative Livestock Association, and the U.S. Forest Service, proposes to remove non-native fish and restore Rio Grande cutthroat trout, and where appropriate Rio Grande chub, Rio Grande sucker, and longnose dace, to the upper Rio Costilla watershed. After completion, Rio Grande cutthroat trout range will be expanded by approximately 150 stream miles, 25 small lakes, and the Costilla Reservoir. Other native fishes will inhabit a subset of the project area where habitat is suitable. Project implementation is expected to take between 10 to 15 years. This leaflet is intended to answer questions about the restoration project in the Rio Costilla watershed.

Q. *Why are Rio Grande cutthroat trout such a management priority?*

A. The Rio Grande cutthroat trout is New Mexico's state fish. Once widespread throughout mountain streams and lakes in southern Colorado and New Mexico, the range of Rio Grande cutthroat trout has declined as a result of past over-fishing, non-native fish introductions, and habitat degradation. Current distribution of Rio Grande cutthroat trout is limited to small, isolated headwaters. The current distribution has increased concern for the long-term persistence of Rio Grande cutthroat trout throughout its historic range. Management efforts seek to expand the range of Rio Grande cutthroat trout into larger, connected habitats which will help secure the long-term persistence of the subspecies in New Mexico.

Q. *What is the concern about continued distribution declines and long-term persistence of Rio Grande cutthroat trout?*

A. Rio Grande cutthroat trout are native to the Rio Grande, Pecos River, and Canadian River drainages and represent an important element of our state's natural history. Also they provide a unique angling resource only found in the southwest. If the subspecies continues to decline across its historic range, it is likely to be listed as a threatened or endangered species under the Federal Endangered Species Act which would likely affect angling and resource development throughout New Mexico.

Q. What is the nature of the fishery management problem?

A. Non-native fish need to be removed from Rio Grande cutthroat trout habitat within the project area for the subspecies to be secure from further declines in distribution. Non-native trout such as brook trout and brown trout out-compete Rio Grande cutthroat trout and have replaced Rio Grande cutthroat trout populations throughout New Mexico. Non-native trout such as rainbow trout readily hybridize with Rio Grande cutthroat trout. Non-native suckers compete with Rio Grande cutthroat trout and also need to be removed. The current fishery in the Rio Costilla watershed includes Rio Grande cutthroat trout, brook trout, brown trout, rainbow trout, cutthroat trout hybrids, longnose sucker, white sucker, and longnose dace.

Q. What alternatives have been discussed to correct the fishery management problem?

A. Prospective actions that could be used to remove non-native fish from the project area include angling, electrofishing and netting, deployment of a piscicide, or some combination of these actions. Upon successful removal of unwanted fish, Rio Grande cutthroat trout will be restocked into the area.

Q. Which fishery management technique is most likely to correct the fishery management problem?

A. Deployment of a piscicide is the technique most likely to be successful for correcting the fishery management problem. Complete removal of unwanted fish is essential for project success.

Q. Why is a piscicide most effective for removing unwanted fish species?

A. Piscicides are the most widely used management technique that consistently removes all unwanted fish from a stream or lake. Electrofishing and angling are not 100% effective because of the ability of fish to evade electrofishing and angling methods.

Q. What is a piscicide?

A. A piscicide is a pesticide that is particularly toxic to fish. There are two types of piscicides available for fisheries managers, rotenone and antimycin.

Q. What is rotenone?

A. Rotenone is a naturally occurring compound that is derived from the roots of a tropic plant in the pea family. People have used rotenone compounds worldwide to stun and kill fish. Several commercial formulations are available and have been approved for fishery management use by the U. S. Environmental Protection Agency.

Q. What is antimycin?

A. Antimycin is a naturally occurring compound that is derived from *Streptomyces* bacteria. People have used antimycin as a piscicide since 1963. Only one commercial formulation is available, Fintrol, and has been approved for fishery management use by the U.S. Environmental Protection Agency.

Q. *Are piscicides harmful to people when used as a fishery management tool?*

A. No. At the concentrations of rotenone used to remove fish, a 154-pound person would have to consume more than 20,000 gallons of rotenone treated water in 24 hours to receive a lethal dose. At concentrations of antimycin used to remove fish, a 154-pound person must consume more than 40,000 gallons of antimycin-treated water in 24 hours to receive a lethal dose. A recent study on rats documented no observable effects from being fed antimycin for 90 days. A 150-pound individual would have to drink 898 gallons of antimycin-treated water for 90 days straight to consume a dosage that was shown to have no effect on rats. Long before a person would have the opportunity to consume such quantities of water, the piscicides will have degraded to non-toxic byproducts, and thus it is extremely unlikely such doses are possible under field conditions. Studies indicate that rotenone and antimycin do not cause adverse carcinogenic, teratogenic, reproductive, or mutagenic effects. The U.S. Environmental Protection Agency has concluded that the use of rotenone and antimycin does not present a risk of unreasonable adverse effects to humans or the environment.

Q. *How long will piscicide treatments take?*

A. The entire project will require 10 to 15 years to complete. The project will be subdivided to facilitate implementation and actual treatments in a subsegment will take several days to weeks to complete in a given year. Restoration efforts will be limited to only a fraction of the project area in a given year, and thus, angling opportunities will still be available within the project area.

Q. *Do piscicides affect all aquatic animals the same?*

A. No. Fish are more susceptible. All animals have natural enzymes in the digestive tract that degrade piscicides. Organisms such as fish, some life-stages of amphibians, and aquatic insects are more susceptible to piscicides because they are gill-breathing animals, and thus, the digestive enzymes cannot degrade the piscicides. Although some aquatic insect numbers are reduced by piscicides, studies have demonstrated that aquatic insects quickly repopulate an area after piscicide treatment.

Q. *Will wildlife that eat dead fish and drink treated water be affected?*

A. No. A bird weighing one-quarter pound would have to consume 100 quarts of treated water or more than 40 pounds of fish and invertebrates within 24 hours to receive a lethal dose of rotenone. To be safe, field staff will collect and bury dead fish to prevent consumption of piscicide exposed fish.

Q. *Will wildlife species be affected by the loss of their food supply following a piscicide treatment?*

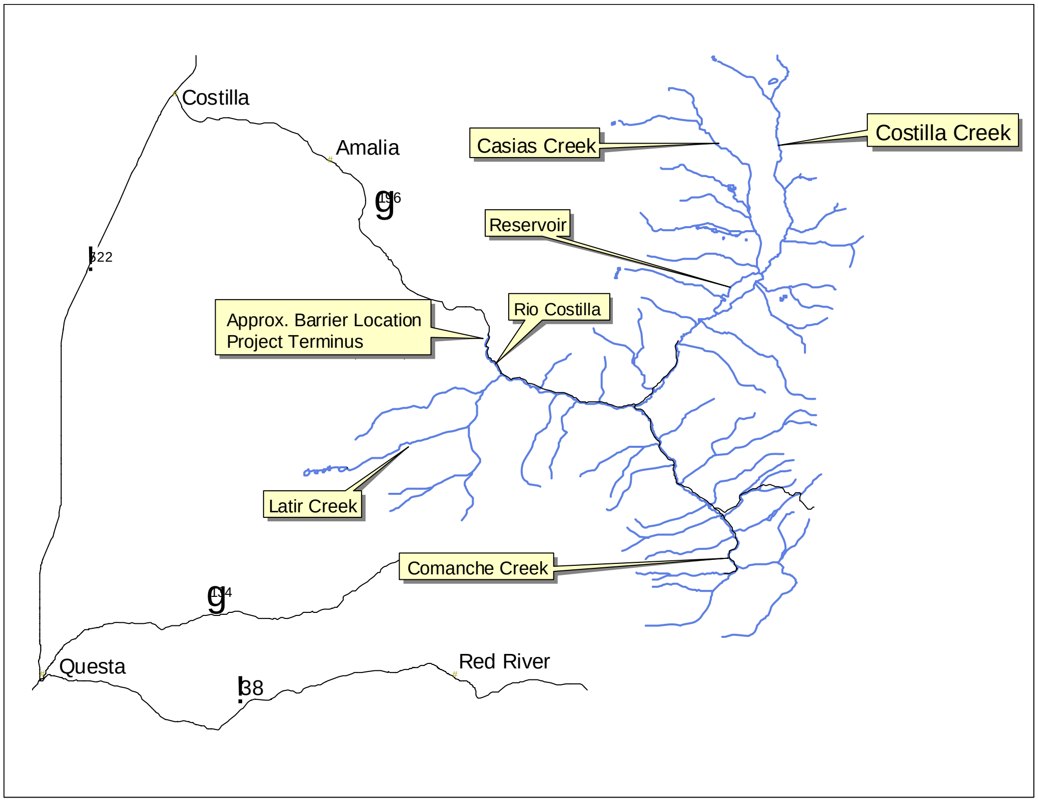
A. There will be a temporary decline in food supplies (fish and aquatic macroinvertebrates) though most wildlife in the area are mobile and will seek forage in other areas. In addition, only sections of the project area will be temporarily affected by reduced food abundance at a particular time.

Q. *What are some of the short-term effects of the proposed restoration project?*

A. Short-term effects include 1) temporary change in water quality, 2) temporary loss of fish, 3) temporary loss of recreation, and 4) temporary reduction of aquatic invertebrates.

Q. *What are some of the long-term effects of the proposed restoration project?*

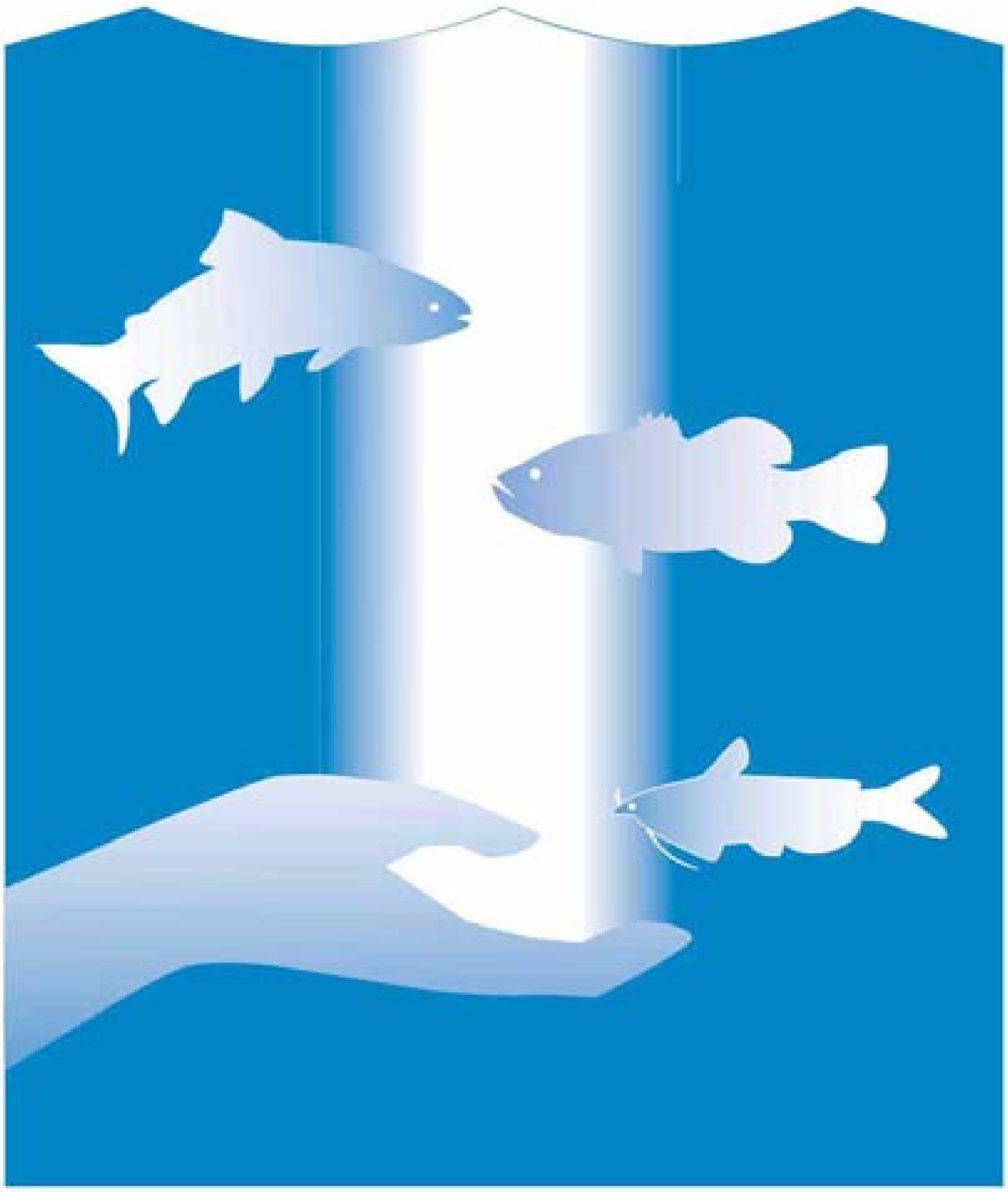
A. Long-term effects include 1) high-quality angling opportunities for native trout, 2) increased tourism and commercial benefits as anglers visit to fish for a unique southwestern trout, 3) expanding the range of interconnected populations of Rio Grande cutthroat trout and other native fishes, and 4) reducing the likelihood of listing Rio Grande cutthroat trout as threatened or endangered under the Federal Endangered Species Act.



Costilla
Amalia
Casias Creek
Costilla Creek
Reservoir
Approx. Barrier Location
Project Terminus
Rio Costilla
Latir Creek
Comanche Creek
Questa
Red River

Better Fishing Through Management:

How Rotenone Is Used to Help Manage
Our Fishery Resources More Effectively.



Americans love to go fishing!

In fact, we love it so much that each year, more than 35 million people go fishing. We spend 626 million days and more than $38 billion annually in pursuit of this favorite pastime.

As our population grows, the demand for quality fishing also increases. Anglers continue to bring high expectations to already heavily impacted aquatic areas. Unfortunately, the number of available ponds, lakes, and rivers is limited.

State and Federal resource agencies are entrusted with the task of maintaining healthy aquatic environments, protecting our bodies of water from misuse, and balancing the demands made by navigation, commercial, residential, recreational, and environmental activities. Since the likelihood of creating new water areas is very low, agencies in charge of fishery resources must manage existing resources to assure that the environment continues to thrive and to ensure that our fisheries are not depleted.

Active intervention may be required to maintain a healthy aquatic balance, such as stocking desirable fish or eradicating fish that threaten ecosystems. Careful management will be required if our waters are to provide the quality fishing we want and still ensure that future generations will be able to enjoy the same privilege. This includes continued existence of desired aquatic species and main-tenence of a sufficient resource to support a reasonable sport fishery. Fish managers rely on a wide variety of tools for the management and assessment of fish populations to maintain diverse and productive aquatic ecosystems and high quality recreational fisheries. One of the most valuable tools is rotenone, which has been used by fish managers since 1934. Rotenone is a naturally occurring substance derived from the roots of tropical plants in the bean family. Rotenone has been used for centuries to capture fish for food in areas where these plants are naturally found.

This publication discusses how rotenone is used in fisheries management, presents scientific evidence that rotenone is safe to use, and lists the precautions that have been taken to assure the safety of rotenone to people and to the environment. Its purpose is to provide information based on research findings that will help you better understand the use of rotenone as a treatment and sampling aid.

USE OF ROTENONE

The use of rotenone and other fish management substances is the only method, other than complete draining, that will eliminate entire populations of fishes. However, dewatering is not a viable option in any stream and most lakes. Complete elimination of fish is often needed to accomplish fish management activities such as eradicating undesirable or harmful exotic fish, eradicating competing fish in rearing facilities, treating drainages prior to impoundment, restoring threatened or endangered species, and eliminating fish to control diseases. Also, rotenone is the only sampling method that provides for an accurate estimation of diverse fish communities.

To be acceptable, a fish management substance must work quickly, break down in a short period of time, and leave no harmful residues. It must not pose a health hazard to those applying, or to animals or birds that might consume treated water or organisms. It also must not affect aquatic plants or deplete the dissolved oxygen in the water. After application, the substance must break down rapidly so populations of non-target organisms can quickly recover from any short-term adverse effects and allow early restocking of desired fish species.

Rotenone meets all these requirements and is the best option to restore waters to a natural balance and provide a quality fishing experience. Rotenone offers an effective means of eradicating unwanted fish species without endangering the surrounding habitat.

ROTENONE: THE APPROVAL PROCESS

Before rotenone can be used in the environment, it must be registered by the U.S. Environmental Protection Agency (EPA). In order for a fish management substance to be registered, research must be

A busy afternoon at the Strawberry Reservoir marina, Utah. It provides in excess of 1,000,000 angler hours annually following the 1990 rotenone treatment.

PHOTO: [illegible], Utah Department of Wildlife Resources conducted to show that the product does not constitute a health hazard or have a long-term effect on humans or the environment. If a substance meets these requirements after years of rigorous testing, it is then considered safe for use in the environment and is registered.

The U.S. Fish and Wildlife Service conducted extensive testing on rotenone in a 10-year period from 1978 to 1988. More than $3 million was invested in developing the data required by the EPA as part of its evaluation process. Rotenone has met all of the safety requirements and is currently registered for fishery uses. The EPA concluded that the use of rotenone for fish management does not present a risk of unreasonable adverse effects to humans or the environment.

State approval is also necessary before fish management substances can be lawfully used; however, the registration process varies for each state. Generally, rotenone must be registered for aquatic use with the state agency charged with this responsibility (usually a state agricultural or environmental agency). In addition, the state agency responsible for management of the natural resources also has policies and procedures governing the use of rotenone in that state. Further, the American Fisheries Society (an organization of professional fisheries scientists) has developed and published a manual to guide fisheries managers in the safe and effective use of rotenone (*Rotenone Use in Fisheries Management: Administrative and Technical Guidelines Manual*).

SUCCESS STORIES

Benefits of Large Reservoir Restoration of Trout Fishery with Rotenone

For almost a century, Strawberry Reservoir has been Utah's most important trout fishery. Rotenone treatments have played a major role in this success. Although the reservoir was constructed to provide water for agriculture, it quickly became a major trout fishery. The fishery was managed with rainbow, cutthroat, and brook trout. A typical opening weekend supported in excess of 50,000 angler hours of fishing recreation. By the late 1950's the fish population was dominated by Utah chub, Utah sucker, yellow perch, and carp. These nongame species were introduced into the reservoir through illegal use of live bait, and fishing recreation was seriously impacted. The Utah Division of Wildlife Resources (UDWR) treated the reservoir with rotenone to remove all fish in 1961. The treatment was successful and the trout fishery quickly recovered.

In 1975, fishing pressure was estimated at 900,000 angler hours. However, Utah chub were again found in the reservoir in 1973, and Utah sucker reappeared in 1978. By 1986, the fishery was providing only about 250,000 to 300,000 angler recreation hours, and about 95% of the reservoir's production was nongame fish. The UDWR began planning another rotenone treatment in 1986 that was completed in 1990. The volume of water treated was about 300,000 acre-feet and 880,000 pounds of powdered and 4,000 gallons of liquid rotenone were used in the treatment. Bear Lake strain cutthroat trout, rainbow trout, and kokanee salmon were restocked and the fishery quickly recovered. For eight years following the treatment, the fishery has provided from approximately 1,000,000 to 1,500,000 angler hours of recreation annually and is again Utah's most important trout fishery.

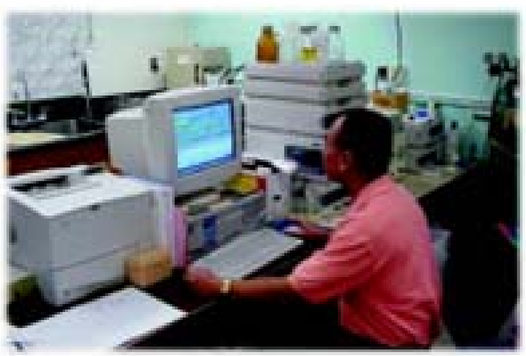


PHOTO: Robert Hovey, California Department of Fish and Game

Concerned with maintaining environmental quality, a chemist with the California Department of Fish and Game analyses water samples for rotenone concentrations using a high performance liquid chromatograph.

Benefits of Threatened Trout Restoration with Rotenone in California

California is home to 12 species or subspecies of native trout, three of which are Federally-listed as threatened species, including the Lahontan cutthroat trout, Paiute cutthroat trout, and Little Kern golden trout. Due to habitat changes, bull trout are no longer found in California. Although habitat degradation has played a significant role in native trout population declines, impacts from competing species and hybridization have resulted in near extinction of certain native trout species.

Since the 1970's, rotenone has played a key role in eliminating non-native trout species, primarily in the Sierra Nevada mountains. The strategy has been to chemically treat the headwaters of drainages with rotenone above fish barriers to remove non-native trout species that compete or hybridize with native trout. After that, native trout are reintroduced to the reclaimed habitats. To date, a total of 10 waters have

A very happy angler showing-off the rainbow trout she caught from Strawberry Reservoir, Utah's most important trout fishery.

PHOTO: ScotBow

been successfully treated and restored with genetically pure native trout populations. Five of these waters now have Lahontan cutthroat trout, two have Paiute cutthroat trout, one has Little Kern golden trout, one has California golden trout, and one has McCloud River redband trout. Six of the treatments removed non-native brook trout which have a history of displacing California native cutthroat trout in streams. One treatment removed non-native brown trout, which was a voracious predator on California golden trout. The remaining three treatments removed rainbow trout, a native to California, but not in the treated streams. Rainbow readily hybridize with cutthroat trout, golden trout, and redband trout, compromising their genetic integrity.

The Truckee, Walker, Carson, Kern, and McCloud River drainages have been the sites for these successful restoration projects, along with the North Fork of Cottonwood Creek. Several of the restored waters are now open to catch-and-release fishing, allowing unique opportunities for anglers to catch and appreciate these rare and beautiful native trout. More rotenone projects are planned with the ultimate goal of recovering enough native trout populations to delist the three species currently listed and make future listings unnecessary. Future project benefits are increased native species biodiversity in California trout populations and improved angling opportunities.

Benefits of Pond Reclamation with Rotenone in New York

Rotenone has been used since the early 1950's in New York to restore brook trout populations. Approximately 150 waters have been treated. Recent restoration projects have focused on perpetuation of native Adirondack strains of brook trout. Following successful removal of competitors, brook trout ponds typically are capable of supporting several times the number of trout than prior to treatment. The resulting improvement in fishing quality is often dramatic. In many cases, the brook trout populations become self-sustaining and only require one or two introductory stockings of fingerling fish. Many anglers highly value the opportunity to catch wild heritage brook trout. Pond reclamation with rotenone has been shown to have restoration benefits beyond those to the fish fauna. Cornell University researchers documented that restoring native fish communities had cascading effects on zooplankton and phytoplankton communities.

The new community structures were consistent with native communities, unlike those in ponds that were dominated by non-native fishes.

QUESTIONS AND ANSWERS

From time to time, people have questions about the use of rotenone to manage fish communities and sample populations. They want to know, "Has rotenone been adequately tested to assure our safety and protect the environment?" The answer is "Yes." Below are questions that have been raised in the past and the answers to those questions based on scientific evidence and studies.

GENERAL INFORMATION

Q. What other uses are there for rotenone?

A. Rotenone is used as an "organic" garden insecticide to control chewing insects, has been used as a dust on cattle, and as a dog and sheep dip to control external parasites.

Q. How does rotenone work?

A. Rotenone inhibits a process at the cellular level making it impossible for fish to use the oxygen absorbed in the blood and needed in the release of energy during respiration.

Use of rotenone in Fisheries Management

Q. Why use rotenone to manage fish communities?

A. Sometimes managers need to eradicate an entire population or communityof fishes and replace them with a desirable population or community. Rotenone can be used to accomplish these objectives with minimum impact to non-target wildlife.

Q. What other methods are used to control fish?

A. The other methods include (1) modifications of angling regulations, (2) physical removal, (3) biological control, (4) draining, water fluctuation, and stream flow augmentation, (5) fish barriers, and (6) explosives. These methods are often too slow, ineffective, expensive and labor intensive and produce unpredictable results.


PHOTO: Les Demong, New York Department of Environmental Conservation

Fly casting for heritage eastern brook trout on Black Pond, Adirondacks, New York. Rotenone is a critical tool in maintaining the wild heritage brook trout fishery.

Q. Why use rotenone to sample fish communities?

A. Biological information is often necessary for the development of management strategies for fish communities. The use of rotenone is often the only sampling method that enables managers to take a snapshot of a fish population at a specific time and makes it possible to clearly follow growth and abundance of the restocked fish.

Q. What other methods are used to sample fish communities?

A. The other methods include (1) electrofishing, (2) nets, (3) explosives, (4) underwater observations, (5) hook and line, and (6) sonar. These methods often have limitations restricting sampling to certain sizes of fish, type of habitats, and weather conditions. These limitations often limit the effectiveness of these other methods.

Q. How is rotenone applied?

A. Rotenone is applied either as a powder made from ground-up plant roots, or as a liquid. Rotenone is very water insoluble (i.e., like oil). Liquid formulations of rotenone contain additional materials (dispersants and emulsifiers such as naphthalene, methylnaphthalenes and xylenes) that aid in the dispersal of rotenone throughout the water column.

Q. Why is rotenone treatment cost effective?

A. It has been estimated that for each dollar spent on rotenone and stocked trout, anglers gained from \$32 to \$105 worth of fishing. On trout lakes that were stocked but not treated, the gain from fish stocking alone was only \$10 to \$15.

Q. How much rotenone is used?

A. Treatment rates range from 0.5 to 10.0 parts per million (ppm) of the commercial products. Because commercial products contain only 2.5% to 5% of rotenone, the actual concentration in the water is only 0.012 to 0.250 ppm of rotenone. The commercial products are most commonly applied at a concentration 1.0 to 2.0 ppm (0.025 to 0.100 ppm of rotenone). The 1 ppm rate is 1 part of the commercial formulation in 1,000,000 parts of water; or the 2 ppm rate is roughly equivalent to 1.3 ounces of the commercial formulation in a 5,000-gallon swimming pool.

Q. How do fisheries biologists determine when it is safe to restock fish?

A. The simplest test used by most fishery specialists is to place several fish in a cage and hold them in the treated water for several days. If they survive, the water is safe for restocking. Analytical techniques can also be used to determine how much rotenone is still present.

PUBLIC HEALTH

Q. How safe is rotenone to people?

A. Millions of dollars were spent on research to determine safety of rotenone prior to registration by the U.S. Environmental Protection Agency (EPA). The EPA concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment when used according to label instructions.

Q. What is a safe exposure level for rotenone?

A. The National Academy of Sciences has suggested a safe level in drinking water of 0.014 ppm of rotenone. The California Department of Health Services has suggested 0.004 ppm of rotenone. These safe levels assume a lifetime exposure to rotenone. For comparison, most rotenone treatments result in exposure levels within the range of 0.012 to 0.25 ppm of rotenone, but rotenone generally persists for no longer than a few weeks, making lifetime exposure highly unlikely.

Q. Is there any danger associated with accidentally drinking rotenone-treated water?

A. The hazard associated with drinking water containing rotenone is very slight because of the low concentration of rotenone used in the treatment (0.012 to 0.25 ppm of rotenone) and the rapid breakdown of rotenone. Estimates on the oral toxicity to humans are 0.023 to 0.039 ounces of rotenone per pound of body weight. Hence, a 160-pound person would have to drink more than 23,000 gallons of water treated at 0.25 ppm of rotenone at one time to receive an effect.

Q. Can rotenone-treated water be used for public consumption or irrigation of crops?

A. Tolerances for rotenone in drinking and irrigation water have not yet been established by EPA even though the studies required for setting tolerances have been completed. This does not mean that rotenone concentrations in drinking or irrigation waters is actually unsafe; it just means that the EPA has not established rotenone tolerances at this time. As a result, water containing residues of rotenone cannot be legally allowed for use as a domestic water source or on crops.

Q. Are there any risks to human health from non-rotenone materials in the powdered formulation?

A. No, the non-rotenone material in the powdered formulations is inert plant root material.

Q. Are there any risks to human health from materials in the liquid rotenone formulations?

A. The EPA has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment. Liquid rotenone formulations contain trace amounts of the carcinogen trichloroethylene (TCE). However, the TCE concentration in water immediately following treatment (less than 0.005 ppm of TCE) is below the level permissible in drinking water (0.005 ppm of TCE), and these levels quickly dissipate within a few days.

Q. How soon can people safely enter water treated with rotenone?

A. The EPA concluded that a reentry interval was not needed for persons who swim in waters treated with rotenone based on an assessment of the toxicology data and exposure level. The EPA said there was no reason to restrict the use of rotenone in waters intended for livestock consumption and recreational swimming.

Q. Is there any risk to public health from airborne rotenone?

A. No public health effects from rotenone use as a fish management substance are known. The use of the powder and liquid formulations have been monitored for airborne drift into adjacent areas. The highest rotenone concentrations that were monitored during a treatment were approximately 1,000-fold lower than the estimated safe level of rotenone in air.

Q. Why can't we eat fish killed by rotenone?

The EPA has not established guidelines for consuming fish killed with rotenone. There is a valid concern of salmonella and other bacteriological poisoning that may occur from consuming fish that have been dead for a period of time. However, fish that end up on land as a result of wave or wind action are no more a threat to public health than fish that die of natural causes.

Q. Why is there no risk to people from consuming fish that have been stocked into a recently treated water body?

A. Fish are not stocked into a treated area until rotenone has neutralized. Hence, stocked fish cannot accumulate residues of rotenone from the water. Residues of rotenone in tolerant fish that survive a rotenone treatment will not last for more than several days because the fish quickly metabolize and excrete rotenone.

ENVIRONMENTAL QUALITY

Q. Why are there no problems with dead and decaying fish on the recovery of fishing?

A. Most dead fish will sink in several days to the bottom of the treated body of water, decompose, and release nutrients back into the water. These nutrients will directly stimulate phytoplankton and indirectly stimulate insect and zooplankton pro-

6.

duction. These organisms are a good food base for fish.

Q. How can the effects of rotenone to fish and other aquatic life be neutralized?

A. If biologists want to quickly neutralize the effects of rotenone in lakes or rivers, potassium permanganate can be used. Potassium permanganate is an oxidizing agent. This substance is used worldwide in treatment plants to purify drinking water.

Q. What is the smell sometimes associated with the use of liquid rotenone formulations?

A. The aromatic (mothball) smell associated with the use of liquid rotenone formulations is from naphthalene and methylnaphthalene. This smell may last for several days, depending on air and water temperatures and wind direction. These compounds remain close to the ground and move down-wind. There are no health effects from this smell.

Q. What happens to rotenone after it has been applied?

A. Rotenone is a compound that breaks down very rapidly when exposed to light, heat, oxygen, and alkaline water. Ultimately, rotenone breaks down into carbon dioxide and water.

Q. How long does rotenone's effects persist?

A. Rotenone is generally neutralized in lakes in less than four weeks and in running waters in a matter of hours. The time for natural neutralization of rotenone is governed primarily by temperature. Studies show that rotenone completely degrades within one to eight weeks within the temperature range of 50°F to 68°F.

Q. How long do the materials other than rotenone persist from liquid formulation treatments?

A. Researchers have found most of the other ingredients in the liquid formulations degrade more rapidly than rotenone through exposure to light, heat, oxygen, and alkaline waters. Many of these materials are the same as those found in fuel oil and are commonly in water because of frequent use of outboard motors and motorized personal watercraft. None of these materials pose a health hazard at the concentrations available in the environment from any rotenone treatment.

Q. Why is rotenone unlikely to enter ground water and pollute water supplies?

A. The ability of rotenone to move through soil is low. This is because rotenone is strongly bound to organic matter in soil so it is unlikely that rotenone would even enter ground water. Monitoring studies in ground waters adjacent to treatment areas have found no contamination associated with rotenone treatments.

Q. Why are there no degradation products from rotenone that can cause environmental problems?

A. The degradation product rotenolone can persist longer than rotenone, especially in cold, alpine lakes. To err on the side of safety, fish stocking would be delayed until both rotenone and rotenolone residues have completely dissipated. Since rotenolone has less effect than rotenone, it poses even less risk to human health and the environment than rotenone.

FISH AND WILDLIFE

Q. How does rotenone affect aquatic animals?

A. All animals including fish, insects, birds and mammals have natural enzymes in the digestive tract that neutralize rotenone, and the gastrointestinal absorption of rotenone is inefficient. However, fish (and some forms of amphibians and aquatic invertebrates) are more susceptible because rotenone is readily absorbed directly into their blood through their gills (non-oral route). Studies have shown that amphibians and invertebrates will repopulate an area when rotenone neutralizes.

Q. Will wildlife that eat dead fish and drink treated water be affected?

A. Birds and mammals that eat dead fish and drink treated water will not be affected. Rotenone residues in dead fish are generally very low, are broken down quickly, and not readily absorbed through the gut of the animal eating the fish.

Q. How will wildlife species be affected by the loss of their food supply following a rotenone treatment?

A. During treatments, fish-eating birds and mammals can be found foraging on dying and recently dead fish for several days following a treatment. Following this abundance of dead fish, a temporary reduction in food supplies may result until the fish and invertebrates are restored. However, most of the affected species are mobile and will seek alternate food sources or forage in other areas.

Q. What about the loss of food supplies to sensitive nesting birds?

A. The temporary loss in food resources for sensitive animals during mating may cause unavoidable impacts. Agencies have mitigated an impact to nesting bald eagles during mating by removing their eggs from the nest to an approved eagle recovery program out of the area. Likewise, some agencies have delayed treatments until young birds have matured and forage elsewhere.

ADDITIONAL INFORMATION

Q. How can more information be obtained on the fishery uses of rotenone and its effects on the environment?

A. An excellent source of information is the *Rotenone Use in Fisheries Management: Administrative and Technical Guidelines Manual* published by the American Fisheries Society. It is available on its website at www.fisheries.org/rotenone. The manual will be updated periodically as new information becomes available.

SUMMARY

Rotenone is an important fisheries management tool that has been used successfully for almost 70 years in the United States and Canada. Its use is carefully regulated to protect the safety and well being of the public and the environment. Most rotenone projects are supported by specific management plans that define the objectives and expected results. Although there may be some short-term losses of fishing opportunities when rotenone is used, the benefits greatly outweigh the losses because the use of rotenone restores balance to the fish community.

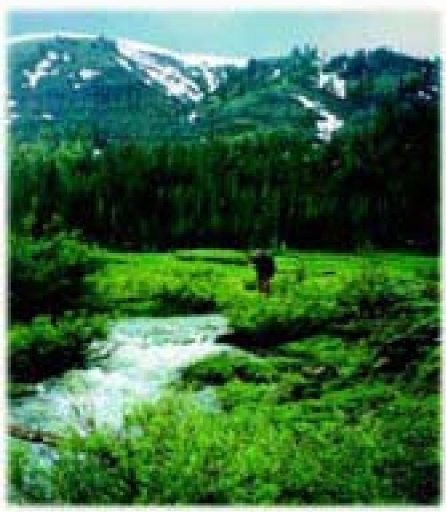


PHOTO: Roger Bloom, California Department of Fish and Game

Fly casting for Lahontan cutthroat trout on the Upper Truckee River, Sierra Nevada Mountains, California. This catch-and-release fishery allows the unique opportunity for anglers to catch and appreciate these rare and beautiful trout.

Prepared by American Fisheries Society
Fish Management Chemicals Subcommittee
Task Force on Fishery Chemicals

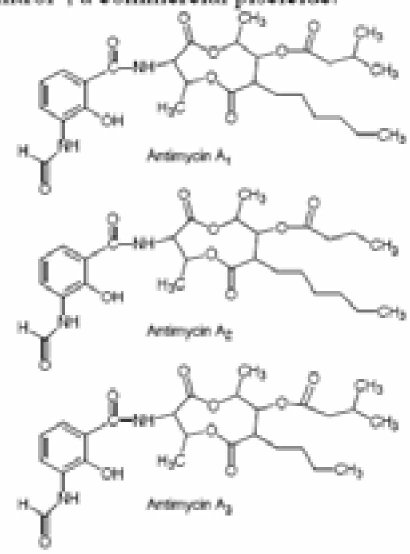
This document was made possible with funds provided by U.S. Fish and Wildlife Service, Division of Federal Aid.

DESIGN: Duane Toutjian, Creative Services

Antimycin. A Brief Review of It's Chemistry, Environmental Fate, and Toxicology.

Kevin C. Ott, Ph.D[‡]

What is Antimycin? Antimycin is the active ingredient in Fintrol®, a commercial piscicide.



Antimycin is a mixture of closely related molecules produced by *Streptomyces* bacteria. Antimycin A_1 was first isolated during the 1940's, and its molecular structure determined a few years later. Antimycin (used to refer to all of the antimycin variants collectively) is an antibiotic that was found to be a potent inhibitor of fungal growth (hence the name), while most bacteria are unaffected. Because of its antifungal properties, antimycin was of interest for potential commercial applications in agriculture. This interest led to a significant number of studies about its mechanism of action, and development of synthetic chemical approaches[1] to prepare the compound. It wasn't until the early '60's that antimycin was found to be highly toxic to fish, which over the last 40 years has led to antimycin being used in a large number of fisheries conservation projects across the US and in New Mexico. It is also used as a commercial fish toxicant to rid catfish farms of undesirable rough fish.

Why is Antimycin Toxic to Fish? Through mechanistic studies, molecular biologists have determined that antimycin is a highly specific inhibitor of respiration. Antimycin interrupts mitochondrial electron transport mechanism that most respiratory and photosynthetic organisms utilize in the uptake of oxygen to support metabolic function. The mitochondrial electron transport complex of proteins is very similar across all species that utilize oxygen. Antimycin interacts at a very specific site in the series of protein structures that make up the electron transport complex. Biochemists utilize this specific binding of antimycin to shunt electron flow and to study the chemical details of oxygen respiration. From these studies, much is known about the details of how antimycin binds to the enzyme site, down to the molecular level and the specifics of how side chains on antimycin influence the binding to the electron transfer protein site.[2] Antimycin binds tightly to a pocket in one of four of the main electron transport proteins. Antimycin binds at the site where ubiquinol, also called coenzyme Q, normally binds to shuttle electrons to O_2 that is bound at an adjacent iron-containing enzyme. Because the electron shuttle is blocked at this point, the bound oxygen is converted to superoxide, a very reactive form of

‡Kevin Ott is a chemist at LANL. He obtained his Ph.D. in physical organometallic chemistry at Caltech in 1982.

[1] F. M. Strong *et al*, "The Chemistry of Antimycin A. IX. The Structure of the Antimycins", J. Am. Chem. Soc.**1960** *82*, 1513.
[2] H. Kim *et al*, "Structure of Antimycin A1, a Specific Electron Transfer Inhibitor of Ubiquinol-Cytochrome *c* Oxidoreductase", J. Am. Chem. Soc. **1999**, *121*, 4902.

oxygen. Superoxide builds up at a rate so high that the cell cannot decompose the superoxide fast enough, overwhelming the cell and leading to cell death.

Cyanide is also an electron transport inhibitor and impacts respiration. Its mechanism of toxicity is significantly different than antimycin. Cyanide binds strongly at an iron site in an adjacent protein, preventing oxygen from binding at all, and so respiration is inhibited, leading to cell death.

Synthetic chemists have manipulated the formyl salicylic acid and dilactone portions of the molecule and studied the binding of the resulting molecule to the electron transport protein.[3,4] They found that these two portions of the molecule are crucial for binding of antimycin to the electron transfer protein target, and hence the toxicity. The side chains are less important. If the dilactone portion is removed entirely, the binding and hence the toxicity is reduced by a very large amount. Thus, the products of antimycin decomposition (see below) are substantially less toxic that antimycin, or non-toxic, particularly at the ppb levels that are generated in the use of antimycin as a piscicide.

How toxic is Antimycin? Antimycin is not poisonous to a broad spectrum of species the way cyanide is. Antimycin toxicity is quite species dependent and varies widely, likely due to subtle species-specific differences in the protein sequence at the ubiquinol binding site that in turn alter the degree of binding and hence the toxicity. Antimycin is in general very toxic to fish, as the route to ingestion of antimycin in fishes is precisely the route with which oxygen is adsorbed – through the gills. Other animals that are not gill breathers are much less susceptible, as ingestion is primarily through the gut, where degradation can take place, reducing quickly the amount that may impact respiratory function. Antimycin is exceedingly toxic to certain fishes, but not to all fishes at the same concentrations. So it can be used as a selective fish toxin. This is the basis for its use in catfish farming – catfish are relatively insensitive to antimycin, and so catfish farmers use antimycin to rid their ponds of fish they are not interested in farming.

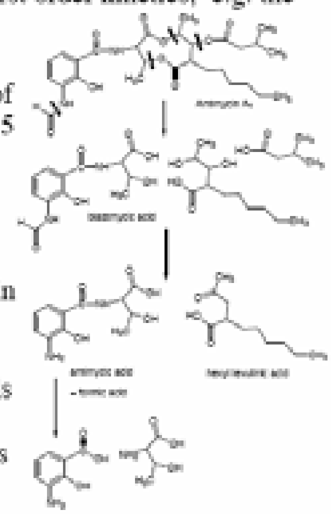
Trout are among the most sensitive of fish to antimycin. Only 5-10 micrograms of antimycin in one liter of water (5-10 parts per billion, ppb) is lethal to trout exposed to antimycin for 2-4 hours, the typical treatment time involved in a trout eradication project. Once exposed to this concentration of antimycin, trout will die.

Once it is in the water, how long does it last?

Antimycin is very susceptible to decomposition reactions that result in detoxification. There is a good deal of literature on the products and kinetics of antimycin hydrolysis under realistic conditions of use. A summary of the degradation chemistry follows.[5] Hydrolysis occurs at the lactone carbonyl sites, leading to blastmycic acid and a fatty acid lactone that hydrolyses to hexyl levulinic acid. Blastmycic acid further hydrolyses to antimycic acid and formic acid; the antimycic acid may further hydrolyse to aminosalicylic acid, a relative of aspirin, and an amino

[3] N. Tokutake *et al*, "Structural Factors of Antimycin A Required for Inhibitory Action", Biochimica et Biophysica Acta **1185**, 271 (1994).
[4] H. Miyoshi *et al*, "A Model of Antimycin Binding Based on Structure-Activity Studies of Synthetic Antimycin A Analogues", *ibid* **1229**, 149 (1995).
[5] T. D. Hubert and L. J. Schmidt, "Antimycin A Use in Fisheries: Issues Concerning EPA Registration", USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI, 2001.

acid. The degradation kinetics of antimycin exhibit well-behaved first order kinetics,[6] e.g. the concentration of antimycin decays exponentially with time. The rates of detoxification *via* hydrolysis are a function of pH, water hardness, temperature, the degree of exposure to sunlight, amount of organic debris in the stream, and other additives.[3, 4, 7, 8] At a pH of 7.5 and a temperature of 17 °C in reconstituted water in the dark, the half-life of antimycin is reported to be 93 hours. Studies of the kinetics of decomposition of antimycin in natural waters are more difficult, as the rates of decomposition are much higher because antimycin readily photolyses in sunlight, and also because antimycin is sensitive to oxidation and oxidizes quickly in well-oxygenated water. In direct sunlight, the half-life decreases to 20 minutes to 2 hours depending on the temperature and degree of aeration, which is related to the stream gradient. Because of the short lifetime in natural waters, application of antimycin in streams is a challenge, as the toxicity may decay quickly below concentrations that are lethal to fish as the compound is carried down the stream. Practitioners make up for this by adding more antimycin to the stream at pre-determined locations downstream in the treatment area.



It is exceedingly difficult to measure with accuracy any organic chemical in natural systems at the ppb level, particularly in the field, because of the plethora of other naturally occurring organic compounds that are in the water that arise from the decomposition of organic matter in the stream – leaves, algae, dead animals, fish, etc. And of course, samples on the way to a laboratory to be analyzed continue to decompose as described above. Currently the best assay in the field is to use the known toxicity of antimycin to yeast or fish; this bioassay may be performed reliably to an antimycin concentration of .03 ppb. Methods for accurate quantification of antimycin at ppb levels that can be performed rapidly in the field are desired, and would be very valuable in tailoring the application of antimycin to the water column.

Practitioners of antimycin fish eradication utilize the sensitivity of antimycin to oxidation to eliminate antimycin at the bottom of the treatment range in the stream. A potent oxidant is added to the stream, and any remaining antimycin is oxidized and detoxified quickly. The oxidant chosen for this use is potassium permanganate. Permanganate is often used in municipal water treatment plants for drinking water production, particularly in locales where treatment with chlorine is inappropriate. The byproducts of permanganate treatment are highly insoluble manganese oxides. The concentrations of permanganate used to destroy antimycin are on the order of 1 ppm, but this depends upon conditions in the stream that are assessed by the practitioner. The residual concentration of manganese in the water is at a low level, and is below

[6] A. Hussain, "Kinetics and Mechanism of Hydrolysis of Antimycin A_1 in Solution", J. Pharm. Sci. **58**, P316 (1969).
[7] R. A. Schnick, "A Review of the Literature on the Use of Antimycin in Fisheries", A report from the Fish Control Laboratory, La Crosse, WI, April 1974, US Fish and Wildlife Service.
[8] B. J. Finlayson *et al*, "Assessment of Antimycin A Use in Fisheries and Its Potential for Reregistration", Fisheries **27**, 10 (2002).

the safe daily required amount of intake recommended for humans as a required nutrient (see below).

Does Antimycin Bioaccumulate?

Many pesticides are persistent in the environment, and they also concentrate in tissues of living animals because of favorable solubility characteristics of the chemical in certain tissues or organs as has been observed, regrettably, with DDT. Antimycin does not exhibit such properties, as it rapidly degrades in aqueous environments to non-toxic, readily biodegradable fragments. Because of the concentrations that are employed, coupled with the fact that antimycin is very likely to be decomposing *in vivo* at even higher rates than in the stream, and the difficulty in assaying the compound in water much less tissue samples, detailed studies on the accumulation of antimycin in tissues have not been performed in any number. There is one study that used radiolabeled antimycin[9] to assess bioaccumulation. The ability to detect radioactivity is straightforward and sensitive, and so is often used in cases such as this. Still, the results are open to interpretation, as any radioactivity detected may arise from not only antimycin, but from any of its degradation products as well. Nonetheless, assuming the entire amount of radioactivity that was detected in this study is due to antimycin, the authors determined that antimycin does not bioaccumulate in fish to a concentration above what was in the stream. This is reasonable given what is known about antimycin decomposition. Antimycin is readily susceptible to cleavage at its amide bonds. The digestive tract of most living things contain ample numbers and varieties of proteases, enzymes that are designed to cleave amide bonds for the hydrolysis of proteins in food to break them down to amino acids that are then consumed metabolically or reused and recycled into proteins in the body. These same proteases will likely rapidly hydrolyse antimycin into its constituent pieces, rendering it harmless, and allowing for efficient excretion. This is also one reason why antimycin is not as toxic to animals other than fish. The respiratory system of fish are exposed very directly to antimycin through their rapid and efficient contact of water with their gills; in mammals and many other animals, ingestion into the gut will likely detoxify much of the antimycin. Compounds that do bioaccumulate typically do so because there is no metabolic route to decompose them to readily excretable fragments.

What about toxicity in other species?

An excellent source of information on the toxicity of antimycin, and a wide variety of common pesticides and other chemicals of commerce is available on the Pesticide Action Network (PAN) website.[10] The database maintained by PAN has over 850 entries of peer-reviewed toxicology studies of antimycin in a variety of aquatic organisms. Toxicity studies of antimycin in mollusks, insects, fish, amphibians, nematodes, zooplankton, and phytoplankton are summarized along with literature references to the studies. While this document is not intended to be a comprehensive review of the toxicology data available, a few entries from the PAN database for antimycin are shown to give an indication of relative toxicity of antimycin in several species. Note that these concentrations refer to exposure for a period of 24 hours, to contrast with the 2-4 hour toxicity typically planned for piscicidal applications as discussed above. The longer exposure time requires lower concentrations to achieve a lethality of 50%. Note that just within

---

[9] E. Greselin and F. Herr, "Further Toxicity Studies with Antimycin, a Fish Eradicant", J. Agr. Food Chem. **22**, 996 (1974).
[10] : Pesticide Action Network Database: http://www.pesticideinfo.org

the fishes, toxicity varies over 3 orders of magnitude. Mollusks and amphibians appear to have greater tolerance to antimycin.

Species	LC_{50}/24 hours exposure	LC_{50}/96 hours exposure
Trout	.07 ppb, Cutthroat	.04 ppb, Rainbow
Black Bullhead Catfish	200 ppb	45 ppb
Channel Catfish	>10 ppb	9 ppb
Goldfish	1 ppb	
Snails	>800 ppb	
Tiger salamander	>1080 ppb	
Tadpoles, Leopard Frog	45 ppb	10 ppb

Tadpoles are unaffected at piscicidal concentrations of antimycin in the 4 hr treatment time anticipated in practice; salamanders are similarly unaffected after an 8-hour exposure to piscicidal concentrations.[11]

Grant Grisak (Montana Fish, Wildlife, and Parks) is publishing a recent study of the toxicity of antimycin and rotenone on Columbia spotted frogs, long toed salamander larvae and adults, and tailed frog tadpoles. In a draft report[12], the authors report the 'No observed effect levels' (NOEL) for Columbia spotted frogs, long-toed salamander larvae, and tailed frogs after 96 hours exposure to antimycin (table below). At the minimum concentration of exposure they used in their study of 7.5 ppb, 15% of the tadpoles perished after 96 hours, and so the determination of a NOEL for tadpoles could not be determined. Upon exposure to *300 ppb* antimycin, only 5% of the tadpoles died after 8 hours of exposure. These data indicate that at piscicidal concentrations and anticipated application times of antimycin (10 ppb, <8 hrs), that the risk to tadpoles is small. To mitigate this remaining risk, it is common for practitioners to delay treatments until tadpoles have metamorphosed, or physically remove the tadpoles from the stream until after treatment.

Species	Life stage	96 hr No Observed Effect Level Antimycin ppb
Columbia spotted frog	Adult	60
Long-toed salamander	Larvae	15
	Adult	
Tailed frog	Tadpole	<7.5

[11] S. Moore *et al*, "Environmental Assessment for Using a Piscicide for Brook Trout Restoration", Great Smoky Mountains National Park (March, 2000).
[12] Grant G. Grisak, Gary L. Michael, Donald R. Skaar, Mark E. Schnee, Brian L. Marotz, and Mark Maskill, "Laboratory Investigations on the Toxicity of Antimycin and Rotenone to the Westslope Cutthroat Trout, Columbia Spotted Frog, Long Toed Salamander, and Tailed Frog" Preprint, May 2005.

In mammals, toxicity is measured as the dose required for lethality in half the population measured in mass of toxin per mass of mammal.

Mammal	LD_{50}, mg/kg
Rat	28
Mouse	25
Lamb	1-5
Dog	>5
Rabbit	10

To put this in context, a half-kilogram rat (about 1 pound) would have to consume 14 milligrams of antimycin to have 50% chance of achieving a lethal dose. If the rat drank 10 ppb antimycin containing water (approximately the concentration intended for trout eradication), the rat would have to drink 14mg/10microgram/liter, or 1,400 liters (370 gallons) of water to achieve a lethal dose. This is clearly not achievable in many rat lifetimes.

However, long before the rat would have a chance to drink that much antimycin treated water from a stream, the antimycin would have decomposed to non-toxic byproducts, and thus it is extremely unlikely that mammals or birds could consume a lethal dose from a treated stream; this is indeed what has been observed. The toxicity to birds is similar to mammals; no effects were observed on exposure of ducks, herons, gulls, and terns to 10 ppb antimycin.[13]

What is known about the impact of antimycin on aquatic insects?

The literature of the toxicity of antimycin to aquatic insects is a difficult topic to assess. The large number of species of insects that may reside in a stream, and the fact that stream insect population makeup can vary significantly depending on location, stream flows, temperatures, etc. have made gaining a consistent set of data a large and difficult task. Reports of toxicity to antimycin vary widely at different locales. Studies in Wisconsin that indicate sensitive insect populations (<50ppb) are found to be insensitive in Wyoming. Some of these differences may be ascribed to differences in water temperatures in these two particular locales, but this is likely to be only one parameter that is involved in the observed differences.

The study of antimycin impact on aquatic insects is one area where the literature is rather sparse in part because of the diversity of insect life found in streams in different geographical locations makes such studies very site specific; more site specific studies may be necessary to better define the impact of antimycin on non-target insect populations in proposed treatment areas. As an example, consider the following result from antimycin treatment of three closely spaced lakes in Wisconsin: " … it is very difficult to relate a change in abundance of a benthic organism to the chemical treatment. For example, the estimated number of Chironomidae in Camp Lake showed a considerable increase in abundance following treatment while in Lamereau Lake the data showed the opposite to be true and in Nancy Lake the number stayed at the same level. If

[13] P. A. Gilderhus *et al*, "Field Trials of Antimycin A as a Fish Toxicant", USFWS Investigations in Fish Control, 27 (1969).

abundance was related to chemical treatment, all three lakes should have shown the same trend."[14]

Post-treatment studies of insect populations have indicated that populations decline, but are not decimated. Populations rebound quickly after an antimycin treatment. Recruitment from adjacent, non-treated waters is thought to contribute to the observed rapid rebound in insect populations, often beyond what was observed prior to the removal of the exotic, non-native fishes. A post-treatment study on Sam's Creek in Great Smoky National Park indicated a decline of 40-50% of the insect population, but that the population rebounded in 5 months to above what it was prior to treatment, partly because of the absence of over-predation by non-native trout.

In a recent study in Wyoming on the effect of antimycin treatment on insect populations in high altitude streams, researchers report "Antimycin alone had little to no effect on invertebrates, with drift rates and bioassay mortality not significantly different than control sites. We did not observe major invertebrate reductions in the benthos after antimycin addition. Antimycin alone appears to have little short-term effect on invertebrates in high elevation streams."[15]

What about human exposure to chronic, non-lethal concentrations of antimycin treated water?

The sub chronic effects to humans from antimycin exposure have been estimated from toxicology studies using mice, a common approach to defining acceptable risk for a wide variety of compounds including pharmaceuticals. Literature estimates of subchronic safe levels of antimycin exposure have been developed using EPA risk assessment protocols.[16] Toxicity studies aimed at determining these values develop a concentration where there is a "No Observed Adverse Effect Level" (NOAEL) of exposure determined in mice. The EPA protocol prescribes a method to apply a 'safety factor' in interpreting the mouse data for use in extrapolating to the toxicity in humans and computes a reference dose, RfD, that is the upper limit of antimycin that could be consumed daily for the rest of ones life without observable effects. Using the values of NOAEL for antimycin determined by toxicology studies to be 0.5 mg/kg/day,[17] and a very conservative value for the risk factor of 300, the RfD for antimycin has been estimated to be 1.7 micrograms/kg/day. This is the estimated and conservative safe dose. For a grown adult weighing 70 kg (154 pounds) who consumes the average daily intake of 2 liters of water (a little more than a half gallon), the safe concentration of antimycin in that water that this adult could consume for life is 1.7 micrograms/kg/day x 70 kg / 2L/day, which is 60 micrograms per liter, or 60 ppb. Thus, an adult could safely drink his daily intake of water for the rest of his life with no adverse effects from an antimycin treated stream, and again, this is based upon the most conservative value of RfD found in the literature. Montana's Division of Environmental Quality

---

[14] Beard, Thomas D. "Impact of repeated antimycin treatments on the zooplankton and benthic organisms in Camp, Lamereau and Nancy lakes, Bayfield County, Wisconsin, Research report Wisconsin. Dept. of Natural Resources, Report 78, Madison, Wisconsin: Dept. of Natural Resources, (1974); available at: http://digital.library.wisc.edu/1711.dl/EcoNatRes.DNRRep078

[15] K. M. Cerreto *et al*, "Antimycin and rotenone: short-term effects on invertebrates in first order, high elevation streams", Abstracts of the NABS Annual Meeting, Vancouver, British Columbia, 2004, Disturbance Ecology 1.

[16] Taken from "Draft EIS, Flathead Westslope Cutthroat Trout Project", Chapter 3 (June 2004).

[17] J. O. Kuhn, "Final Report. Acute Oral Toxicity Study in Rats", Stillmeadow, Inc., Submitted to Aquabiotics Corp. (March 2001).

determined "there would be no effect on human health even if the chemicals (antimycin and rotenone) were not detoxified, did not break down, and people drank the "contaminated" water continuously for the rest of their lives."[18] In the State of New Mexico, a very conservative approach has also been considered, using a daily intake of 4L/day for a 70 kg adult, with similar conclusions.[19]

What is known about the toxicity of other components of Fintrol®?

Antimycin is insoluble in water. To be effective, it must be solubilized with the aid of other compounds, such as detergents. The commercial product Fintrol® contains acetone, diethyl phthalate, and nonoxynol-9 to aid in the solubilization of antimycin in water.

Nonoxynol-9 is a non-ionic detergent used commercially in surgical scrubs as an antiseptic, and as an intravaginal spermicide. Acetone is a common solvent. Many recognize it as fingernail polish remover. Diethyl phthalate is a component of plastics, and it makes plastics pliable. It is also a common ingredient in cosmetics, hand lotions, and other personal care products.

Fintrol®, when mixed with Fintrol® Diluent, results in a mixture containing approximately 12.5% antimycin, 57% acetone, 8.5% nonoxynol-9 detergent, and 15 % diethyl phthalate, and 7% soy lipids. When antimycin is delivered at 10 ppb, this results in concentrations of approximately 13 ppb diethyl phthalate, 50 ppb acetone, and 7 ppb nonoxynol-9. The toxicology of these compounds has been studied, and safe reference doses have been determined[20] and are summarized in the table below. Based upon the published data, the application of Fintrol® as a piscicide at the concentrations of its intended use does not create any concern to human health according to assessments by the US EPA.

Fintrol® components at concentration of intended use	Antimycin 10 ppb	Diethyl phthalate 13 ppb	Acetone 50 ppb	Nonoxyl 9 7 ppb	Manganese 1 ppm
RfD (from EPA documents)	1.7μg/kg/day	800μg/kg/day	900μg/kg/day	30μg/kg/day	140μg/kg/day
Fraction of RfD, 2L/day water, 70kg human	17%	0.05%	0.16%	0.7%	20%
Quantity water required to be consumed to equal RfD	12 L (3.2 gals)	4300 L (1136 gals)	1260 L (333 gals)	300 L (79 gals)	10 L (140 L/37 gals)

Included in the table above is the estimate of a safe reference dose for manganese from permanganate that is used for the destruction of antimycin at the lower end of the treatment range in the stream. The amount is less than the recommended daily dose of manganese as an essential nutrient in the human diet.

[18] Taken from "Cherry Creek Native Fish Introduction Project EA", Helena, MT (1999)
[19] Sworn testimony of Dr. Stephen Wust, Division Director, Water and Waste Management, NM Environmental Department, NM Water Quality Control Commission, (August 12, 2004).
[20] Source: EPA's Integrated Risk Information System (IRIS) site: www.epa.gov/iris/

Are there teratogenic or mutagenic properties of antimycin or any of the other components of Fintrol® or permanganate?

There are a few studies of the mutagenicity of antimycin. In one study of the mutagenicity of antimycin using a mouse lymphoma model[21], negative results were found at a concentration of 20 millimolar (equivalent to *11 parts per thousand*), a concentration one million times greater than the concentration of antimycin used in trout eradication. A search of the literature for teratogenic effects of antimycin resulted in no hits.

Diethyl phthalate (DEP) has yielded negative results in mammalian cell chromosomal aberration assays. [22] According to EPA, DEP is a 'group D' compound, meaning inadequate or no human and animal evidence for carcinogenicity has been found. EPA has set the drinking water equivalent level (DWEL) for DEP for a safe lifetime, non-cancer dose to be 30 mg/L, or 30,000 ppb.[23]

Carcinogenicity studies of acetone at concentrations ranging from 10,000 to 70,000 ppm have been negative; "To date there are no epidemiological studies demonstrating an association between exposure to acetone and increased risk of cancer".[24]

Studies of nonoxynol 9 have not triggered EPA's categorization to date, as there is not enough compelling evidence to do so.[25]

Is antimycin, or other components of Fintrol®, considered endocrine disruptors?

Endocrine disruptors affect the endocrine system that regulates a number of metabolic processes. An EPA web site states "Evidence suggests that environmental exposure to some anthropogenic chemicals may result in disruption of endocrine systems in human and wildlife populations. A number of the classes of chemicals suspected of causing endocrine disruption fall within the purview of the U.S. Environmental Protection Agency's mandates to protect both public health and the environment. Although there is a wealth of information regarding endocrine disruptors, many critical scientific uncertainties still remain". There are no coherent lists of endocrine disruptors, nor any 'official' lists at this time because of lack of supporting data.

---

[21] J. Wangenheim and G. Bolcsfoldi, Mutagenesis **3**, 193 (1988).
[22] Source: EPA's Integrated Risk Information System (IRIS) site: www.epa.gov/iris/
[23] 2004 Edition of the Drinking Water Standards and Health Advisories, EPA 822-R-04-005, Office of Water, U.S. Environmental Protection Agency, Washington DC
[24] Source: EPA's Integrated Risk Information System (IRIS) site: www.epa.gov/iris/
[25] *ibid*

Appendix D. Categorical Exclusion for Comanche Creek RGCT Management Barrier.

Decision Memo

Comanche Creek Fish Barrier – FR 1950 Culvert Replacement

USDA Forest Service
Questa Ranger District, Carson National Forest
Taos County, New Mexico

BACKGROUND, PURPOSE & NEED

The Carson National Forest, Questa Ranger District proposes to replace an existing road culvert located at the crossing of Comanche Creek and Forest Road 1950 about 100 yards below the confluence of Little Costilla Creek and Comanche Creek, which when replaced will serve as a fish barrier for the mid to upper reaches of Comanche Creek.

The culvert replacement will limit the upstream movement of non-native fish, thereby protecting current populations of Rio Grande cutthroat trout (Oncorhynchus clarki virginalis) (RGCT), in Comanche Creek and its tributaries. A fish barrier is needed to restrict the upstream passage of non-native trout above the barrier and protect the existing RGCT population as non-native trout will out-compete RGCT for food and space, as well as cause RGCT to lose their genetic purity over time due to cross breeding with non-native rainbow trout.

Rio Grande Cutthroat trout are a native trout of New Mexico and south-central Colorado. The RGCT is found in only certain cold water streams in the State. The current distribution of RGCT is reduced, occupying only a percentage of its historic range and now limited to small, isolated headwater streams in the mountainous areas of the State. There is a risk, if nothing is done to stop and reverse this trend, these trout could become a federally listed species and afforded the protection as authorized under the Endangered Species Act. Lawsuits have been filed against the US Fish and Wildlife Service to list this species under the Endangered species Act.

By itself, Comanche Creek and its tributaries provide habitat for RGCT on 50+ miles of stream. The proposed culvert replacement will protect against further degradation of RGCT population in the upper reaches of Comanche Creek.

The Comanche Creek drainage is being evaluated by the New Mexico Department of Game and Fish (NMGF) as part of a larger effort to restore RGCT into historical habitat. The NMGF is completing a RGCT restoration analysis in partnership with various government agencies and private landowners for certain streams and lakes within the Rio Costilla Drainage on Vermejo Park and the Rio Costilla Cooperative Livestock Association private lands.

It should be noted though that the Comanche Creek culvert replacement is not directly, indirectly or cumulatively affected by the NMGF's proposal to reintroduce RGCT throughout much of Costilla Creek and its tributaries. The reinstallation of the culverts to provide a fish barrier is intended to protect existing RGCT populations within the drainage regardless of actions taken by the NMGF. Management of fish populations are the responsibility of NMGF, if at some time in the future a restoration is done and it is decided that a barrier at the proposed location is no longer needed to protect RGCT populations above it , the barrier will be removed/replaced to allow fish passage.

Again, the proposed action is to replace an existing road culvert at the crossing of Comanche Creek and FR 1950, which when replaced will also serve as a fish barrier.

Project Location: The project area is located in T30N, R15E, Section 35. (See attached map).

DECISION, RATIONAL, LEVEL OF DOCUMENTATION

I have decided to authorize the replacement of an existing road culvert at the crossing of Comanche Creek and FR 1950. This decision does require specific mitigations measures, as follows:

Water Quality Mitigation:

1. 404 and 401 water quality certifications will be attained from the Corp of Engineers and New Mexico Environment Department, respectively, prior to project implementation. All requirements of the 404 and 401 permits will be met.
2. Sediment retention materials, such as sediment screens and straw bales, will be used to prevent soil movement into the creek.
3. The culvert replacement and splash pad construction will occur during a time of low flow in Comanche Creek.
4. All disturbed areas will be mulched and seeded following culvert replacement/splash pad construction.

Public Access Mitigation

1. Culvert replacement may require that FR 1950 be temporarily closed during removal and installation activities. Signs notifying the public of this temporary road closure will be posted as follows: a. Turn-off of SH 522 and SH 196. b. At the entrance to RCCLA lands. c. At the west side entrance to the Valle Vidal. d. At Clayton Corral. Forest Road 1950 may be temporarily closed for up to 20 minutes during culvert replacement and splash pad construction.

CATEGORY:

This project is categorically excluded from documentation in an Environmental Assessment (EA) or Environmental Impact Statement (EIS). The project is covered under Forest Service Manual (FSM) 1909.15, Chapter 30, Section 31.2, Categorical Exclusion Category #7, "Modification or maintenance of stream aquatic habitat improvements using native materials or normal practices."

According to this regulation, this action may be categorically excluded from documentation in an Environmental Impact Statement (EIS) or Environmental Assessment (EA), when there are no extraordinary circumstances.

These include the following:

a. No erosive soils or steep slopes will be affected.

b. It was determined that this action will have "no effect" on any federally listed threatened or endangered species or habitat.
c. It was determined that this action will not affect heritage resources.
d. It was determined that this action will not affect any flood plains, wetlands, or municipal watersheds.
e. This proposal is not associated with any congressionally designated areas.
f. This proposal will not affect any inventoried roadless area.
g. This proposal will enhance the delivery of Forest products or services provided to area residents and visitors.

PUBLIC INVOLVEMENT (SCOPING)

The proposal was provided to the public and other agencies for comment via a scoping letter dated February 7, 2005 to agencies, groups, adjacent private landowners, and persons who had shown an interest in this type of project on Questa Ranger District. Two written comment(s) was/were received, a letter of support from the Truchas Chapter of Trout Unlimited and a reply letter from NMED. No negative or adverse comments were received.

FINDINGS REQUIRED BY OTHER LAWS

This action is in compliance with all Federal, State, and local laws and requirements imposed for the protection of the environment.

This proposal is consistent with direction in the ***Valle Vidal Multiple Use Guide***, the ***Carson Forest Land and Resource Plan***, and the ***NMGF Draft Rio Grande Cutthroat Management Plan***, and complies with the Federal Land Policy and Management Act of 1976.

> This action is consistent with the Valle Vidal Multiple Use Guide. Guidelines include "Management Emphasis….Special emphasis is placed on providing a diverse and high quality wildlife and fisheries resource…" "Implement soil and water conservation measures…to insure maintenance and improvements of watershed conditions." "Fish and wildlife habitat will be managed to maintain viable populations of exisiting native and non-native vertebrates." "Manage the unit in a manner which will maintain, protect, and enhance the habitat…" And, "Manage riparian areas to protect the productivity and diversity of riparian dependent resources…"
>
> This action is consistent with Forest Plan sections Riparian and Wildlife And Fish Habitat. Guidelines include; "Riparian…is probably the single most critical management area on the Carson… In brief, riparian zones are important to many users." Wildlife guidelines include; "Improve T&E and sensitive species habitat." "Manage sensitive species not already on federal lists, to sustain viability and prevent listing as threatened or endangered." And, "Continue activities to improve Rio Grande Cutthroat habitat…"
>
> This action is consistent with NMGF Draft Rio Grande Cutthroat Management Plan. Guidelines include "Protect populations from non-native salmonids by securing barriers on all conservation populations. Work with land management agencies to improve barriers and construct new barriers as needed."

This Decision complies with the National Historic Preservation Act of 1966 as amended (4), the Endangered Species Act of 1973 (5), the Clean Water Act, and the Clean Air Act (5). This Decision also complies with Executive Order 12898 for Environmental Justice, which is it does not disproportionately and adversely affect human health or environment of any minority or low-income population.

CUMULATIVE EFFECTS

In consideration of other past, present and future activities, this proposal will not cumulatively contribute any adverse environmental, social/cultural, and/or economic effects.

ADMINISTRATIVE REVIEW OR APPEAL OPPORTUNITIES/IMPLEMENTATION

This decision, pursuant to 36 CFR 215.8 (a) (4), is not subject to appeal and may be implemented immediately.

CONTACT PERSON:
For further information regarding this project contact Forest Fisheries Biologist Juan Martinez (505-758-6200) or District Ranger Ron Thibedeau, (505-586-0520), Questa Ranger District, P.O. Box 110, Questa, NM 87556.

Ron Thibedeau
District Ranger

3/28/05
Date

Appendix E. History of Stocking and Native Fish Restoration within the Project Area.

Waters within the upper Rio Costilla watershed are known for providing a high quality angling experience. Much of this watershed has been privately owned until the Valle Vidal unit of Carson National Forest was donated to the U.S. Forest Service, Carson National Forest, in 1982. Historic fishes occurring with the upper watershed were Rio Grande cutthroat trout, Rio Grande sucker, Rio Grande chub, and longnose dace. Flathead chub and fathead minnow were likely present in lower portions of the watershed (Sublette et al. 1990). Rio Costilla Dam was constructed below the confluence of Casias Creek and Costilla Creek to store water for irrigation purposes and later enhanced in the 1980s. A 4.8 mile segment of the Rio Costilla was leased by NMDGF from the RCCLA in 1986 to provide public angling access for a term of 30 years. The Latir Lakes were leased by NMDGF from the RCCLA in the past though public access is currently obtained for a fee. Vermejo Park Ranch was purchased by Turner Enterprises, Inc. in 1996. The current cutthroat trout state record (10 lb. 2 oz.) came from the Latir Lakes in 1981. All waters have been managed as coldwater fisheries and provide excellent angling opportunities for native or non-native trout.

Stocking History

First records of stocking within the project area documented stocking of rainbow trout into Latir Creek in 1912 and brook trout into Comanche Creek and the Rio Costilla in 1915. Since that time, waters within the project area have been stocked with a variety of species ranging from brown trout, brook trout, Yellowstone cutthroat trout, Native black spotted trout, New Mexico cutthroat trout, Rio Grande cutthroat trout, and rainbow trout. Recent stocking (past 10 years) of non-native trout has been limited to rainbow trout in the lower reaches of the Rio Costilla (NMDGF) and Latir Lakes (RCCLA). Rio Grande cutthroat trout were stocked as recently as 2004 into the upper Costilla Creek drainage after a successful piscicide restoration.

Native Fish Restoration

Two piscicide projects within the project area have removed non-native trout and reestablished Rio Grande cutthroat trout populations.

<u>Powderhouse Creek</u>
Powderhouse Creek contained a sympatric population of RGCT and brook trout. Brook trout were becoming dominant in the creek and their removal was necessary to preserve the RGCT population. Electrofishing surveys conducted in 1995 revealed that brook trout were seven times more abundant than RGCT above the existing fish barrier. On 3 separate occasions brook trout were removed from this section of stream. A total of 3,000 brook trout were removed. Despite these removals of brook trout, the project leaders decided that complete removal of all brook trout with electrofishing would not be possible.

NEPA requirements were completed to support the Powderhouse Creek restoration and a decision notice was released. In the fall of 1997 Fintrol was deployed into Powderhouse Creek to eliminate the unwanted brook trout. The treatment covered a stream distance of 6 km. Carson National Forest and NMDGF staff electrofished and removed RGCT from the stream. Approximately 340 RGCT were held in a hatchery transport truck during the treatment. An additional 160 brook trout and 50 RGCT were removed with the piscicide application.

After the creek was re-electrofished and found to be free of any fish, RGCT were removed from the hatchery transport truck and returned to Powderhouse Creek. Surveys in 2000 and again in 2004 indicate this population of RGCT has expanded and is self-sustaining.

Costilla Creek System

Fish species targeted in the upper Costilla Creek system included brook trout and hybrid cutthroat trout. NEPA documentation was completed and a decision notice released by the USFWS in 2002. The project area included East and West Fork Costilla Creek (in Colorado), Costilla Creek, State Line Creek, Glacier Creek, the three Glacier Lakes, and Number One Lake. Two man-made barriers were used to divide the project into segments (Figure 1). New Mexico Game and Fish Department in cooperation with the Colorado Division of Wildlife (CDOW) and VPR applied Fintrol to Costilla Creek and four lakes during the period July 22 to August 2, 2002 and one lake from June 24 to 25, 2003. Rio Grande cutthroat trout were restocked into Costilla Creek during the fall of 2002 followed by several stockings in subsequent years. Surveys in 2004 and 2005 indicate the population is reproducing and has reached pre-treatment abundance (C. Kruse, pers. comm.).

During a stocking event in 2004, staff from NMDGF and VPR discovered the presence of a few rainbow trout mixed in with the RGCT that were being stocked into the project area. Further investigation at the NMDGF Seven Springs Hatchery discovered the presence of additional rainbow trout in the hatchery system. Upon discovering this situation, staff from NMDGF, VPR and CDOW conducted electrofishing removals on three occasions in 2004 to determine the prevalence of rainbow trout within the project area. Approximately 50 rainbow trout were removed between the barriers during these removal efforts. No rainbow trout were collected above the upper barrier. In addition, two brook trout, probably survivors of the piscicide application, were collected between the barriers. No rainbow trout were collected within the project area in 2005.

Success of this project depends upon the area considered. The upper project area, upstream of the first barrier, is considered a secure population of RGCT and the project is a success (Figure 1). Downstream of this barrier, the area affected by the rainbow trout stocking, is tentatively considered a success but additional treatments may be necessary if any rainbow trout did survive and reproduce. Additional genetic testing in 2005 indicates the population between the barriers is a pure population of RGCT (NMDGF files). Because of this uncertainty, the section of stream located between the two barriers is included within the project area for the Rio Costilla restoration as future treatments may be required.

Figure 1. Rio Grande cutthroat trout restoration area on Costilla Creek, 2002.

Appendix F. Non-Native Fish Removal Techniques.

Meronek et al. (1996) reviewed available literature to determine the rate of success for various fish removal techniques. Among the projects using chemicals for removal of unwanted fish (similar size waterbodies as the proposed action), success rate of the project ranged from 94% to 40% depending upon waterbody size. By comparison, physical removal success rate ranged from 11% to 43%. Combination of physical and chemical techniques for fish removal increased the success rate to 100% though sample size was small. Below is a discussion of pertinent literature to better understand the rationale for selecting the proposed action.

Use of Electrofishing for Non-native Fish Removal

Electrofishing is commonly used for sampling fish in streams, lakes, and rivers. Generally, fish exposed to electric current are temporarily stunned, making them susceptible to capture, and recover quickly once removed from the electric field. Electrofishing efficiency depends upon water body type and size, water conductivity, power applied, species of fish, and netting efficiency. Electrofishing can cause adverse injuries to individual fish (McMichael 1993) though Kocovsky et al. (1997) noted no population level effects of annual electrofishing. Frequent exposure to electricity (>1 time per year) can reduce growth and condition (Thompson et al. 1997, Gatz et al. 1986).

NMDGF routinely removes non-native trout from RGCT streams to suppress the unwanted fish population (NMDGF files). Complete removal from biologically significant segments of streams (Hilderbrand and Kershner 2000) is unlikely and would require tremendous effort. Several factors affect electrofishing efficiency including cover and habitat complexity (Grant and Noakes 1987, Thompson and Rahel 1996), fish size (Reynolds 1989), and water depth (Riley and Fausch 1992). Habitat complexity greatly reduces the ability to remove fish as they are beyond the reach or line of sight of staff conducting the removals. Water depth limits the ability of staff to effectively stun and collect the fish. Small fish are not readily stunned by the electric current as are larger fish and thus capture efficiency is reduced. All of these factors combine to reduce the effectiveness of electrofishing for non-native fish removal.

Kulp and Moore (2000) successfully removed rainbow trout from an 898 m section of stream in Tennessee with a total of six passes through the system totaling 682 hours of effort. For comparison, 6,715 hours of effort were required to remove unwanted fish from 3.8 km of stream over an eight year period in a stream near the Kulp and Moore study site (Moore et al. 1986). The authors noted that electrofishing was successful for suppressing populations of unwanted fish though complete eradication would require additional methodologies.

Use of Gill Nets for Non-native Fish Removal

Knapp and Matthews (1998) developed criteria for assessing whether non-native trout could be eradicated from high mountain lakes and thereby reducing the need to use piscicides. Their criteria were applied to the lakes within the project area to determine the likelihood of success of mechanical removal (Table 1). Among the lentic waterbodies that are currently suitable habitat for fish (23), four waterbodies (17%) meet their minimum criteria proposed as characteristics that would allow eradication of trout by means of gill nets. Of these four waterbodies, several are adjacent to waterbodies that do not meet their criteria and could be reinvaded by non-native trout should conditions permit.

Table 1. Comparison of morphometric characteristics of lentic waterbodies within the Rio Costilla watershed to minimum characteristics proposed by Knapp and Matthews (1998) increasing the possibility of eradication with gill nets.

Lake Name	Area (acres)	Max. Depth (m)	Max Depth ≤ 6 m	Surace area ≤ 4.0 ha	Width of inlets ≤0.5 m	Width of outlet ≤ 1 m	Total area stream spawning habitat ≤ $1m^2$
Seven Lakes Lake 1	2.2	2.1	Y	Y	N	Y	Y
Seven Lakes Lake 2	1.9	4.7	Y	Y	Y	Y	N
Seven Lakes Lake 3	1.0	2.2	Y	Y	Y	Y	N
Seven Lakes Lake 4				Not currently fish habitat			
Seven Lakes Lake 5	4.0	8.5	N	N	Y	Y	Y
Seven Lakes Lake 6	0.8	3.7	Y	Y	Y	Y	Y
Seven Lakes Lake 7	1.5	2.7	Y	Y	Y	Y	N
Twin Lakes #1				Not currently fish habitat			
Twin Lakes #2				Not currently fish habitat			
Beaver Lake		Not Available	NA	N	N	N	N
Lake #2		Not Available	NA	Y	NA	NA	NA
Casias Lake 1	2.7	2.8	Y	Y	N	Y	N
Casias Lake 2	1.1	2.3	Y	Y	Y	N	N
Casias Lake 3	1.0	1.2	Y	Y	N	N	N
Casias Lake 4	1.5	5.8	Y	Y	Y	N	N
Costilla Reservoir			N	N	N	Y	N
Latir Lake 1	4.0	1.2	Y	Y	N	N	N
Latir Lake 2	0.7	0.9	Y	Y	N	N	N
Latir Lake 3	13.1	11.2	N	N	N	N	N
Latir Lake 4	4.6	3.3	N	N	N	N	N
Latir Lake 5	4.1	6.0	N	N	N	N	N

Latir Lake 6	1.6	1.4	Y	Y	Y	N	N
Latir Lake 7	2.0	2.4	Y	Y	Y	Y	Y
Latir Lake 8	3.1	3.3	Y	Y	Y	Y	Y
Latir Lake 9	10.8	12.8	N	N	Y	Y	Y
Little Blue Lake	2.8	10.8	N	N	Y	Y	Y

Summary of Chemical Treatments for Rio Grande Cutthroat Trout Restoration in NM.

Twelve projects in NM have used piscicides for Rio Grande cutthroat trout restoration (Table 2). Of those twelve projects, four projects resulted in unintended fish kills below the detoxification station. Project success has varied over time with non-native trout reinvading some sections of stream. Successful projects have increased Rio Grande cutthroat trout distribution by greater than 50 km of habitat and four small lakes.

Table 2. Summary of Rio Grande cutthroat trout restoration projects where piscicides were used.

Water Name	Year	Piscicide Used	Stream Length (km)	Problems with Treatment	Initial Purpose Achieved
Rio de las Vacas	1982	Rotenone	15	Fish kill below barrier	Yes
Nabor Creek and Nabor Lake	1982	Rotenone	2.2 (in NM)	None	Yes
Upper Pecos River	1992	Antimycin	5.2	None	Yes
Jacks Creek	1992	Antimycin	9.6	None	Yes
Rio Cebolla	1994	Antimycin	6.5	Fish kill below barrier	Yes
Doctor Creek	1996	Antimycin	1.0	None	Yes
Little Willow Creek	1997	Antimycin	6.1	None	Yes
Powderhouse Creek	1997	Antimycin	6.7	None	Yes
Poso Creek	1998	Antimycin	3.0	Fish kill below barrier	No
Leandro Creek	1998	Antimycin	4.8	Fish kill below barrier	Yes
South Ponil Creek	2000	Antimycin	11.2	None	Yes
Costilla Creek and three lakes	2002	Antimycin	21.0	None	Yes

Literature Cited

Gatz, A. J., Jr., J. M. Loar, and G. F. Cada. 1986. Effects of repeated electroshocking on instantaneous growth of trout. North American Journal of Fisheries Management 6:176-182.

Grant, J. W. A., and D. L. G. Noakes. 1987. Escape behavior and use of cover by young-of-year brook trout, *Salvelinus fontinalis*. Canadian Journal of Fisheries and Aquatic Sciences 45:1390-1396.

Hilderbrand, R. H., and J. L. Kershner. 2000. Conserving inland cutthroat trout in small streams: how much stream is enough? North American Journal of Fisheries Management 20:513-520.

Kocovsky, P. M., C. Gowan, K. D. Fausch, and S. C. Riley. 1997. Spinal injury rates in three wild trout populations in Colorado after eight years of backpack electrofishing. North American Journal of Fisheries Management 17:308-313.

Knapp, R. A., and K. R. Matthews. 1998. Eradication of nonnative fish by gill netting from a small mountain lake in California. Restoration Ecology 6:207-213.

Kulp, M. A., and S. E. Moore. 2000. Multiple electrofishing removals for eliminating rainbow trout in a small Appalachian stream. North American Journal of Fisheries Management 20:259-266.

McMichael, G. A. 1993. Examination of electrofishing injury and short-term mortality in hatchery rainbow trout. North American Journal of Fisheries Management 13:229-233.

Meronek, T. G., P. M. Bouchard, E. R. Buckner, T. M. Burri, K. K. Demmerly, D. C. Hatleli, R. A. Klumb, S. H. Schmidt, and D. W. Coble. 1996. A review of fish control projects. North American Journal of Fisheries Management 16:63-74.

Moore, S. E., G. L. Larson, and B. Ridley. 1986. Population control of exotic rainbow trout in streams of a natural area park. Environmental Management 10:215-219.

Reynolds, J. B. 1989. Electrofishing. Pages 147-163 *in* L. A. Nielsen and D. L. Johnson, editors. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

Riley, S. C., and K. D. Fausch. 1992. Underestimation of trout population size by maximum-likelihood removal estimates in small streams. North American Journal of Fisheries Management. 12:768-776.

Thompson, P. D., and F. J. Rahel. 1996. Evaluation of depletion-removal electrofishing of brook trout in small Rocky Mountain streams. North American Journal of Fisheries Management 16:332-339.

Thompson, K. G., E. P. Bergersen, R. B. Nehring, D. C. Bowden. 1997. Long-term effects of electrofishing on growth and body condition of brown trout and rainbow trout. North American Journal of Fisheries Management 17:154-159.

Appendix G. Description of Piscicide Use Effects on Water Quality, Human Health, Livestock and Wildlife

Technical Description of Effects of Fintrol (antimycin) on Water Quality, Human Health, Livestock, and Wildlife

Antimycin is a naturally occurring substance produced by *Streptomyces* bacteria. Walker et al. (1964 cited in Schnick 1974) reported antimycin toxicity to fish. Gill breathing organisms are more susceptible to antimycin due to the exposure pathway, gills. Alternatively, humans and terrestrial animals are typically exposed through the gastrointestinal tract. Antimycin acts as an inhibitor of cellular respiration (Schnick 1974). Cellular respiration is the process by which a cell uses oxygen to extract energy from organic acids with the production of CO_2. Antimycin interrupts cellular respiration by inhibiting electron transport between cytochrome b and cytochrome c in Complex III of the cellular respiratory chain (Potter and Reif 1952).

Antimycin decomposition is rapid and the initial products of breakdown are blastmycic acid and antimycin lactone (Hubert and Schmidt 2001). Final products of antimycin degradation are fatty acids (Hussain 1969) and these compounds have very low toxicity to either fish or mammals (Herr et al. 1976). Antimycin degradation rate increases with increasing pH; Marking and Dawson (1972) showed that antimycin had a half-life of 310 hours at pH of 6.0 and only 1.5 hours at pH 10 in 54º F water. Lee et al. (1971) demonstrated that exposure to sunlight decreased the half-life to as little as 20 minutes. Conditions within the study area indicate that antimycin breakdown and loss of toxicity would be rapid.

Direct ingestion of normal quantities of water containing 8-12 ppb antimycin during the peak of a treatment would have no effect on humans, wildlife, or livestock. Herr et al. (1967) found oral LD_{50} values for a variety of mammals ranging from 1.0 mg/kg for lambs to 55 mg/kg for mice. A 150-lb (68-kg) individual would have to consume 1,800 gallons (6,800 liters) of water during the treatment period (3 gallons/minute) to reach a dosage of 1.0 mg/kg – a consumption rate that is physiologically impossible and lethal in its own right. Much larger livestock would have to drink substantially more water. Antimycin has never been demonstrated to produce carcinogenic, teratogenic, mutagenic or fetotoxic effects.

Fintrol is 20% active antimycin. Other products include soy lipids, acetone, diethyl phthalate, and nonoxyl-9. Acetone is a ketone commonly used as a solvent, it is also a product of metabolism in the human body. The amount of acetone associated with a 10-ppb treatment would be less than 50 pp<u>b</u>. By comparison, federal regulations allow 30 pp<u>m</u> for acetone residues in food spices (21 CFR 176.210). Irritation to skin, eyes, and lungs are noted at 250-500 pp<u>m</u> (>1000 times the levels of treated water). There are no indications that acetone is carcinogenic (PAN Pesticide Database). Diethyl phthalate is used for packaging foods and naturally undergoes biodegradation by microorganisms. At common treatment levels (10 ppb of Fintrol) the levels of diethyl phthalate would be 13 ppb, which is well below EPA water quality criteria of 17,000 ppb (http://www.epa.gov/waterscience/criteria/wqcriteria.html). At a concentration of 10 ppb of antimycin, nonoxyl-9 levels would be approximately 7.3 ppb. Nonoxyl-9 (nonylphenol ethoxylate) is commonly used as a surfactant in detergents as well as an antiseptic in spermacides (Fintrol label directions, Adult Industry Medical Health Care Foundation 2002).

Water quality testing from a previous Fintrol project within the Costilla watershed documented only trace amounts of acetone or diethyl phthalate (Table 1). Of the five water quality samples collected post-treatment, only two contained diethylphthalate above detectable limits- 28.8 ppb post-treatment and 0.6 ppb 48 hours post-treatment. Only one of five post-treatment samples contained acetone at a concentration of 80 ppb.

Table 1. Volatile and Semivolatile Organic Compound Water Quality Results from the Upper Rio Costilla Restoration, July 2002. EPA method 8270 Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry was used to detect Diethylphthalate. EPA Method 8260 Volatiles by Purge and Trap Gas Chromatography Mass Spectrometry was used to detect Acetone.

Sample Site Name	Location	Time	Concentration (ug/L)	
			Acetone	Diethyl phthalate
Site A	Below Barrier	Pre-treatment	ND	ND
		Post-treatment	80	28.8
		48 hours Post-treatment	ND	ND
Site B	Lower Costilla Creek (downstream of site A)	Pre-treatment	ND	ND
		Post-treatment	ND	ND
		48 hours Post-treatment	ND	ND
Site C	Costilla Reservoir (downstream of Site B)	Pre-treatment	4.6	ND
		48 hours Post-treatment	ND	0.6

ND = Not detectable

Long-term persistence of antimycin or any components of Fintrol is unlikely. If chronic exposure was possible, a human drinking an average of 2L per day would still be well below a reference dose for antimycin (No Observed Adverse Effects Level of 0.5 mg/kg/day, risk factor of 300) or any of the components of Fintrol (EPA's Integrated Risk Information System (IRIS) site: www.epa.gov/iris/). That is, a human could consume these amounts of water everyday for the rest of that person's life without reaching the reference dose for antimycin or any Fintrol components (Table 2).

Table 2. Summary of Fintrol component concentrations, percent of reference dose, and daily quantity of water consumed to meet reference dose.

Fintrol Components at concentration of 10 ppb	Antimycin 10 ppb	Diethyl phthalate 13 ppb	Acetone 50 ppb	Nonoxyl 9 7 ppb
Fraction of RfD, 2/Liters/day, 70 kg human	17%	0.05%	0.16%	0.7%
Quantity of water required to be consumed to equal RfD	12 L (3.2 gal.)	4300 L (1136 gal.)	1260 L (333 gal.)	300 L (79 gal.)

A "reference dose"(RfD) is an estimate of "a daily exposure to the human population (including sensitive sub-groups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

<u>Consumption of Antimycin Killed Fish</u>

When orally ingested, enzymes in the digestive system break down antimycin. In Schnick's (1974) summary of antimycin toxicity, no studies found any effects of antimycin on birds and mammals at treatment concentrations. This review included studies assessing affects of treated water exposure and eating fish killed by antimycin. Ritter and Strong (1966) found that trout contain residual antimycin in tissues ranging from 76 to 388 ppb or µg/kg. Herr et al. (1967) calculated an oral LD_{50} for quail (*Colinus* sp.) of 39 mg/kg. Thus, if quail were to eat antimycin killed trout that maintained the highest antimycin residue (388 ppb, Ritter and Strong 1966), one quail (0.5 kg) must ingest approximately 500, 200-mm (8-inch) trout in order to receive a LD_{50} dose. Several researchers have noted no immediate effects to fish eating birds such as pelicans (*Pelacamus* sp.), cormorants (*Phalacrocorax* sp.) and herons (Family: *Ardeidae*) (Berger et al. 1967, Berger and Lennon 1967, Gilderhus et al. 1969 all cited in Schnick 1974). Similarly, for mammals, a 15-kg coyote (33 lb) (*Canis latrans*) would have to ingest at least 2,000 trout with Ritter and Strongs (1966) maximum tissue concentration to reach the minimum dosage found harmful to a domestic dog. Based upon these consumption rates, the probability that any wildlife would be affected by consumption of antimycin killed fish is negligible.

<u>Technical Description of Effects of CFT Legumine and Prentox Fish Toxicant Powder (Rotenone) on Water Quality, Human Health, Livestock, and Wildlife</u>

Rotenone is a naturally produced chemical by tropical plants in the bean family. Ground up derris root has been used for centuries by native South Americans to collect fish as food sources (Finlayson et al. 2000). Rotenone is a common garden insecticide and is also used in organic farming as a natural, botanical insecticide.

Rotenone degradation is affected by temperature (Dawson et al. 1991), pH, and dissolved oxygen. Sunlight also accelerates chemical breakdown (Finlayson et al. 2000). Temperatures of 50-75°F provide the greatest toxicity for most species (Davies and Shelton 1983) probably due to elevated metabolism under those temperatures. Rotenone readily binds with organic matter and thus it is unlikely that rotenone would reach groundwater (Dawson et al. 1991). The metabolite of rotenone, rotenolone, persists longer than rotenone. Studies indicate that rotenolone is approximately one-tenth as toxic as rotenone. No rotenone or rotenone products were detected during groundwater monitoring of 26 wells in California (Finlayson et al. 2001). Rotenone degrades more rapidly in flowing compared to standing water as photolysis is increased.

At the levels used for fish control projects, rotenone does not present "unreasonable adverse effects to humans and the environment" (USEPA 1981b, 1989b). Research indicates that rotenone does not cause birth defects, reproductive dysfunction, gene mutations, or cancer (Biotech Research 1981, Goethem et al. 1981, USEPA 1981b, Hazleton Raltech Laboratories 1982, Spencer and Sing 1982, Tisdel 1985 all cited in CDFG 1994). Estimated single lethal dose of rotenone for humans is 300-500 mg/kg of body weight. That would equate to a 160 lb. individual drinking 23,000 gallons of water treated at 0.25 pp<u>m</u> active rotenone (highest allowable treatment rate for fish management per label). At a concentration typically used for native trout restoration projects, 40 ppb, a 160 lb. human would have to ingest more than 130,000 gallons of treated water. An intake of 0.7 mg of rotenone per kg of body weight is considered safe (Haley 1978) which is much greater than could be expected from fish control projects (Finlayson et al. 2000).

Wildlife or livestock may be exposed for short periods to water treated with rotenone. Studies have shown that a 0.25 lb bird would have to consume 25 gallons of treated water or more than forty pounds of fish or invertebrates in 24 hours to receive a lethal dose (Finlayson et al. 2000). Honeybees exhibit low toxicity to rotenone ($LD_{50} > 30$ µg a.i./bee, Stevenson 1978). An LD_{50} for mallard ducks is greater than 2000 mg/kg of body weight (Tucker and Crabtree 1970, cited by Schnick 1974b). A 1.6 kg duck must consume greater than 12,000 gallons of water treated with rotenone at 50 ppb.

Long-term persistence of rotenone or any components of the two proposed rotenone products is unlikely. If chronic exposure was possible, a human drinking an average of 2L per day of rotenone treated water would still consume less rotenone than the reference dose of 4 µg/kg/day (EPA's Integrated Risk Information System (IRIS) site: www.epa.gov/iris/). At a treatment concentration of 40 ppb rotenone, a human could safely consume up to 7L of water per day for the rest of that person's life.

There are several formulations of rotenone available as a piscicide, liquid and powder formulations. CFT Legumine and Prentox Fish Toxicant Powder are the rotenone formulations selected for this project. Inert ingredients in Prentox Fish Toxicant Powder are cube resins, essentially plant fiber from the root of the plants after they are ground up to produce the product (Finlayson et al. 2000). The entire root is ground up and packaged rather than extracting and/or concentrating the active chemical rotenone from ground up roots

(Hisata 2001). CFT Legumine contains several components primarily composed of diethylene glycol ethyl ether (DEGEE) and methyl-pyrrolidone (NMP) (Table 3). Trace amounts of naphthalene, benzene, and toluene are also included but make up less than 1% of the formulation. CFT Legumine was designed in Europe to treat large river systems to combat a salmonid parasite *Gyrodactylus*. The product was intended to provide an alternative formulation of rotenone which significantly reduced reliance upon petroleum based hydrocarbons such as naphthalene, benzene, and toluene. At one ppm formulation, a concentration commonly used in native trout restoration projects, DEGEE and NMP would be applied at approximate concentrations of 569 and 90 ppb, respectively. Rats given 10,000 ppm DEGEE in drinking water over two years exhibited slight, if any, adverse effects (http://toxnet.nlm.nih.gov). This dose is nearly 90,000 times greater than the concentration anticipated for the proposed action. DEGEE is readily biodegradable and does not bioaccumulate. DEGEE is not considered carcinogenic (www.pesticideinfo.org), mutagenic (http://toxnet.nlm.him.gov), fetotoxic or teratogenic (Hardin et al. 1984). NMP is a common industrial solvent and is seeing increasing use in the pharmaceutical industry. A reference dose or water quality guidelines is not available but literature data indicates that the no observable adverse effects level for NMP in rats is 6,000 to 18,000 ppm (http://toxnet.nlm.him.gov). In mice, the value is 2,500 ppm. Adding in a safety factor of 1,000, this would translate into a safe reference dose (a dose a 70 kg human could safely ingest every day for the rest of that persons life) of 2 to 6 ppm. This is a factor of 25 times greater than typical piscicide application rates. NMP does not bioaccumulate and is biodegradeable. The remaining components concentrations would be in the parts per trillion (ppt) and thus well below any water quality criteria or lifetime exposure guidelines set by the USEPA (Finlayson et al. 2000).

Table 3. Summary of CFT Legumine components and expected concentrations during field application.

Analyte	CFT Legumine Component at 1 ppm applied formulation
n-methyl pyrrolidone	90 ppb
Diethylene glycol ethyl ether	569 ppb
Ethylbenzene	0.004 ppb
Sec-butylbenzene	0.004 ppb
n-butylbenzene	0.08 ppb
Naphthalene	0.35 ppb
Methyl naphthalene	0.14 ppb
p-isopropyltoluene	0.005 ppb

Consumption of Rotenone Killed Fish

Non-target organisms may be exposed to rotenone through treated water or dead fish and aquatic invertebrates. Rotenone is a common ingredient in many treatments for external parasites on domestic animals including cattle, dogs, and cats. Gill breathing organisms are the most susceptible to rotenone due to direct gill absorption of the toxin. In the digestive system, enzymes neutralize much of the effects of rotenone. Rotenone levels in dead fish are generally less then 0.1 ppm. Studies have determined that a 4-oz. bird would have to consume 100 quarts of treated water or more than 40 pounds of dead fish and invertebrates in a 24 hour period to receive a lethal dose (CDFG 1994).

Potassium permanganate and water quality

Any remaining piscicide would be neutralized at the project boundary with potassium permanganate applied at 1-4 ppm. Potassium permanganate is an oxidizing agent that breaks down rapidly into naturally occurring non-toxic compounds of potassium, manganese, and water (Archer 2001). Sustained exposure to potassium permanganate in a laboratory setting can be lethal to fish (Marking and Bills 1975), but in piscicide-treated water potassium permanganate is quickly broken down as it reacts to organic material and the piscicide. Potassium permanganate degradation products have no deleterious environmental effects at concentrations used for neutralization of piscicides (Finlayson et al. 2000). Potassium permanganate is one of the most widely used inorganic chemicals for the treatment of municipal drinking water and wastewater. Drinking water treatment plants, large and small, use this versatile oxidant to improve taste and odors; to oxidize iron, manganese, and arsenic; to treat for and control zebra mussels and biofilm in raw water intake lines; to remove color; and to provide an alternative pre-oxidant to chlorine in a trihalomethane control program. Potassium permanganate is used to treat ground water as well as surface supplies. A refence dose for manganese has been estimated at 140 µg/kg/day (www.epa.gov/iris/). At concentrations of potassium permanganate commonly used to neutralize piscicides, 1-4 ppm, a 70-kg human could consume 2 – 10 liters of potassium permanganate treated water per day for the rest of that person's life and be considered "safe".

Tracer dyes and water quality

Various commercial tracer dye products are available to measure travel time in conjunction with piscicide applications. In practice, a small amount of tracer dye (~100 ml) is introduced into the stream at an initial location and time recorded to travel to an endpoint. Upon introduction of the dye to the system, it readily dissipates within the water column. Common tracer dyes include rhodamine. An 24-hour LC_{50} for mice orally exposed to rhodamine was calculated at ~2,000 mg/kg (Bright Dyes MSDS). Considering the small amount of dyes used and the short presence within the system, humans, wildlife, and livestock could not consume enough tracer dye to be affected.

Literature Cited

Adult Industry Medical Health Care Foundation. 2002. Spermicides and Nonoxynol – 9. Sherman Oaks. California.

Archer, D. L. 2001. Rotenone neutralization methods. Pp. 5-8 *In:* Cailteux, R. L., L. DeMong, B. J. Finlayson, W. Horton, W. McClay, R. A. Schnick, and C. Thompson. Ed. Rotenone in Fisheries: Are the Rewards Worth the Risks? American Fisheries Society, Bethesda, Maryland.

Berger, B. L. and R. E. Lennon. 1967. A test of antimycin A, a fish toxicant, an Beauty Lake, Quebec. U.S. Fish and Wildlife Service Fish Control Laboratory, LaCrosse, Wisconsin. Unpublished Report.

Berger, B. L., P. A. Gilderhus, and R. E. Lennon. 1967. Attempted reclamation of Whitewater Lake, Valentine National Refuge, Nebraska. U.S. Fish and Wildlife Service Fish Control Laboratory, LaCrosse, Wisconsin.

Biotech Research. 1981. Analytical studies for the detection of chromosomal aberrations in fruit flies, rats, mice, and horse bean. Report to U.S.G.S. Upper Midwest Environmental Services Center (U.S. Fish and Wildlife Service Study 14-16-990-81-042), La Crosse, Wisconsin.

California Department of Fish and Game. 1994. Final programmatic environmental impact report (subsequent): rotenone use for fisheries management.

Davies, W. D. and W. L. Shelton. 1983. Sampling with toxicants. In. Nielsen, L. A. and D. L. Johnson eds. Fisheries Techniques. American Fisheries Society. Bethesda, Maryland.

Dawson, V. K., W. H. Gingerich, R. A. Davis, and P. A. Gilderhus. 1991. Rotenone persistence in freshwater ponds: effects of temperature and sediment adsorption. North American Journal of Fisheries Management 11: 226-231.

Finlayson, B. J., R. A. Schnick, R. L. Cailteux, L. DeMong, W. D. Horton, W. McClay, C. W. Thompson, and G. J. Tichacek. 2000. Rotenone use in fisheries management, administrative and technical guidelines manual. American Fisheries Society. Bethesda, Maryland.

Finlayson, B. J., S. Siepmann, and J. Trumbo. 2001. Chemical residues in surface and ground waters following rotenone application to California lakes and streams. Pages 37-54 *in* R.L. Cailteux, L. DeMong, B. J. Finlayson, W. Horton, W. McClay, R. A. Schnick, and C. Thompson, editors. Rotenone in fisheries: are the rewards worth the risks? American Fisheries Society, Trends in Fisheries Science and Management 1, Bethesda, Maryland.

Gilderhus, P. A., B. L. Berger, and R. E. Lennon. 1969. Field trials of antimycin A as a fish toxicant. U. S. Fish and Wildlife Service, Investigations in Fish Control No. 27: 1-21.

Goethem, D., B. Barnhart, and S. Fotopoulos. 1981. Mutagenicity studies on rotenone. Report to the U.S.G.S. Upper Midwest Environmental Services Center (U.S. Fish and Wildlife Service Study 14-16-009-80-076), La Crosse, Wisconsin.

Haley, T. 1978. A review of the literature of rotenone. Journal of Environmental Pathology and Toxicology 1: 315-337.

Hardin, B. D., P. T. Goad, and J. R. Burg. 1984. Development toxicity of four glycol ethers applied cutaneously to rats. Environmental Health Perspectives 57:69-74.

Hazleton Raltech Laboratories. 1982. Teratology study with rotenone in rats. Report to U.S.G.S. Upper Midwest Environmental Services Center (U.S.Fish and Wildlife Sercice Study 81178), LaCrosse, Wisconsin.

Herr, F., E. Greslin and C. Chappel. 1967. Toxicology studies of antimycin, a fish eradicant. Transactions of the American Fisheries Society. 96:320-326.

Hisata, J. S. 2001. Draft Supplemental Environmental Impact Statement. Lake and Stream Rehabilitation: Rotenone Use and Health Risks. Washington Department of Fish and Wildlife.

Hubert, T. D., and L. J. Schmidt. 2001. Antimycin A use in fisheries: issues concerning EPA reregistration. U.S.G.S. Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin.

Hussain, A. 1969. Kinetics and mechanism of hydrolysis of antimycin A in solution. Journal of Phramaceutical Sciences 58:316-320.

Lee, T.H., P.H. Derse, and S.D. Morton. 1971. Effects of physical and chemical conditions on the detoxification of antimycin. Transactions of the American Fisheries Society. 100:13-17.

Marking, L.L. and V. K. Dawson. 1972. The half-life of biological activity of antimycin determined by fish bioassay. Transaction of the American Fisheries Society. 101:100-105.

Marking, L.L. and T.D. Bills. 1975. Toxicity of potassium permanganate to fish and its effectiveness for detoxifying antimycin. Transactions of the American Fisheries Society. 104:579-583.

Potter, V. R., and A. E. Reif. 1952. Inhibition of an electron transport component by antimycin A. Journal of Biological Chemistry 194:287-297.

Ritter, P. O. and F. M. Strong. 1966. Residues in tissues of fish killed by antimycin. Journal of Agriculture and Food Chemistry 14: 403-407.

Schnick, R. A. 1974. A review on the literature on the use of antimycin A in fisheries. USDI, Fish and Wildlife Service, La Crosse, Wisconsin.

Schnick, R. A. 1974b. A review of the literature on the use of rotenone in fisheries. USDI Fish and Wildlife Service, Springfield, Virginia.

Stefferud, J. A., D.L. Probst, and G.L. Burton. 1992 Use of antimycin to remove rainbow trout from White Creek, New Mexico. In D. A. Hendrickson (*ed*) Proceedings of the Desert Fishes Council, Volume 22-23. Bishop Ca.

Stevenson, J. H. 1978. The Acute Toxicity of Unformulated Pesticides to Worker Honey Bees (*Apis mellifera* L.). Plant Pathology 27(1): 38 - 40.

Spencer, F., and L. Sing. 1982. Reproductive responses to rotenone during decidualized pseudogestation and gestation in rats. Bulletin of Environmental Contamination and Toxicology 228: 360-368.

Tisdel, M. 1985. Chronic toxicity study of rotenone in rats. Report to U.S.G.S. Upper Midwest Environmental Sciences Center (U.S. Fish and Wildlife Service Study No. 6115-100), La Crosse, Wisconsin.

Tucker, R.K., and Crabtree, D.G. (1970). *Handbook of Toxicity of Pesticides to Wildlife,* Resource Publication Series No. 84, US Fish and Wildlife Service, Washington, D.C., 131 p.

USEPA (U.S. Environmental Protection Agency). 1981b. Completion of pre-RPAR review of Rotenone USEPA Office of Toxic Substances, Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 1989. Guidance for the reregistration of pesticide produces containing rotnone and associated resins as the active ingredient. USEPA Report 540/RS-89-039. Washington, D.C.

Walker, C. R., R.E. Lennon, and B. L. Berger. 1964. Preliminary observations on the toxicity of antimycin A to fish and other aquatic animals. Bureau of Sport Fisheries and Wildlife. Circular 1986, Washington, D.C.

Appendix H. List of aquatic macroinvertebrate taxa collected in the upper Rio Costilla watershed (Jacobi 1988, Lang 1998, Vinson 2002, 2003, and 2004, and NMDGF Files).

Order	Family/Subfamily	Taxa	Location
ACARI			Rio Costilla
AMPHIPODA	Gammaridae	*Gammarus lacustris*	Latir Lakes
AMPHIPODA	Hyalellidae	*Hyalella azteca*	Powderhouse Creek
Class HIRUDINEA			Latir Lake Three, Comanche Creek
Phylum NEMATODA			Rio Costilla, Powderhouse Creek
Class OLIGOCHAETA			Rio Costilla
Class OLIGOCHAETA		*Lumbricus aquaticus*	Rio Costilla
BASOMMATOPHORA	Lymnaeidae	*Lymnaea* sp.	Rio Costilla, Casias Creek, Comanche Creek
BASOMMATOPHORA	Lymnaeidae	Fossaria	Rio Costilla
BASOMMATOPHORA	Planorbidae		Comanche Creek,
BASOMMATOPHORA	Physidae	*Physa gyrina*	Latir Lake 3
BASOMMATOPHORA	Physidae	*Physa* sp.	Rio Costilla, Casias Creek
BASOMMATOPHORA	Physidae	Physella	Comanche Creek
COLEOPTERA	Curculionidae		Powderhouse Creek
COLEOPTERA	Dryopidae	*Helichus sp.*	Casias Creek, Rio Costilla, Powderhouse Creek, Comanche Creek, Vidal Creek
COLEOPTERA	Dytiscidae	*Agabus sp.*	Comanche Creek
COLEOPTERA	Elmidae	*Cleptelmis sp.*	Powderhouse Creek, Comanche Creek
COLEOPTERA	Elmidae	*Heterlimnius sp.*	Rio Costilla, Casias Creek, Powderhouse Creek, Comanche Creek, Chuckwagon Creek, Little Costilla Creek, Fernandez Creek
COLEOPTERA	Elmidae	*Heterlimnius corpulentus*	Rio Costilla, Casias Creek
COLEOPTERA	Elmidae	*Narpus sp.*	Powderhouse Creek, Comanche Creek, Little Costilla Creek, Fernandez Creek
COLEOPTERA	Elmidae	*Optioservus sp.*	Rio Costilla, Powderhouse Creek, Comanche Creek, Fernandez Creek, Vidal Creek
COLEOPTERA	Elmidae	*Optioservis quadrimaculatus*	Rio Costilla
COLEOPTERA	Elmidae	*Zaitzevia parvula*	Casias Creek, Comanche Creek
COLEOPTERA	Hydraenidae	*Hydraena sp.*	Comanche Creek, Vidal Creek
COLEOPTERA	Hydrophilidae		Powderhouse Creek
COLLEMBOLA			Powderhouse Creek
DIPTERA	Athericidae	*Atherix sp.*	Rio Costilla, Powderhouse Creek
DIPTERA	Athericidae	*Ahterix pachypus*	Rio Costilla
DIPTERA	Blephariceridae	*Agathon sp.*	Powderhouse Creek
DIPTERA	Ceratopogonidae	*Atrichopogon sp.*	Comanche Creek, Chuckwagon Creek
DIPTERA	Ceratopogonidae	*Bezzia sp.*	Powderhouse Creek
DIPTERA	Ceratopogonidae	*Probezzia sp.*	Powderhouse Creek, Comanche Creek, Chuckwagon Creek, Little Costilla Creek, Vidal Creek
DIPTERA	Chironomidae	*Chironomidae sp.*	Casias Creek, Rio Costilla, Powderhouse Creek, Comanche Creek
DIPTERA	Chironomidae	*Tanypodinae sp.*	Powderhouse Creek, Comanche Creek, Rio Costilla
DIPTERA	Tabanidae	*Tabanus sp.*	Rio Costilla
DIPTERA	Dixidae		Comanche Creek

DIPTERA	Empididae	*Chelifera sp.*	Rio Costilla, Comanche Creek
DIPTERA	Empididae	*Oreogeton sp.*	Rio Costilla, Powderhouse Creek
DIPTERA	Empididae	*Trichoclinocera sp.*	Powderhouse Creek
DIPTERA	Muscidae	*Limnophora sp.*	Casias Creek
DIPTERA	Orthocladiinae		Powderhouse Creek, Chuckwagon Creek, Little Costilla Creek, Fernandez Creek, Vidal Creek, Comanche Creek
DIPTERA	Psychodidae	*Pericoma sp.*	Powderhouse Creek
DIPTERA	Simuliidae	*Prosimulinum sp.*	Comanche Creek
DIPTERA	Simuliidae	*Simuliidae sp.*	Rio Costilla, Casias Creek, Powderhouse Creek
DIPTERA	Simuliidae	*Simulium vittatum*	Rio Costilla
DIPTERA	Simuliidae	*Simulium sp.*	Powderhouse Creek, Comanche Creek, Chuckwagon Creek, Vidal Creek
DIPTERA	Stratiomyidae		Comanche Creek
DIPTERA	Stratiomyidae	*Odontomyia*	Rio Costilla
DIPTERA	Tipulidae	*Antocha monticola*	Casias Creek, Rio Costilla, Comanche Creek
DIPTERA	Tipulidae	*Dicranota sp.*	Rio Costilla, Powderhouse Creek, Comanche Creek, Chuckwagon Creek
DIPTERA	Tipulidae	*Hexatoma sp.*	Casias Creek, Rio Costilla, Powderhouse Creek, Comanche Creek, Chuckwagon Creek, Vidal Creek
DIPTERA	Tipulidae	*Holorusia grandis*	Rio Costilla, Comanche Creek
DIPTERA	Tipulidae	*Tipula sp.*	Rio Costilla, Comanche Creek, Vidal Creek
DIPTERA		*Culicoides sp.*	Rio Costilla
DIPTERA		*Dicanota sp.*	Rio Costilla
EPHEMEROPTERA	Ameletidae	*Ameletus sp.*	Comanche Creek, Fernandez Creek, Vidal Creek
EPHEMEROPTERA	Baetidae	*Baetis sp.*	Powderhouse Creek, Comanche Creek, Little Costilla Creek, Fernandez Creek, Vidal Creek
EPHEMEROPTERA	Baetidae	*Acentrella sp.*	Rio Costilla, Comanche Creek
EPHEMEROPTERA	Baetidae	*Baetis tricaudatus.*	Casias Creek, Rio Costilla, Powderhouse Creek, Comanche Creek
EPHEMEROPTERA	Baetidae	*Baetis insignificans*	Rio Costilla
EPHEMEROPTERA	Ephemerellidae	*Attenella*	Rio Costilla
EPHEMEROPTERA	Ephemerellidae	*Attenella margarita*	Comanche Creek
EPHEMEROPTERA	Ephemerellidae	*Drunella coloradensis*	Powderhouse Creek, Comanche Creek, Little Costilla Creek, Fernandez Creek
EPHEMEROPTERA	Ephemerellidae	*Drunella doddsi*	Rio Costilla, Powderhouse Creek
EPHEMEROPTERA	Ephemerellidae	*Drunella grandis*	Casias Creek, Rio Costilla, Powderhouse Creek, Comanche Creek, Fernandez Creek
EPHEMEROPTERA	Ephemerellidae	*Ephemerella inermis*	Comanche Creek, Rio Costilla
EPHEMEROPTERA	Ephemerellidae	*Ephemerella infrequens*	Rio Costilla, Casias Creek
EPHEMEROPTERA	Ephemerellidae	*Timpanoga hecuba*	Rio Costilla, Comanche Creek
EPHEMEROPTERA	Heptageniidae	*Cinygmula sp.*	Powderhouse Creek, Comanche Creek, Fernandez Creek, Rio Costilla
EPHEMEROPTERA	Heptageniidae	*Epeorus sp.*	Rio Costilla, Powderhouse Creek, Comanche Creek, Little Costilla Creek, Fernandez Creek
EPHEMEROPTERA	Heptageniidae	*Heptagenia*	Rio Costilla
EPHEMEROPTERA	Heptageniidae	*Leucrocuta sp.*	Comanche Creek
EPHEMEROPTERA	Heptageniidae	*Rhithrogena*	Rio Costilla
EPHERMEROPTERA	Heptageniidae	*Rhithrogena robusta*	Rio Costilla
EPHEMEROPTERA	Heptageniidae	*Rhithrogena hageni*	Rio Costilla, Casias Creek, Powderhouse Creek, Comanche Creek

EPHEMEROPTERA	Leptophlebiidae	*Paralptophlebia sp.*	Rio Costilla, Comanche Creek, Chuckwagon Creek
EPHEMEROPTERA	Leptophlebiidae		Powderhouse Creek
EPHEMEROPTERA	Leptohyphidae	*Trichorhythodes*	Vidal Creek, Comanche Creek
EPHEMEROPTERA	Leptohyphidae	*Trichorhythodes minutus*	Comanche Creek
HEMIPTERA	Gerridae		Comanche Creek
HAPLOTAXIDA	Tubificidae		Rio Costilla, Comanche Creek
LEPIDOPTERA			Comanche Creek
ODANATA	Gomphidae	*Ophiogomphus sp.*	Comanche Creek
PLECOPTERA	Capniidae		Casias Creek, Powderhouse Creek, Comanche Creek
PLECOPTERA	Chloroperlidae	*Suwallia*	Comanche Creek, Little Costilla Creek, Fernandez Creek
PLECOPTERA	Chloroperlidae	*Sweltsa* sp.	Casias Creek, Powderhouse Creek, Comanche Creek, Chuckwagon Creek
PLECOPTERA	Chloroperlidae	*Triznaka sp.*	Comanche Creek
PLECOPTERA	Nemouridae	*Amphinemura sp.*	Rio Costilla, Powderhouse Creek, Comanche Creek
PLECOPTERA	Nemouridae	*Malenka*	Powderhouse Creek
PLECOPTERA	Nemouridae	*Zapada sp.*	Rio Costilla
PLECOPTERA	Perlidae	*Hesperoperla*	Powderhouse Creek
PLECOPTERA	Perlidae	*Hesperoperla pacifica*	Rio Costilla, Comanche Creek, Little Costilla Creek, Fernandez Creek
PLECOPTERA	Perlidae	*Claassenia sabulosa*	Rio Costilla
PLECOPTERA	Perlodidae	*Cultus sp.*	Comanche Creek, Chuckwagon Creek, Fernandez Creek
PLECOPTERA	Perlodidae	*Isoperla sp.*	Rio Costilla, Casias Creek, Comanche Creek
PLECOPTERA	Perlodidae	*Isogenoides. sp.*	Rio Costilla
PLECOPTERA	Perlodidae	*Megarcys*	Powderhouse Creek
PLECOPTERA	Perlodidae	*Megarcys signata*	Comanche Creek
PLECOPTERA	Perlodidae	*Skwala paralella*	Comanche Creek
PLECOPTERA	Perlodidae	*Pteronarcella*	Comanche Creek
PLECOPTERA	Pteronarcyidae	*Pteronarcella badia*	Casias Creek, Rio Costilla, Comanche Creek, Little Costilla Creek
PLECOPTERA	Pteronarcyidae	*Pteronarcys sp.*	Comanche Creek
PLECOPTERA		*Paraleuctra sp.*	Rio Costilla
PODOCOPIDA			Powderhouse Creek
RHYNCHOBDELLIDA	Glossiphoniidae	*Helobdella stagnalis*	Comanche Creek
TRICHOPTERA	Brachycentridae	*Brachycentrus sp.*	Casias Creek, Rio Costilla, Powderhouse Creek, Comanche Creek, Fernandez Creek, Vidal Creek
TRICHOPTERA	Brachycentridae	*Brachycentrus americanus*	Rio Costilla
TRICHOPTERA	Brachycentridae	*Micrasema* sp.	Casias Creek, Rio Costilla, Powderhouse Creek, Comanche Creek, Fernandez Creek
TRICHOPTERA	Glossosomatidae	*Anagapetus*	Comanche Creek
TRICHOPTERA	Glossosomatidae	*Agapetus sp.*	Casias Creek, Comanche Creek, Rio Costilla
TRICHOPTERA	Glossosomatidae	*Agapetus boulderensis*	Casias Creek
TRICHOPTERA	Glossosomatidae	*Agapetus.*	Comanche Creek
TRICHOPTERA	Glossosomatidae	*Glossosoma sp.*	Rio Costilla, Powderhouse Creek, Comanche Creek, Chuckwagon Creek, Little Costilla Creek, Vidal Creek
TRICHOPTERA	Hydropsychidae	*Arctopsyche sp.*	Rio Costilla, Casias Creek, Powderhouse Creek, Comanche Creek, Chuckwagon Creek
TRICHOPTERA	Hydropsychidae	*Arctopsyche grandis*	Rio Costilla

TRICHOPTERA	Hydropsychidae	*Cheumatophyche sp.*	Rio Costilla
TRICHOPTERA	Hydropsychidae	*Helicopsyche borealis*	Rio Costilla
TRICHOPTERA	Hydropsychidae	*Hydropsyche sp.*	Rio Costilla, Casias Creek, Powderhouse Creek, Comanche Creek, Chuckwagon Creek, Vidal Creek
TRICHOPTERA	Hydropsychidae	*Parapsyche sp.*	Powderhouse Creek
TRICHOPTERA	Hydroptilidae	*Hydroptila sp.*	Rio Costilla, Comanche Creek
TRICHOPTERA	Hydroptilidae	*Ochrotrichia* sp.	Rio Costilla, Casias Creek, Powderhouse Creek
TRICHOPTERA	Lepidostomatidae	*Lepidostoma sp.*	Powderhouse Creek, Comanche Creek, Chuckwagon Creek, Fernandez Creek, Rio Costilla
TRICHOPTERA	Leptoceridae	*Oecetis sp.*	Comanche Creek
TRICHOPTERA	Limnephilidae	*Dicosmoecus sp.*	Powderhouse Creek
TRICHOPTERA	Limnephilidae	*Dicosmoecus atripes*	Rio Costilla
TRICHOPTERA	Limnephilidae	*Ecclisomyia sp.*	Powderhouse Creek
TRICHOPTERA	Limnephilidae	*Hesperophylax sp.*	Comanche Creek
TRICHOPTERA	Limnephilidae	*Limnephilus sp.*	Casias Creek, Comanche Creek, Vidal Creek
TRICHOPTERA	Limnephilidae	*Limnephilus abbreviatus*	Casias Creek
TRICHOPTERA	Limnephilidae	*Psychoglypha sp.*	Comanche Creek
TRICHOPTERA	Limnephilidae	*Oligophlebodes*	Casias Creek
TRICHOPTERA	Philopotamidae	*Dolophilodes sp.*	Powderhouse Creek
TRICHOPTERA	Rhyacophilidae	*Rhyacophila*	Powderhouse Creek, Little Costilla Creek, Fernandez Creek
TRICHOPTERA	Rhyacophilidae	*Rhyacophila brunea cpx.*	Casias Creek, Powderhouse Creek, Comanche Creek
TRICHOPTERA	Rhyacophilidae	*Rhyacophila acropedes*	Rio Costilla
TRICHOPTERA	Rhyacophilidae	*Rhyacophila coloradensis*	Rio Costilla
TRICHOPTERA	Rhyacophilidae	*Rhyacophila hyalinata*	Casias Creek, Rio Costilla, Powderhouse Creek
TRICHOPTERA	Uenoidae	*Neophylax sp.*	Powderhouse Creek
TRICHOPTERA	Uenoidae	*Neothremma sp.*	Comanche Creek, Fernandez Creek
TRICHOPTERA	Uenoidae	*Oligophlebodes* sp.	Powderhouse Creek, Casias Creek
TRICHOPTERA	Uenoidae	*Oligophlebodes minutus*	Rio Costilla
TROMBIDIFORMES			Powderhouse Creek
VENEROIDEA	Pisidiidae	*Pisidium casertanum*	Latir Lake 3
VENEROIDEA	Pisidiidae	*Pisidium gyrina*	Latir Lake 3
VENEROIDEA	Pisidiidae	*Pisidium ventricosum*	Latir Lake 3
VENEROIDEA	Pisidiidae	*Pisidium sp.*	Comanche, Vidal Creek

Appendix I. Native wildlife known or expected to occur within the project area (Bison M 4/06).

Common Name	Scientific Name
Fence lizard	*Sceloporus undulates*
Mountain short-horned lizard	*Phrynosoma hernandesi*
Western rattlesnake	*Crotalus viridis Cerberus*
Many-lined skink	*Eumeces multivirgatus*
Blackneck garter snake	*Thamnophis cyrtopsis*
Wandering garter snake	*Thamnophis elegans*
Bull snake	*Pituophis catenifer*
Smooth green snake	*Liochlorophis vernalis*
Blue grouse	*Dendragapus obscurus*
Badger	*Taxidea taxus*
Big brown bat	*Eptesicus fuscus*
Fringed bat	*Myotis thysanodes*
Hoary bat	*Lasiurus cinereus*
Long-eared myotis	*Myotis evotis*
Long-legged myotis	*Myotis volans*
Silver-haired bat	*Lasionycteris noctivagans*
Western small-footed myotis	*Myotis ciliolabrum*
Little brown myotis bat	*Myotis lucifugus*
Black bear	*Ursus americanus*
Beaver	*Castor Canadensis*
Bobcat	*Lynx rufus*
Colorado chipmunk	*Neotamias quadrivittatus*
Least chipmunk	*Neotamias minimus*
Coyote	*Canis latrans*
Mule deer	*Odocoileus hemionus*
Gunnison’s prairie dog	*Cynomys gunnisoni*
Common gray fox	*Urocyon cinereoargenteus*
Red fox	*Vulpes vulpes*
Botta’s pocket gopher	*Thomomys bottae*
Northern pocket gopher	*Thomomys talpoides*
Mountain lion	*Puma concolor*
Yellow-bellied marmot	*Marmota flaviventris*
American marten	*Martes Americana*
Brush mouse	*Peromyscus boylii*
Deer mouse	*Peromyscus maniculatus*
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*
Western jumping mouse	*Zapus princeps*
Rock mouse	*Peromyscus nasutus*
Common muskrat	*Ondatra zibethicus*
Pika	*Ochotona princeps*
Porcupine	*Erethizon dorsatum*
Mountain cottontail	*Sylvilagus nuttalli*
Snowshoe hare	*Lepus Americana*
Raccoon	*Procyon lotor*
Bushy-tailed wood rat	*Neotoma cinerea*
Mexican wood rat	*Neotoma Mexicana*
Masked shrew	*Sores cinereus*
Merriam’s shrew	*Sorex merriami*
Dusky shrew	*Sorex monticolus*
Water shrew	*Sorex palustris*
Striped skunk	*Mephistis mephitis*
Golden mantled ground squirrel	*Spermophilus lateralis*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*

Rock squirrel	*Spermophilus variegates*
Spotted ground squirrel	*Spermophilus spilosoma*
Abert's squirrel	*Sciurus aberti*
Red squirrel	*Tamiasciurus hudsonicus*
Heather vole	*Phenacomys intermedius*
Meadow vole	*Microtus pennsylvanicus*
Long-tailed vole	*Microtus longicaudus*
Red-backed vole	*Clethrionomys gapperi*
Ermine weasel	*Mustela erminea*
Long-tailed weasel	*Mustela frenata*

Appendix J. Bird species found or potentially found within the project area that are protected under the Migratory Bird Treaty Act (Bison M 4/06).

Common Name	Scientific Name
Brewer’s blackbirds	*Euphagus cyanocephalus*
Red-winged blackbirds	*Agelaius phoeniceus*
American redstart	*Setophaga ruticilla tricolora*
Mountain bluebird	*Sialia currucoides*
Western bluebird	*Sialia Mexicana bairdi*
Bushtit	*Psaltriparus minimus*
Black-capped chickadee	*Poecile atricapilla*
Mountain chickadee	*Poecile gambeli*
Brown creeper	*Certhia Americana*
Belted kingfisher	*Ceryle alcyon*
Red crossbill	*Loxia curvirostra*
White-winged crossbill	*Loxia leucoptera*
American crow	*Corvus brachyrhynchos*
American dipper	*Cinclus mexicanus*
Mourning dove	*Zenaida macroura*
Mallard duck	*Anas platyrhynchos*
Common merganser	*Mergus merganser*
Northern pintail	*Anas acuta*
Golden eagle	*Aquila chrysaetos*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Cassin’s finch	*Carpodacus cassinii*
House finch	*Carpodacus mexicanus*
Rosy finch	*Leucosticte atrata*
Northern flicker	*Colaptes auratus*
Ash-throated flycatcher	*Myiarchus cinerascens*
Cordilleran flycatcher	*Empidonax occidentalis*
Dusky flycatcher	*Empidonax oberholseri*
Hammond’s flycatcher	*Empidonax hammondii*
Olive-sided flycatcher	*Contopus cooperi*
American goldfinch	*Carduelis tristis*
Lesser goldfinch	*Carduelis psaltria*
Gray catbird	*Dumetella carolinensis ruficrissa*
Canada goose	*Branta Canadensis*
Evening grosbeak	*Coccothraustes verpertinus*
Pine grosbeak	*Pinicola enucleator*
Red-tailed hawk	*Buteo jamaicensis*
Sharp-shinned hawk	*Accipiter striatus*
Swainson’s hawk	*Buteo swainsoni*
Black-chinned hummingbird	*Archilochus aleandri*
Broad-tailed hummindbird	*Selasphorous platycercus*
Rufous hummingbird	*Selasphorus rufus*
Calliope hummingbird	*Stellula calliope*
Gray jay	*Perisoreus canadensis*
Pinyon jay	*Gymnorhinus cyanocephalus*
Scrub jay	*Aphelocoma californica*
Stellar’s jay	*Cyanocitta stelleri*
Dark-eyed junco	*Junco hyemalis*
American kestrel	*Falco sparverius*
Killdeer	*Charadrius vociverus*
Cassin’s kingbird	*Tyrannus vociferans*
Western kingbird	*Tyrannus verticalis*

Belted kingfisher	*Ceryle alcyon*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendula*
Black-billed magpie	*Pica hudsonica*
Meadowlark	*Sturnella neglecta*
Common nighthawk	*Chordeiles minor*
Clark's nutcracker	*Nucifraga columbiana*
Pygmy nuthatch	*Sitta pygmaea*
Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinensis*
Flammulated owl	*Otus flammeolus*
Great-horned owl	*Bubo virginianus*
Long-eared owl	*Asio otus*
Northern pygmy owl	*Glacidium gnoma*
Northern saw-whet owl	*Aegolius acadicus*
Western screech owl	*Otus kennicottii*
Long-eared owl	*Asio otus*
Common raven	*Corvus corax*
American robin	*Turdus migratorius*
Spotted sandpiper	*Actitis macularia*
Red-naped sapsucker	*Sphyrapicus nuchalis*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Pine siskin	*Carduelis pinus*
Townsend's solitaire	*Myadestes townsendi*
Common Snipe	*Gallinago gallinago*
Brewer's sparrow	*Spizella breweri*
Chipping sparrow	*Spizella passerine*
Lark sparrow	*Chondestes grammacus*
Lincoln's sparrow	*Melospiza lincolnii*
Savannah sparrow	*Passeerculus sandwichensis*
Song sparrow	*Melospiza melodia*
Vesper sparrow	*Pooecetes gramineus*
White-crowned sparrow	*Zonotrichia leucophrys*
Bank swallow	*Riparia riparia*
Barn swallow	*Hirundo rustica*
Cliff swallow	*Petrochelidon pyrrhonota*
Rough-winged swallow	*Stelgidopteryx serripennis*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*
White-throated swallow	*Aeronautes saxatalis*
Hepatic tanager	*Piranga flava*
Western tanager	*Piranga ludoviciana*
Hermit thrush	*Cathatus guttatus*
Swainson's thrush	*Catharus ustulatus*
Juniper titmouse	*Baeolophus ridgwayi*
Green-tailed towhee	*Pipilo chlorurus*
Spotted towhee	*Pipilo maculatus*
Solitary vireo	*Vireo solitarius*
Cassin's vireo	*Vireo cassinii*
Plumbeous vireo	*Vireo plumbeus*
Warbling vireo	*Vireo gilvus*
Turkey vulture	*Cathartes aura*
Grace's warbler	*Dendroica graciae*
Black-throated gray warbler	*Dendroica nigrescens*
Macgillivray's warbler	*Oporornis tolmiei*
Orange-crowned warbler	*Vermivora celata*
Townsend's warbler	*Dendroica townsendi*

Wilson's warbler	*Wilsonia pusilla*
Yellow warbler	*Dendroica petechia*
Yellow-rumped warbler	*Dendroica coronata*
Bohemian waxwing	*Bombycilla garrulus*
Acorn woodpecker	*Melanerpes formicivorus*
Downy woodpecker	*Picoides pubescens*
Ladder-backed woodpecker	*Picoides scalaris*
Lewis's woodpecker	*Melanerpes lewis*
Three-toed woodpecker	*Picoides tridactylus*
Canyon wren	*Catherpes mexicanus*
House wren	*Troglodytes aedon*
Common yellowthroat	*Geothlypis trichas*