East Fork Boulder Creek Native Trout Restoration Project

Environmental Assessment

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Escalante Ranger District
Dixie National Forest
Garfield County, Utah

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1. INTRODUCTION

The Utah Division of Wildlife Resources (UDWR) has proposed to implement a chemical treatment of East Fork Boulder Creek with the fish toxicant rotenone for one treatment per year for three consecutive years. The treatment would occur on National Forest System (NFS) land within the Dixie National Forest (Forest). Treatment activities may also include use of motorized vehicles off of designated roads, trails, or areas on the Forest. The use of any pesticide on NFS land requires U.S. Forest Service (Forest Service) authorization, as does the use of motorized vehicles off of designated roads, trails, or areas on the Forest. Forest approval would be through issuance of a pesticide use permit to the UDWR for the use of rotenone on NFS lands and written authorization to use motorized vehicles where such use is required off of the designated system for the treatment. UDWR is the project proponent and has requested the pesticide use permit from the Forest Service in order to move forward with the UDWR's Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*, CRCT) restoration program for the Boulder Creek drainage.

The Forest Service has prepared this Environmental Assessment in compliance with the NEPA and other relevant Federal and State laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the East Fork Native Trout Restoration Project, proposed by the UDWR. The document is organized into four main parts:

Introduction. This section includes information on the history of UDWR's project proposal, the purpose of and need for the project, and the Forest Service's proposal (Proposed Action) to authorize UDWR's actions for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Alternatives, including the Proposed Action: This section describes alternatives that were considered and provides a more detailed description of alternatives that were fully analyzed. This section also discusses design criteria and connected actions. Finally, this section provides a summary table of the environmental consequences and activities associated with the alternatives.

Affected Environment and Environmental Consequences: This section describes the environmental effects of implementing each alternative. This analysis is organized by resource area. Direct effects, indirect effects, and cumulative effects from the Forest Service action and connected actions are analyzed. Analyses for cumulative effects include consideration of past, present, and reasonably foreseeable actions that are relevant to the cumulative effect being analyzed.

Agencies and Persons Consulted: This section provides a list of preparers, federal agencies, and non-federal individuals consulted during the development of the Environmental Assessment.

Additional documentation, including more detailed analyses of the effects to the resources in the UDWR project area, may be found in the project record located at the Supervisor's Office, Dixie National Forest, in Cedar City, Utah.

1.1 Project Area

UDWR's proposed project would be located approximately 7 miles northwest of Boulder, Utah. The total treatment activity area, including those of connected actions, is as follows:

- approximately 7.8 miles (12.6 km) of East Fork Boulder Creek from the natural barrier (below headwater meadow) on East Fork Boulder Creek to its confluence with West Fork Boulder Creek;

- approximately 0.2 miles (0.4 km) of lower West Fork Boulder Creek, from a previously constructed barrier to its confluence with East Fork Boulder Creek;

- approximately 0.5 miles (0.8 km) of Boulder Creek from the confluence of East Fork Boulder Creek and West Fork Boulder Creek downstream to a previously constructed fish barrier;

- all seeps and springs flowing into those sections of streams proposed for UDWR's fish removal; and

- the Garkane Energy water transfer pipeline between the West Fork Reservoir and King's Pasture Reservoir; King's Pasture (East Fork) Reservoir; a pond on private property in King's Pasture, and the Garkane Energy penstock, between King's Pasture Reservoir and the Garkane Energy Boulder Creek Hydroelectric Power Plant (main power plant).

The UDWR treatment stream reaches flow through portions of Sections 27, 28, 33, and 34 of T31S, R4E, and Sections 3, 10, 15, 21, 22, and 28 of T32S, R4E, Salt Lake Baseline Meridian (See Figure 1). Treatment would include connecting waters, including relatively large inflows or tributaries with permanent fish habitat and smaller springs and seeps that are capable of at least temporarily holding small fish. Known tributaries and inflows vary in length from 10 meters to over 750 meters.

The reaches on NFS-lands are all on the Escalante Ranger District of the Forest in Garfield County, Utah. The inflow of the water transfer pipeline is at the West Fork Reservoir in Section 8, T32S, R4E, and the outflow is at King's Pasture Reservoir in Section 10 of T32S, R4E. The inflow of the penstock is at King's Pasture Reservoir, and the outflow is at the main power plant in Section 35 of T32S, R4E.

1.2 Purpose and Need for Action

The purpose of the project proposed by UDWR is to restore CRCT to their historic range within East Fork Boulder Creek and West Fork Boulder Creek. UDWR is the project proponent and has requested a pesticide use permit and authorization for use of motorized vehicles off of designated routes from the Forest Service in order to move forward with the UDWR's CRCT restoration program for the Boulder Creek drainage.

The need for UDWR's project is two-fold: (1) to comply with Article 402 and 4(e) conditions of the Federal Energy Regulatory Commission (FERC) License for the Boulder Creek Hydroelectric Project (Project No. 2219-020), and stipulations of the associated Settlement Agreement between Garkane Energy, UDWR, and the Forest Service and (2) to fulfill obligations of UDWR and the Intermountain Region of the Forest Service to address conservation actions for CRCT, as signatories to the Colorado River Cutthroat Trout Conservation Agreement and Strategy (CRCT Conservation Team 2006, CRCT Coordination Team 2006).

Garkane Energy FERC license. On August 31, 2007, FERC issued Garkane Energy its new license for the Boulder Creek Hydroelectric Project (Project No. 2219-020). As required under Article 402 of the license, Garkane Energy developed a Non-native Fish Eradication and Cutthroat Trout Stocking Plan for the purpose of re-establishing CRCT in the streams affected by the license. Article 402 also requires Garkane Energy to implement the plan. The plan includes specific measures to be undertaken to eradicate non-native fish by chemical treatment and to re-stock CRCT at the following locations:

1. East Fork Boulder Creek: from the natural barrier (below headwater meadow) to the confluence with West Fork Boulder Creek

2. Boulder Creek: from the confluence of East Fork Boulder Creek and West Fork Boulder Creek to approximately 0.5 miles downstream

The license, Section 4(e), item 16, condition 14 also includes construction of fish migration barriers at the downstream end of the treatment area. These barriers were completed in 2009. A natural barrier occurs at the upstream end of the treatment area. Upon completion of the UDWR treatment, CRCT are to be reintroduced by UDWR to the treatment area.

Conservation actions for CRCT. The U.S. Fish and Wildlife Service (FWS) identified CRCT as a "Category 2" candidate in 1985 (Federal Register 50(181):37958-37967). Category 2 "comprises taxa for which information now in possession of the [U.S. Fish and Wildlife] Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules" (ibid.). The species remained a Category 2 candidate with status "declining" in 1991 (Federal Register 56(225):58804-58836) and 1994 (Federal Register 59(219):58982-59028).

The FWS Category 2 Candidate Status was removed when a conservation agreement and strategy for the management of CRCT in Utah was developed in 1997 (Lentsch and Converse 1997). The agreement and strategy provided a list of guidelines and actions for implementation in order to protect and enhance populations of the native trout. Soon after, a range-wide conservation strategy was initiated by the wildlife agencies in Colorado, Utah and Wyoming to reduce threats to CRCT, stabilize or enhance its populations, and maintain its ecosystems. The range-wide strategy was revised in 2006 (CRCT Conservation Team 2006, CRCT Coordination Team 2006). Conservation efforts to preserve or expand CRCT in the Escalante River drainage are also outlined in the *Escalante River Drainage Management Plan Hydrologic Unit 14070005, Addendum* (Ottenbacher and Hepworth 2003).

A petition to list CRCT trout was reviewed by the FWS in 2004. They concluded in a "90-day finding" that the petition did not present sufficient information to warrant listing or further consideration (Federal Register 69:21151-21158). The FWS concurred with the petitioner that the current range of CRCT had been greatly reduced from their historic distribution but noted that "State management efforts….continue to improve the outlook for the CRCT." Later, in 2007, the FWS, in a "12-month finding," concluded that listing of CRCT was not warranted at that time; however, they did determine that the distribution of CRCT had been reduced from historic levels to about 13 percent of historic habitat and that existing populations continue to face adverse impacts, specifically hybridization with and competition from non-native trout, in most of the historic range (Federal Register 72 (113): 32589 – 32605).

Implementation of conservation actions through the *Conservation Agreement and Strategy* have been the major management efforts the FWS felt had improved the outlook for the species in both their 2004 and 2007 findings of not warranted for listing for the species (Federal Register 69(76):21151-21158 and 72(113):32589-32605). Reintroduction efforts within CRCT's historic range have been the most important conservation actions for ensuring persistence of the species and preventing federal listing under the Endangered Species Act. Reintroduction projects typically involve construction or enhancement of fish-migration barriers, the removal of non-native trout, and transfer of native trout from "core" source populations. These techniques have been instrumental in increasing the number of known CRCT populations in southwestern Utah (Lower Colorado Geographic Management Unit) from 5 populations in about 8.2 miles (13.2 km) of stream in 1998 to 13 populations in over 59.8 miles (96.2km) of stream in 2007 (Hepworth et al. 2001d, Hadley et al. 2008). These past treatments and reintroductions have made the status of CRCT more secure.

Expanding the population of CRCT in the Boulder Creek drainage is an important step in securing the persistence of the subspecies within its historic range. CRCT are managed within eight geographical management units (GMUs), as outlined in the range-wide conservation strategy. Boulder Creek is one of the major drainages within the Lower Colorado GMU and represents some of the best potential habitat remaining for renovation within the unit. Three of the other four remnant populations have already been expanded within their respective drainages, and the one that has not (Water Canyon Creek) has little, if any, additional suitable habitat for population expansion within the drainage. Additionally East Fork Boulder Creek and West Fork Boulder Creek both contain remnant populations of CRCT that were isolated from non-native trout above barriers prior to their discovery (Hepworth et al. 2001c). The remnant population in

East Fork Boulder Creek is currently only secure in a 0.5 mile (0.8 km) section of stream above a waterfall barrier (Hepworth et al. 2001d). A similar, secure remnant population existed in the 2.0 miles (3.2 km) of West Fork Boulder Creek above the West Fork Reservoir dam in the late 1990s. In 2000 and 2001, this population was expanded to repopulate the stream from below the West Fork Reservoir to just above its confluence with East Fork Boulder Creek, through barrier construction, non-native trout removal, and CRCT reintroduction (Native Trout Enhancement Projects in Southwestern Utah Waters, Finding of No Significant Impact, August 30, 1999).

The proposed expansion of the population of CRCT in East Fork Boulder Creek would improve population persistence, health, and security in two major ways. First, the current population faces a high probability of extinction, because it is isolated in an extremely small section of stream, which increases the risk of negative demographic or stochastic events causing extirpation (Hildebrand and Kershner 2000). Increasing size and distribution of the secured remnant population would help mitigate the threat of extirpation associated with small populations that are restricted to fragmented habitats. Second, expanding the current population of CRCT in East Fork Boulder Creek downstream from the confluence with West Fork Boulder Creek would connect the two populations, creating a metapopulation in the drainage. The connection would provide additional protection against catastrophic events, as well as facilitate genetic exchange between populations without the need for active management (Allendorf 1983; Lindenmayer and Lacy 1995). Connecting the populations in East Fork Boulder Creek and West Fork Boulder Creek would create the largest (over 15.7 miles [25.3 km] of stream) connected population of CRCT in the Escalante River drainage.

CRCT is also a sensitive species for the Intermountain Region of the Forest Service. Forest Service Manual (FSM) 2670.32(1) policy is that for sensitive species Forests will "1. Assist states in achieving their goals for conservation of endemic species." This UDWR project would do that.

1.3 Relationship to the LRMP

This analysis incorporates by reference the direction provided in the Dixie National Forest Land and Resource Management Plan (LRMP), 1986, as amended. This analysis is a project level analysis that is not intended to re-examine the basic land use allocations made in the LRMP, nor propose broad changes in land use allocations. Instead, planning at the project level involves the development, analysis, and disclosure of likely environmental impacts associated with the implementation of specific actions designed to achieve the overall goals and objectives of the LRMP. The portion of the UDWR project area on NFS lands falls within management area 9A (Riparian Management).

1.4 Proposed Action

The Proposed Action is to approve the pesticide use proposal form (Forest Service form FS-2100-2, referred to in this analysis as the "pesticide use permit") that the Forest Service requires the UDWR to have to apply the fish toxicant rotenone to East Fork Boulder Creek, a segment of Boulder Creek, and a segment of West Fork Boulder Creek where they flow on NFS lands for a maximum of three treatments, one treatment per year for three consecutive years, and to authorize use by UDWR of motorized vehicles off of designated routes where necessary to implement their project. The UDWR project activities that would be authorized by the Forest under the Proposed Action would completely eradicate non-native trout from NFS lands in East Fork Boulder Creek, a short segment of Boulder Creek, and a very short segment of West Fork Boulder Creek. All fish would be temporarily eliminated by UDWR from target waters. Application of the rotenone by UDWR would occur in fall for a 3 to 24 hour period. The Proposed Action and the actions that would be authorized under it are described in detail in Section 2.

Approval does not affect several actions outside of Forest Service jurisdiction that are expected to occur to meet the purpose and need for UDWR's project. These are also described in detail in Section 2 and included in the analysis in Section 3.

1.5 Decision Framework

Although fish eradication for the UDWR project area is under the jurisdiction of UDWR, the use of a pesticide on NFS lands requires Forest Service approval, and use of motorized vehicles off of designated routes must be authorized by the Forest. The pesticide use permit provides permission for UDWR's application of rotenone on waters that are on NFS lands only.

The decision for this UDWR project does not affect actions on non-NFS lands, and it does not affect actions for which Forest Service authorization is not required.

The Forest Supervisor, Dixie National Forest, is the Responsible Official for this decision. The Responsible Official must decide to authorize the use of NFS land as proposed (Proposed Action), to proceed with this action by modifying the Proposed Action, not to authorize the proposed use of NFS land at this time (No Action), or to proceed with an alternative action.

Proposed Action. A decision to proceed with this action as proposed by UDWR is to approve the pesticide use permit and authorize motorized vehicle use off of designated routes that would be required by UDWR for the application of rotenone to waters of the treatment area on NFS lands. Design criteria included in the Proposed Action would also be included in the permit or authorization.

Modify the Proposed Action. A decision to proceed with this action by modifying the Proposed Action would be to approve the pesticide use permit and authorize use of motorized vehicles off of designated routes but with modification to the permit conditions and/or design criteria.

No Action. A decision not to authorize the use of NFS land as proposed at this time, referred to as the "No Action" alternative, is a decision not to issue the pesticide use permit to UDWR for the application of rotenone to waters of the treatment area on NFS lands and not to authorize use of motorized vehicles off of designated routes. The No Action alternative would not preclude implementation of other actions on NFS lands that would meet the purpose and need for this UDWR project but do not require Forest Service authorization.

***Alternative*. A decision to proceed with an alternative would not authorize the use of NFS land as proposed by UDWR at this time but to authorize actions or uses other than as proposed by UDWR to meet the purpose and need.1.6 Public Involvement**

The Forest posted a legal notice and initiated the 30-day legal notice and comment period on March 17, 2010. In addition, as part of the public involvement process, the Forest posted the scoping document on its public website, located at the following:

http://www.fs.fed.us/r4/dixie/projects/projects.shtml.

A copy of the scoping notice and document was mailed to 113 individuals, groups, agencies, and tribes. The proposal was listed in the Schedule of Proposed Actions beginning April 1, 2010.

The Forest also held a public meeting on April 15, 2010, in Boulder, Utah. Announcement of the meeting was made through a news release distributed on April 7, 2010. The announcement was also posted on the Forest's public website located at:

http://www.fs.fd.us/r4/dixie/news/2010/eforkmeeting.htm.

The Forest Public Affairs Officer consulted with several members of the Boulder community prior to the meeting to discuss the format that would best provide information to those expressing concerns. Twenty-nine people signed in, twenty-seven of whom were from Boulder.

Fifty-two responses were submitted during the 30-day legal notice and comment period and include those submitted at the public meeting. Two were submitted after the 30-day legal notice and comment period, one of which provided additional documentation for a comment submitted during the comment period. All fifty-four were considered by the Responsible Official and interdisciplinary team.

In addition, Forest personnel met with several individual adjacent landowners, at their request, to clarify the Proposed Action and the UDWR proposed project activities.

1.7 Issues

The Forest separated the comments into three groups: substantive issues, topics of concern, and non-substantive issues. Substantive issues were defined as those directly or indirectly caused by implementing the Proposed Action that would affect project design, mitigation, or alternatives.

Topics of concern were those that would not affect project design, mitigation, or alternatives but are within the scope of the project and addressed in the analysis. Non-substantive issues were identified as those: 1) outside the scope of the proposed project; 2) already decided by law, regulation, LRMP, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations require this delineation in Section 1501.7, ". . . identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3). . . ." A full comment analysis may be found in the project record.

All submitted comments were made available to the interdisciplinary team and Responsible Official. Each comment was reviewed. Because many comments were similar, comments were grouped by topic. All of the comments and other issues raised in the comments were either incorporated by the interdisciplinary team through modifying the Proposed Action, developing appropriate project design criteria, developing an alternative analyzed in this document, or determined not to constitute substantive issues.

1.7.1 Substantive Issues

The Forest considers substantive issues as those that would affect project design, mitigation, or alternatives. The Forest identified five substantive issues, as follows:

Substantive Issue 1: The 2007 EPA reregistration documentation includes risk mitigation measures to address ecological risks from unintended exposure and human health risks from swimming in treated areas, consuming treated fish, and handling rotenone.

Disposition of Issue: Design criteria for the Proposed Action were modified to include in the pesticide use permit the requirement to placard to addresses the risk mitigation measures for these risks (design criterion #3). Other risk mitigation measures were already included in the design criteria in the scoping notice.

Substantive Issue 2: Concerns were raised about the potential effects to public health from rotenone, its formulation, potassium permanganate, and its formulation. Identified potential health effects included, but were not limited to, neurologic diseases. Concerns included those of short-term and long-term effects, effects from low doses, and synergistic effects from combining the chemicals.

Disposition of Issue: The EA includes analysis of potential effects to human health from the chemicals that the Forest would authorize for use by UDWR under the Proposed Action. Also, at the Forest's request, UDWR developed the Non-chemical Treatment alternative, described in Section 2.1.3, which was analyzed fully to provide comparison with the actions that would be authorized by the Forest under the Proposed Action. This Non-chemical Treatment alternative would require Forest Service authorization for the possible use of motorized vehicles off of designated routes and approval of a special use authorization for the burial of removed fish.

Substantive Issue 3: Concerns were raised about the potential effects to public health from exposure to potassium permanganate and the carrier for the rotenone.

Disposition of Issue: The design criteria that were added or previously included to address EPA's risk mitigation measures for rotenone would also address risks from exposure to potassium permanganate; therefore, disposition of Substantive Issue 3 is the same as for Substantive Issue 1. Also, the Non-chemical Treatment alternative was developed, as described above and in detail in Section 2.1.3, and would not involve use of potassium permanganate.

Substantive Issue 4: Concerns were raised that the use of chemicals in UDWR's project area would affect the perception of the pristine quality of the area and that visitation would drop, affecting the local businesses, including beekeeping and those with organic certification, and economic stability of the community.

Disposition of Issue: The Non-chemical Treatment alternative was developed, as described above and in detail in Section 2.1.3, and would not involve the use of chemicals.

Substantive Issue 5: Concern was raised that a reasonable range of alternatives was not provided.

Disposition of Issue: As described above, the Non-chemical Treatment alternative was developed as a feasible option that the UDWR may execute in lieu of applying rotenone. As described above, the treatment method under this option does not require Forest Service authorization, but the option was analyzed fully to provide comparison of effects among no treatment, chemical treatment, and non-chemical treatment. Other non-chemical methods that were suggested in comments are discussed in the EA, Section 2.2.

1.7.2 Other Topics of Concern

The Forest also identified the following topics of concern, which were raised during the comment period and are within the scope of the decision but did not affect project design, mitigation or alternatives. They are addressed in this environmental analysis:

1. Effectiveness of the rotenone treatment (Appendix B)
2. Effect of climate change on project success (Section 2.5)
3. Effects of rotenone, potassium permanganate, and their formulations as they pertain to public health and irrigation uses (Sections 3.3.2, 3.7.2, and 3.7.3)
4. Effects on groundwater (Section 3.3.2)
5. Effects on non-target aquatic and terrestrial species, including effects to food web and rare or endemic species (Section 3.1, 3.2, and 3.4)
6. Effects on sportfishing (Section 3.5)
7. Effects on downstream Wild and Scenic River suitable segments (Section 3.5), and
8. Effects to psychological and cultural values (Section 3.8.2).

2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This chapter describes and compares the Forest Service alternatives considered. It includes a description of the UDWR's proposed project and considers UDWR's treatment alternative in detail. This section also presents the alternatives and the UDWR activities that would be authorized or connected actions to the alternatives in comparative form. Some of the information used to compare the alternatives is based on the design of the alternative, and some of the information is based on the environmental, social and economic effects of UDWR implementing activities that would be authorized by the Forest under the alternatives.

2.1 Alternatives Analyzed in Detail

2.1.1 No Action- No Further Treatment Scenario

Under the No Action alternative, the Forest would not approve the pesticide use permit to UDWR, would not authorize UDWR to use motorized vehicles off of designated routes for the application of rotenone to waters of the treatment area on NFS lands, and would not approve a special use authorization for UDWR to bury removed fish.

The No Action alternative would not preclude UDWR from implementing actions on NFS lands that would meet the purpose and need for UDWR's project but do not require Forest Service authorization. This includes UDWR activities described under the Non-chemical Treatment alternative (Section 2.1.3) except for the use motorized vehicles off of designated routes or burial of removed fish on NFS lands. The No Action alternative would also not preclude UDWR from implementing actions on non-NFS lands that are related to the purpose and need for UDWR's project but not under Forest Service jurisdiction or authorization.

One possible option for UDWR is to take no further action to meet the purpose and need of the proposed project. This possible option is identified in this analysis as the "No Action - No Further Treatment Scenario" and is the basis for the effects analysis for the No Action alternative to provide the base line for comparison of expected future conditions if neither the Proposed Action nor Non-chemical Treatment alternative were implemented by the Forest and UDWR were to take no further action to meet the purpose and need.

2.1.2 Proposed Action

The Proposed Action is to approve the pesticide use permit that the Forest Service requires the UDWR to have to apply the fish toxicant rotenone to waters that flow on NFS lands and to authorize motorized vehicle use off of designated routes. The pesticide use permit would authorize the UDWR to implement a maximum of three treatments on NFS land, one treatment per year for three consecutive years. Waters on NFS land that would be treated by UDWR under the Forest Service pesticide use permit are as follows:

- approximately 7.8 miles (12.6 km) of East Fork Boulder Creek from the natural barrier (below headwater meadow) on East Fork Boulder Creek to its confluence with West Fork Boulder Creek;

- approximately 0.2 miles (0.4 km) of lower West Fork Boulder Creek, from a previously constructed barrier to its confluence with East Fork Boulder Creek;

- approximately 0.5 miles (0.8 km) of Boulder Creek from the confluence of East Fork Boulder Creek and West Fork Boulder Creek downstream to a previously constructed fish barrier; and

- all seeps and springs flowing into those sections of the stream reaches specified in the permit.

The UDWR activities that would be authorized by the Forest under the Proposed Action would completely eradicate non-native trout from East Fork Boulder Creek, a short segment of Boulder Creek, and a very short segment of West Fork Boulder Creek. All fish would be temporarily eliminated by UDWR from target waters. Use of motorized vehicles by UDWR off of designated routes may be needed to facilitate placement of equipment, especially neutralization equipment, in effective locations.

Several actions that are not part of the Forest Service decision are connected to the UDWR project, as follows. UDWR is proposing chemical treatment of connected waters on private property to meet the purpose of the UDWR project. The entire proposed treatment area is described in Section 1.1 (Figure 1). Following fish removal, UDWR would introduce the CRCT into the treated stream segments to establish self-sustaining populations. Sterile hybrids of species of non-native trout may also be stocked by UDWR at some locations following the treatments to provide sport fishing opportunities while native trout become established. The following describes the UDWR project in detail, including identification of those actions that do not require Forest Service authorization.

Chemicals. Liquid emulsifiable rotenone (Liquid Rotenone, 5% Active Ingredient, EPA Registration No. 432-172) would be used by UDWR to treat target waters. Rotenone was selected as the chemical to use because of its effectiveness in controlling fish populations and its lack of long-term effects on the environment (Sousa et al 1987). When used at the concentrations planned for the UDWR project, rotenone is a naturally occurring fish toxicant that is toxic to only fish, some aquatic invertebrates, and some juvenile amphibians. EPA found it to be not toxic to humans, other mammals, and birds at the concentrations used to remove fish (EPA 2007). It has been widely used in the United States since the 1950's. UDWR has used rotenone successfully in many similar projects and has refined application techniques to minimize adverse side effects to the environment (Hepworth et al. 2001a, Hepworth et al. 2001b, Hepworth et al. 2001c, Ottenbacher and Hepworth 2001, Chamberlain and Hepworth 2002a, Chamberlain and Hepworth 2002b, Chamberlain and Hepworth 2002c, Fridell et al. 2004, Fridell et al. 2005, Fridell and Rehm 2006).

Potassium permanganate would be used by UDWR to neutralize the rotenone at suitable locations to prevent the movement of rotenone into non-target waters. Potassium permanganate was selected, because it is a strong oxidizer that breaks down into potassium, manganese, and water. All are common in nature and have no deleterious environmental effects at the

concentrations that would be used for the UDWR project activities, including those that would be authorized by the Forest under the Proposed Action (Finlayson et al. 2000). Potassium permanganate is used as an oxidizing agent in treatment plants to purify drinking water (EPA 1999). Although the oxidation process is not immediate, neutralization should occur within an estimated 0.25 to 0.5 miles of the neutralization site.

A more detailed description of the chemicals that would be used for the UDWR project activities, including those that would be authorized by the Forest under the Proposed Action, can be found in Appendix A.

Application. Liquid rotenone would be applied by UDWR at a rate of 0.5 to 2.0 ppm. In the pond and reservoir, liquid rotenone would be dispersed from personnel on small water-craft using pressurized backpack spray units. For flowing waters, seeps, and springs, liquid rotenone would be applied using a combination of 30 gallon and 5 gallon dispensers with constant flow drip-heads at approximately 50 to 60 stations throughout the UDWR project area over a 3 to 24 hour period (Finlayson et. al 2000, Ottenbacher et al. 2009). One 30 gallon drip station would be used by UDWR at each at the following (Figure 2):

- lower end of the headwater meadow at the upstream end of the UDWR project area,
- approximately halfway between the headwater meadow and King's Pasture Reservoir,
- immediately below King's Pasture Reservoir, and
- at the intake for the water flow pipeline between the West Fork Reservoir and King's Pasture Reservoir.

Five-gallon drip stations would be located by UDWR at approximately 1 mile intervals, beginning one mile below King's Pasture Reservoir and ending 1 mile upstream from the fish barriers on the main stem of East Fork Boulder Creek, and at all major springs and seeps within the UDWR project area. The interval placement of drip stations on the main stem of East Fork Boulder Creek would be to facilitate efficient travel time of chemicals. Depending on flow volume, a single 30 gallon or 5 gallon drip would be placed by UDWR on the lower fish barrier on West Fork Boulder Creek. Pressurized backpack sprayers would be used by UDWR to apply a diluted solution of the chemical to springs and backwater areas containing fish that were not effectively treated by boat or drip station.

Rotenone would be neutralized by UDWR with potassium permanganate downstream from target waters. Three sites are planned (Figure 3): where the penstock water is released at the upper power plant, where water is released at the main power plant, and at the fish barrier at the lower end of the treatment area. Each site would have a main neutralization station and at least one contingency neutralization station to ensure effectiveness. The neutralization stations would prevent rotenone from escaping the target area, except for the estimated 0.25 to 0.5 miles downstream in which the neutralization or natural degradation of rotenone would be occurring.

Post-treatment activity. Following confirmation of complete non-native trout removal, UDWR would reintroduce CRCT into project stream reaches from "core" CRCT populations or from fish produced by UDWR CRCT brood stocks. Sterile hybrids of species of non-native trout may also be stocked by UDWR at some locations following the treatments to provide sport fishing opportunities while native trout become established. All UDWR transfers or stocking of fish would comply with Utah Department of Agriculture and Food rules and UDWR policies.

Design Criteria. The following design criteria would be implemented and included in the Forest Service authorizations:

1. Stream sections will be treated in the fall to minimize impacts on non-target wildlife species (amphibians, insectivorous birds and bats). The fall treatment period will also minimize the impacts on sport fishing recreation.

2. Each treatment will be preceded by internal and external notifications and media releases to notify the public of treatment sites and dates and will include the following: notification of the Boulder Town Council, notification of private landowners in the treatment area, and news releases in local papers.

3. The treatment area will be placarded to prohibit public access during treatment and for at least 3 days following treatment.

4. Application of the chemical will be conducted by licensed pesticide applicators in accordance with all applicable regulations and policies.

5. Access by motorized vehicles will be on National Forest System roads designated for motorized vehicle use to the extent possible. Any use of motorized vehicles off of designated routes will be minimal and will require written Forest Service approval.

6. Neutralization sites will be placed to maximize their effectiveness at preventing downstream escapement of rotenone.

7. Treated waters will remain open to fishing.

8. Transport to the site and storage of chemicals on the site will comply with FSH 2109.14.40 (Pesticide-Use Management and Coordination Handbook, Chapter 40 - Storage, Transportation, and Disposal).

9. Sentinel fish ("in situ bioassay") will be used for pesticide residues monitoring to determine the presence or absence of unacceptable environmental effects.

10. Treatments will be discontinued if the objective of complete removal of non-native trout from the project area has been met.

Actions connected to but not included in the decision. The following parts of the UDWR project, as described above, are not subject to Forest Service permit requirements, and therefore are not

included in the Forest Service decision. Selection of the Proposed Action is for issuance of the pesticide use permit for the application of rotenone on NFS lands only. The following, however, are considered connected actions and thus included in the environmental analysis:

1. The proposed UDWR treatment area includes private property, including property owned by Garkane Energy; thus, this area is not under Forest Service jurisdiction. This includes approximately 1.4 miles of East Fork Boulder Creek, Kings Pasture Reservoir, and the pond in Kings Pasture. To meet the purpose and need of the UDWR project, these areas as well as the water in the transmission pipeline and penstock must be treated by UDWR. Forest Service approval of the pesticide use permit for UDWR to apply rotenone to waters on NFS land is not approval of UDWR activities on non-NFS lands; however, the Forest Service would not approve the pesticide use permit unless UDWR is able to complete its project by treating waters off of NFS land.

   The expectation is that the entire UDWR project treatment area would receive chemical treatment as described below, although the UDWR may decide to use another method or methods to achieve the treatment objective. FERC license order Section 4(e), item 16, condition 4, requires Garkane Energy to use its reasonable efforts to cooperate in the work of UDWR and other agencies to remove non-native fish and re-establish CRCT in the above stream sections. This cooperation has already been demonstrated through construction of the fish barriers and through the first chemical treatment of Kings Pasture Reservoir in 2009.

2. Stocking of fish is under the jurisdiction of UDWR; thus, the CRCT stocking is not under Forest Service jurisdiction. To meet the purpose and need of the UDWR project, the stream would need to be stocked by UDWR with CRCT from core populations or UDWR brood stock post-treatment.

   The expectation is that the post-treatment recolonization/stocking of CRCT would occur as described. The purpose and need for the UDWR project, including stocking with CRCT, is to implement conservation actions under the CRCT Conservation Agreement and Strategy, to which UDWR is a signatory. In addition, the Forest Service conditions regarding the non-native fish eradication and fish restocking were included in a 2006 settlement agreement relating to the FERC license conditions and signed by Garkane Energy, Forest Service, and UDWR.

3. Fishing regulations, including whether or not treated waters would remain open to fishing, is under the jurisdiction of UDWR.

   The expectation is that UDWR would manage the fishing regulations to meet the conservation actions under the CRCT Conservation Agreement and Strategy. UDWR recognizes the importance of the area to recreation users. Because of this, UDWR may also stock sterile hybrids of species of non-native trout at some locations following the treatments while native trout become established.

2.1.3 Non-chemical Treatment Alternative

Under the Non-chemical Treatment alternative, the Forest Service would authorize UDWR to use motorized vehicles off of designated routes and approve a special use authorization for UDWR to bury fish that are removed as necessary to implement a non-chemical treatment to remove non-native trout from waters on NFS land.

The non-chemical treatment methods would not involve the use of rotenone or other pesticides on NFS lands and, therefore, would not require Forest Service approval. The effects of the non-chemical treatment are being analyzed, because this option may be exercised by UDWR in the event that the Forest Service were to choose not to authorize pesticide use, and the approach would be a connected action to the authorization of the use of motorized vehicles off of designated routes and approval of a special use authorization for burial of removed fish. The other connected actions that would also not require new Forest Service action are described below. UDWR's non-chemical treatment and other connected actions may or may not occur under the No Action alternative if the UDWR were to use motorized vehicles only on designated routes. These UDWR actions also may or may not occur under the Proposed Action.

Under the Non-chemical Treatment alternative, UDWR would use electrofishing to remove non-native trout from the treatment waters on NFS lands. Except for possible motorized vehicle use off of designated routes and burial of removed fish, this alternative would not require Forest Service authorization.

Treatment area. The treatment area would remain the same as described in the Proposed Action.

Methodology and Equipment. Electrofishing would be used by UDWR to remove non-native trout from the treatment area on NFS lands. Electrofishing introduces an electric current into the water and is commonly used as a fish removal method. The electricity causes an involuntary muscle contraction in the fish, attracting them toward the source of the electricity (electrode). Workers with long-handled nets then collect the stunned fish. Voltage, amperage, pulse frequency, and waveform are manipulated to maximize effectiveness, which can be influenced by water flow and velocity, temperature, clarity, conductivity (dissolved mineral content), and substrate. Other factors influencing effectiveness include the fish size, species and behavior, presence of aquatic vegetation, time of year, and time of day. It is most effective in shallow water and is, therefore, most commonly used in rivers and streams and occasionally in the shallow water zones of lakes.

Electrofishing removal would be accomplished by UDWR using multiple Smith-Root LR24 backpack electrofishing units or their equivalent from another manufacturer. Block nets of sufficient width would be set up to prevent fish emigration during removal activities. Dip nets, buckets, and live wells would also be necessary for capture and removal of brook trout (*Salvenlinus fontinalis*) and capture and safe holding of CRCT.

Removal activities. Mechanical removal of non-native trout species using backpack electrofishing has been attempted in several other projects (Moore et al. 1986, Meronek et al. 1996, Thompson and Rahel 1996, Buktenica et al. 2000, Kulp and Moore 2000, Shepard et al.

2002, Peterson et al. 2004, Moore et al. 2005, Meyer et al. 2006, Earle et al. 2007). The results of these prior mechanical removal projects indicate: 1) achieving complete mechanical removal of trout in streams with the width, complexity, and number of small, heavily vegetated springs/tributaries found in East Fork Boulder Creek would be difficult; 2) success would be enhanced by implementing multiple-pass depletion removal efforts 3 to 4 times within the same year, and 3) success would be enhanced by treatment over multiple years (minimum of 2). For this UDWR project, the multi-year removal effort would involve a minimum of 5 to 6 people conducting multiple-pass removal efforts for the majority of summer and early autumn (late June to September) over a period of several years. While such removal efforts would undoubtedly cause major reductions in brook trout density and biomass, they may or may not result in complete eradication. UDWR would begin CRCT reintroduction efforts only when no brook trout are found within the project area.

The electrofishing removal by UDWR would follow the population monitoring methods used by Utah State University's Institute for Natural Systems Engineering, Utah Water Research Lab (INSE) during their Garkane-funded fish population monitoring on the Boulder Creek system (Hardy et al. 2009a, Hardy et al. 2009b). Personnel would electrofish approximately 100-meter reaches in 8.5 miles of the mainstem of East Fork Boulder Creek, West Fork Boulder Creek, and Boulder Creek along with all spring inflows and tributary streams. A block net would be placed across the upstream and downstream end of each reach to increase capture efficiency by preventing emigration. Up to 4 passes, or until no fish were collected, would be completed through each reach. Each pass would involve all personnel walking in the stream channel and on the banks while applying constant electric current to the water from at least two backpack electrofishers. All organisms within the stream would be subjected to the electric field. All non-native brook trout would be removed from the system, killed and buried. Any CRCT collected would be held in buckets/live wells and returned to the stream after completion of the 4 pass removal.

Effort. One crew would consist of at least 2 personnel using backpack electrofishers, 2 netters retrieving stunned fish, and 1 person with a bucket receiving and disposing of fish. Electrofishing batteries would be recharged using small gasoline powered generators. Based on their previous monitoring efforts, INSE estimated that in a 40 hour work week, 9 sites that were each 100 m long could be completed by a 5 to 6 person crew using the four pass methodology (C. Williams, Institute for Natural Systems Engineering, personal communication with M. Golden, Dixie National Forest, 3/12/2010). Based on this INSE estimate, for UDWR fish removal activities under the Non-chemical Treatment alternative, one removal effort on the 11.5 km mainstem stream (12.8 reaches, 900 m long) on NFS land would require approximately 512 hours (12.8 reaches times 40 hours) or 63 days (8 hours per day) to be completed by a 5 to 6 person crew using the four pass method. An additional effort of approximately 13 days would be needed to treat the 2.3 km mainstem on private property.

Because UDWR's removal activities would need to occur between late-June or early July and September to minimize access, weather, and high stream flow issues, each removal effort would be limited to approximately 20 days to be able to conduct 4 removal efforts in a single year. To be able to treat the entire mainstem stream, on NFS lands and private lands, during any one removal effort, 20 people (four 5-person crews) would be needed. For four removal efforts, this

would total up to 80 days per year. As described below, UDWR may need up to 10 years of removal effort under this method.

During the UDWR's 2009 chemical treatment of East Fork Boulder Creek above King's Pasture Reservoir, 23 relatively large inflows or tributaries with permanent fish habitat were identified, along with many smaller springs and seeps capable of at least temporarily holding small fish. These tributaries and inflows varied in length from 10 m to over 750 meters. Additional inflows and tributaries that contain fish habitat are probably present in the reach below Kings Pasture and could add another 30 days or more to the estimated treatment time.

Efficiency of fish removal by electrofishing is substantially lower in certain types of habitats found in the treatment area, especially those with heavy aquatic vegetation, root wads, woody debris, and boulder fields. The time for one removal effort in these types of areas could be higher, and effectiveness could be lower. Also, in order to eliminate the possibility of fish moving between treated and untreated reaches, crews would need to operate simultaneously, which may negatively impact fish-removal efficiency, as stream bed disturbance from upstream crews would impact water clarity and visibility for downstream crews. Because of reduced removal efficiency with electrofishing as the fish removal method, the UDWR project may extend to 10 years.

Post-Fish Removal activities. Post-fish-removal activities by UDWR would be the same as those described for the Proposed Action.

Design Criteria. The following design criteria would be included in the written authorization for use of motorized vehicles off of designated routes and the special use authorization for the burial of removed fish:

1. State of Utah decontamination protocols for prevention of the spread of Aquatic Nuisance Species will be followed for all gear and personnel involved with the removal project.

2. The Forest Archaeologist will be consulted about potential locations to bury fish to avoid impacts to cultural resources.

3. Dead fish collected will be buried no closer than 300 feet from the stream and away from known camping areas to minimize bear/human interactions.

4. Access by motorized vehicles will be on National Forest System roads designated for motorized vehicle use to the extent possible. Any use of motorized vehicles off of designated routes will be minimal, and will require written Forest Service approval.

5. Trails will be used whenever possible to move from one location to another to minimize soil and vegetation disturbance and to prevent establishing new trails.

6. Sensitive plant habitat will be avoided during action implementation.

7. Personnel will ensure reach being treated is void of livestock and people not involved with the operation. Treated waters will remain open to fishing.

Actions connected to fish removal actions on NFS lands. The following parts of the UDWR project, as discussed above, are not subject to Forest Service permit requirements, and therefore are not included in the Forest Service decision. They are considered connected actions to UDWR's fish removal activities on NFS lands and thus included in the environmental analysis:

1. As described for the Proposed Action, the UDWR treatment area includes private property, including that owned by Garkane Energy; thus, this area is not under Forest Service jurisdiction.

   The expectation is that under the Non-Chemical Treatment alternative, the UDWR would implement non-chemical treatment methods on non-NFS lands, as described below, although the UDWR may decide to use another method or methods to achieve the treatment objective on the private lands or not pursue treatment on the private lands. The flowing portions of the project area on private lands would undergo similar electrofishing removal by UDWR, as described for NFS lands above.

   For the non-flowing portions of the project area on private lands, electrofishing would not be effective in removing brook trout from King's Pasture Reservoir or the pond in Kings Pasture. To remove brook trout from these areas without use of chemicals, UDWR would deploy experimental gill nets with many different mesh sizes at several locations and depths throughout each water body. Other studies where this method has been successful at eradicating brook trout suggest that it would take at least two and up to four seasons of semi-continuous netting to eliminate all size classes of trout from small lakes with relatively low trout densities (Knapp and Matthews 1998, Parker et al. 2001).

2. Potential recolonization from East Fork Boulder Creek would severely reduce the efficacy of removing brook trout from King's Pasture Reservoir; therefore, UDWR would need to construct a fish migration barrier in East Fork Boulder Creek on private property above King's Pasture Reservoir (Figure 4).

   The barrier would generally consist of a small check dam constructed of boulders and large rocks, creating a vertical drop of approximately 5 ft on the downstream side. The location for the barrier would be selected by UDWR to utilize any naturally occurring drops which can be enhanced and where the stream channel and floodplain are confined to minimize the size of the structure and the amount of water impounded behind it. Barrier construction would comply with laws, regulations, and permitting requirements of the State Engineer for stream channel alteration. Barrier materials would be taken from the ground surface, near the stream. The collection of these materials would not require excavation, stream alteration, or vegetation disturbance. If sufficient material is not available on site, additional materials would be hauled to the barrier site from an approved source.

The barrier location would be selected by UDWR to minimize changes in stream gradient, hydraulic function, and water pooling. In addition, the barrier would be constructed by UDWR adjacent to existing roads where equipment access is acceptable, thus requiring little disturbance to surrounding areas. Riparian vegetation would be disturbed as little as possible during the construction of the barrier, while areas where surface disturbance would occur would be restored to pre-project conditions. The barrier would not be placed in areas of cultural or historic significance or in areas where sensitive, threatened or endangered plants occur. It would be designed to operate under the natural fluctuations of a stream flow without routine maintenance. The barrier would be designed to pose little, if any, threat to the natural stream system or its associated riparian area so that if it were to fail, no damage would result to the stream environment. UDWR's maintenance could include the adjustment or replacement of individual rock materials, but such work would be minor. The barrier could be removed but only after treatment is determined to be fully successful.

Neither netting nor electrofishing are options for UDWR for removing any non-native trout that may be using the upper portion of the penstock inflow or the lower portion of the pipeline from the West Fork Reservoir during treatment efforts. Shutting off water to these areas until they were completely dry would be the only way to ensure complete eradication; however, this is not feasible (M. Avant, Garkane Energy, personal communication with M. Golden, Dixie National Forest, 4/1/2010). Because of this, the effectiveness of the rest of the treatment would be reduced, contributing to the likelihood of the longer period of treatment.

3. Stocking of fish by UDWR would be as described for the Proposed Action.

4. As described for the Proposed Action, fishing regulations, including whether or not treated waters would remain open to fishing, is under the jurisdiction of UDWR. The expectation is as described for the Proposed Action.

2.2 Alternatives Considered but Eliminated from Detailed Study

In comments that were submitted, numerous alternative methods or programs were suggested for removing non-native trout:

1) increased angler pressure, such as unlimited catch and hold for brook trout in affected sections or at specific times

2) organized netting effort, including volunteers

3) double barricades, including barriers above King's Pasture Reservoir to ensure non-native species cannot travel and spawn above that point

4) intensive stocking with cutthroat to pressure out brook trout or to compensate for the CRCT's inability to compete with brook trout

5) cease stocking non-native trout in any lake or pond above East Fork Boulder Creek headwaters that has the potential to release water and non-native fish into the headwaters just below the Boulder Mountain escarpment

6) volunteer help to remove fish other than with chemicals

7) permitted commercial fishing to remove brook trout

8) use of weir nets then smoking fish for sharing fish for local consumption.

The Forest discussed these suggestions with the UDWR as alternatives to the need for the pesticide use permit. They were dismissed from detailed analysis in this document. Unlike the possible effectiveness of UDWR removing non-native trout through chemical treatment or electrofishing, methods such as increasing angling pressure or commercial fishing would not be effective for removal of fish smaller than catchable size. Barricades are already in place where needed to prevent non-native trout from moving into the treatment area; however, their presence would not reduce the existing populations of non-native trout in the treatment area. When brook trout were introduced, they outcompeted what was the dominant species, CRCT, indicating that intensive stocking by UDWR would not compensate for CRCT's inability to compete with brook trout. In conjunction with the activities that would be authorized by the Forest under the Proposed Action, current and future UDWR fish management for waters draining into the proposed UDWR project area is stocking with CRCT, sterile brook trout, or sterile hybrids. As discussed in the Non-chemical Treatment alternative, netting has limited effectiveness in removing all age classes of non-native trout, especially in the type of substrate and flowing water environment of the treatment area.

As with the UDWR treatment methods in the Non-chemical Treatment alternative, these suggested alternatives generally do not require Forest Service approval or authorization. The decision to be made for the Proposed Action would not preclude future consideration by UDWR for use of these methods or programs for the purpose of non-native trout eradication from the treatment area. Some associated activities with these methods, such as construction of barricades if on NFS land, may require Forest Service authorization, which, if needed and requested, would undergo appropriate review procedures and appropriate NEPA analysis.

2.3 Comparison of Alternatives

This section provides a summary of the activities and effects of UDWR implementing their proposed project, including those activities that would be authorized by the Forest under the different alternatives.

Because the decision would affect only those UDWR activities on NFS land for which Forest Service authorization is required, the overall set of possible UDWR activities on NFS-land and non-NFS land in the UDWR proposed project area under each of the alternatives has multiple potential combinations. They are as follows:

- On NFS land
    - No further treatment
        - No Action, Proposed Action, Non-chemical Treatment alternative
    - Chemical treatment
        - Proposed Action
    - Non-chemical treatment as described in the Non-chemical Treatment alternative
        - No Action, Proposed Action, Non-chemical Treatment alternative
    - Non-chemical treatment other than as described in the Non-chemical Treatment alternative (but not included in alternatives because not considered feasible)
        - No Action, Proposed Action, Non-chemical Treatment alternative
    - Motorized use off of designated routes
        - Proposed Action, Non-chemical Treatment alternative
    - Burial of fish
        - Non-chemical Treatment alternative
- On non-NFS land
    - No further treatment
        - No Action, Proposed Action, Non-chemical Treatment alternative (although under the Proposed Action, the Forest Service will not approve the pesticide use permit unless UDWR is able to complete the project by treating, by whatever means, the waters on non-NFS land)
    - Treatment by any method
        - No Action, Proposed Action, Non-chemical Treatment alternative.

Table 1 identifies the Forest Service actions that are involved with each alternative. Because of the numerous possible combinations of treatment actions, the analysis addresses the range of possible effects from the UDWR activities by including analysis for no further treatment by UDWR anywhere in the proposed project area (as described as the No Action – No Further Treatment Scenario), chemical treatment by UDWR throughout the proposed project area (as described for the Proposed Action), and non-chemical treatment by UDWR throughout the proposed project area (as described for the Non-chemical Treatment Alternative). Information in Table 1 is focused on activities and concern topics for which different levels of effects can be distinguished quantitatively or qualitatively among alternatives.

Table 1. Comparison of alternatives, including connected actions

	No Action – No Further Treatment Scenario	Proposed Action	Non-chemical Treatment Alternative
Forest Service action	No authorizations	Authorize pesticide use permit for UDWR chemical treatment; authorize UDWR use of motorized vehicles off of designated routes	Authorize UDWR use of motorized vehicles off of designated routes; special use authorization for UDWR to bury removed fish
Fish	No effect	Eradicate all fish in treatment area, followed by recolonization/ restocking of CRCT	Eradicate all non-native fish in treatment area, possible injury/mortality to native fish, followed by recolonization/ restocking of CRCT
Colorado River cutthroat trout conservation	None	Meet purpose and need; recolonization/restocking with CRCT in 2 or 3 years	Success questionable; probable longer period before recolonization/restocking
Terrestrial wildlife	No effect	Possible effects to but not adversely affect California condor, Mexican spotted owl, bald eagle, flammulated owl, three-toed woodpecker, northern flicker, northern goshawk, peregrine falcon, spotted bat, Townsend's big-eared bat, mule deer, Rocky Mountain elk, wild turkey, broad-tailed hummingbird, American dipper	Same as for Proposed Action except for potential adverse effects to northern goshawk if territory is active and to peregrine falcon if active nest is in area because of timing and duration of disturbance
Water quality	No effect	Short-term effects from chemicals on infrequent primary contact recreation but mitigated with design criterion; short-term effects to cold water species of game fish and other cold water aquatic life	Short-term increase in turbidity
Boulder Top draft unroaded/undeveloped area – Special Feature	Non-native fish would remain	CRCT would be restored	Decreased likelihood of creating self-sustaining population of CRCT
Boulder Mountain/ Boulder Top/Deer Lake and New Home Bench Inventoried Roadless Areas – Diversity of Plant and Animal Communities	Existing effects of non-native species on amphibians would remain	Diversity of amphibian species likely to improve	Same as for Proposed Action
Chemical effects to public health	None	Potential impacts from acute exposure from chemicals but ameliorated by project design	None
"Pristine" environment and Boulder, Utah, goals relating to "quiet atmosphere" and noise	No effects	Long-term, same as No Action – No Further Treatment Scenario. Short-term activity disturbance from crews commuting to access sites and chemical application activities.	Same as for Proposed Action except disturbance will be from fewer people but for more treatment days and years and includes barrier construction.

2.4 Findings and Disclosures

2.4.1 National Forest Management Act

This analysis incorporates by reference the direction provided in the Dixie National Forest Land and Resource Management Plan (LRMP) (1986) as amended. This analysis is a project level analysis that is not intended to re-examine the basic land use allocations made in the LRMP, nor propose broad changes in land use allocations. Instead, planning at the project level involves the development, analysis, and disclosure of likely environmental impacts associated with the implementation of specific actions designed to achieve the overall goals and objectives of the LRMP. The portion of the UDWR project area on NFS lands falls within management area 9A (Riparian Management).

The Proposed Action would be consistent with the desired future condition and management direction for management area 9A. All UDWR project activities that would be authorized by the Forest under the Proposed Action fully comply with the LRMP.

The Non-chemical Treatment alternative would be consistent with the desired future condition and management direction for management area 9A. The UDWR activities that could occur may not be consistent with maintaining the minimum viable population for northern goshawk as listed on Table II-13A of the LRMP, because the timing and duration of disturbance expected with the Non-chemical Treatment alternative could likely cause nest abandonment if the territory was active.

The No Action – No Further Treatment Scenario would not be consistent with LRMP Goal No. 13, Coordinate fish and wildlife program with UDWR; Goal No. 14, Improve the quantity and quality of aquatic habitats through direct habitat improvement and increased coordination with other land use programs; and Goal No. 17, Manage classified species habitat to maintain or enhance their status through direct habitat improvement and agency cooperation.

2.4.2 Endangered Species Act

The Endangered Species Act of 1972 (ESA) requires that actions of Federal agencies do not jeopardize or adversely modify Critical Habitat of federally listed species. None of the alternatives are anticipated to have adverse direct, indirect, or cumulative effects on any threatened or endangered species in or outside the UDWR project area. No Critical Habitat for any listed species will be adversely impacted with implementation of any of the alternatives. A biological assessment is included in the project record.

2.4.3 National Historic Preservation Act

Neither the No Action – No Further Treatment Scenario nor Proposed Action alternative would result in ground-disturbing activities; therefore, no cultural or historic resources would be impacted. The Non-chemical Treatment alternative would include design criterion #2 as the appropriate measure that would be implemented to prevent impact to cultural or historic resources.

2.4.4 Clean Water Act

The Clean Water Act (CWA) requires each state to implement its own water quality standards. The State of Utah's Water Quality Antidegradation Policy requires maintenance of water quality to protect existing instream Beneficial Uses on streams designated as Category 1 High Quality Waters. All surface waters geographically located within the outer boundaries of Forest, whether on private or public lands, are designated as High Quality Waters (Category 1). This means they would be maintained at existing high quality. Application of rotenone by UDWR is considered a point source; however, design criterion #4 of the Proposed Action would require UDWR to obtain all necessary approvals, including those to meet CWA requirements. Non-point sources would be controlled to the extent feasible through implementation of Best Management Practices (BMPs) or regulatory programs of the Utah Division of Water Quality. The State of Utah and the Forest Service have agreed through a 1993 Memorandum of Understanding to use LRMP Standards and Guidelines and the Forest Service Handbook (FSH) 2509.22 Soil and Water Conservation Practices (SWCPs) as the BMPs. The UDWR's use of SWCPs as the BMPs in implementing their proposed treatment, including actions that would be authorized under the Proposed Action or the Non-chemical Treatment alternative, would meet the water quality protection elements of the Utah Nonpoint Source Management Plan.

The Beneficial Uses and High Quality of water in the streams draining the UDWR project area would be maintained during and following UDWR's project implementation through UDWR's proper implementation of BMPs (SWCPs) as described in affected environment section.

2.4.5 Clean Air Act

Emissions anticipated from the implementation of any UDWR project activities that would be authorized by or connected to the Forest under the Proposed Action or Non-chemical Treatment alternative would be of short duration and would not be expected to exceed State of Utah ambient air quality standards (18 AAC 50).

2.4.6 Executive Order 11990 of May 1997

This order requires Federal agencies to take action to minimize destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In compliance with this order, Federal agency direction requires that an analysis be completed to determine whether adverse impacts would result.

The locations of wetlands in the UDWR project area were identified in the delineation and inventory of critical watershed areas. No ground disturbing activities would occur within 50 ft of any wetland, seep, or spring. With a 50 ft buffer area around any wetlands, seeps, or springs and implementation of SWCPs and BMPs, any of the alternatives would be in compliance with Executive Order 11990.

2.4.7 Executive Order 11988 of May 1997

This order requires Federal agencies to provide leadership and to take action to (1) minimize adverse impacts associated with occupancy and modifications of floodplains and reduce risks of flood loss, (2) minimize impacts of floods on human safety, health, and welfare, and (3) restore and preserve the natural and beneficial values served by floodplains. In compliance with this order, the Federal agency requires an analysis be completed to determine the significance of proposed actions in terms of impacts to floodplains.

Ground disturbing activities by UDWR would be limited to a small zone at the barrier site for the Non-chemical Treatment alternative only. The barrier would be constructed of large native rock and would mimic natural boulder plunge-pool habitats. It would be keyed into adjacent banks to prevent erosion and promote development of a new floodplain above the structure. Disturbed areas would be revegetated. No new roads would be established under any of the alternatives.

Because under the Proposed Action or Non-chemical Treatment alternative UDWR's ground disturbing activities would be limited and revegetated, either of the proposed alternatives will be in compliance with Executive Order 11988.

2.4.8 Strategy for Implementing MBTA and EO 13186

Executive Order 13186, signed January 10, 2001, directs Federal agencies to protect migratory birds by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practical, adverse impacts on migratory birds' resources when conducting agency actions. This order directs agencies to further comply with the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act, and other pertinent statutes. This analysis is compliant with the National Memorandum of Understanding between the USDA Forest Service and the USFWS to promote the conservation of migratory birds (USFS 2008b). In addition, the Forest is compliant with the letter of understanding to the USFWS Utah Field Office concerning compliance with MBTA and Executive Order 13186 (USFS 2007).

2.4.9 Executive Order 12898 of February 1994

This order requires each Federal agency, to the greatest extent practicable and permitted by law, to make achieving environmental justice part of its mission by identifying and addressing as appropriate, disproportionately high and adverse human health or environmental effects, including social and economic effects, of its programs, policies and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. Boulder, Utah, is the only community within the watershed of the UDWR project area. It would be considered a low-income community, with a median household income of $30,000 being lower than the state median household income of $45,726 (per 2000 census, last full census data, www.factfinder.census.gov). It would not be considered a minority community, with racial demographics being white (75.1%).

Similar projects that have occurred in other locations on the Forest were based on conservation requirements, regardless of income level or minority population of nearby communities. The location of this proposed UDWR project was selected based on conservation requirements for the CRCT, as discussed in Section 1.2 of this document.

This document analyzes human health, economic, and social effects of the proposed UDWR project activities, including those that would be authorized by the Forest under the Proposed Action or Non-chemical Treatment alternative. Design criteria have been included to reduce environmental effects. As described in Section 1.6, public scoping included a public meeting in Boulder to make participation by Boulder residents as easy as possible. The analysis, consideration in design criteria development, and public involvement meet the USDA regulation DR5600-2, which provides direction to agencies for integrating environmental justice considerations into USDA programs and activities in compliance with Executive Order 12898.

2.5 Effect of Climate Change on Meeting the UDWR project Purpose

Climate change may have an effect on the CRCT habitat conditions in the treatment reach. A drier interior of the west could result in reduced stream flow or increased temperature; however, the lack of hydrologic observing systems designed specifically for the purposes of detecting climate change or its effects on water resources, as well as compounding effects of other influences on water quality, makes impossible a model or prediction of future changes (Lettenmeier 2007). Although the extent of future change is unknown, the CRCT in the treatment reach have persisted despite flows that were below the minimum 2 cfs that is now required under the Boulder Creek FERC license. Water flow in the treatment reach is regulated and will be above those conditions through which CRCT have persisted; therefore, climate change is not expected to influence the effectiveness of the proposed UDWR project.

3. Affected Environment and Environmental Consequences

This section summarizes the physical, biological, social and economic environments of the affected UDWR project area and the potential changes to those environments due to UDWR's implementation of treatment activities, as described in Section 2 for each alternative and including those that would be authorized by the Forest under the alternatives and UDWR actions that are not included in part of the Forest Service decision but connected actions to the project. The effects analysis for the No Action alternative is based on the No Further Treatment Scenario, as described in Section 2.1.1. More complete analysis can be found in resource specialist reports, which may be found in the project record. The analysis also presents the scientific and analytical basis for the comparison of alternatives presented in Table 1 above.

3.1 Fisheries and Aquatic Biota

3.1.1 Affected Environment

The aquatic biota of streams in two 6th field Hydrologic Unit Codes (HUCs) would be potentially affected by the proposed UDWR project: Headwaters Boulder Creek (140700050206) and Bear Creek-Boulder Creek (140700050209). Streams within these HUCs potentially affected by the proposed UDWR project include: East Fork Boulder Creek, West Fork Boulder Creek, and Boulder Creek. Lakes and reservoirs affected by activities connected to the proposed UDWR project include King's Pasture Reservoir and the pond in King's Pasture.

Aquatic species selected for this analysis include: (a) species that are listed as threatened, endangered, or proposed under the ESA; (b) fish species, including those on the Regional Forester's Sensitive Species List and the Management Indicator Species (MIS) list in the LRMP; (c) amphibians; and (d) aquatic macroinvertebrates.

The MIS for fish habitat for the UDWR project area would be non-native trout combined (specifically, brook trout, rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*)) for Boulder Creek and native cutthroat trout (specifically, CRCT) for East Fork Boulder Creek and West Fork Boulder Creek. CRCT are on the Regional Forester's Sensitive Species List.

In addition the native, non-game mottled sculpin (*Cottus bairdi*) is also present adjacent to the UDWR project area.

Threatened, Endangered, or Proposed Species under the ESA

There are no aquatic species listed as threatened, endangered, or proposed under the ESA and no designated or proposed critical habitat for aquatic species in the UDWR project area or cumulative effects area (CEA); therefore, this topic will not be analyzed further.

Fish

In the 1980s and 1990s remnant populations of CRCT were found in East Fork Boulder Creek and West Fork Boulder Creek (Hepworth et al. 2001a). CRCT are the native trout to the Colorado River system, and the East Fork Boulder Creek population was the first remnant population to be identified in the Escalante River system. CRCT were a Category 2 Candidate Species for listing under the ESA until 1996. A range-wide conservation agreement and strategy for the species was signed in 2001 and renewed in 2006, with Intermountain Region of the Forest Service as a signatory (CRCT Conservation Team 2006, CRCT Coordination Team 2006). CRCT are also an Intermountain Region Sensitive Species.

In the late 1990s CRCT were found throughout 3.8 miles (6.1 km) of East Fork Boulder Creek, but the only significant abundance and standing crop of the species was found in a 0.5 mile (0.8 km) section of stream in the headwater meadow, above a series of natural waterfalls and cascades (Young et al. 1996, Hepworth et al. 2001d, Hadley et al. 2008). The cascades and waterfalls and/or cold temperatures appeared to have prevented non-native brook trout from invading the headwater meadow area. Monitoring since the late 1990s has shown that CRCT can occasionally be found throughout East Fork Boulder Creek in low abundance, but only the headwater meadow and upstream areas maintain a self-sustaining population (Hadley et al. 2008, Hardy et al. 2009 a, Hardy et al. 2009b, Williams and Hardy 2010). Throughout the remainder of East Fork Boulder Creek, brook trout are the dominant species with standing crops that would be considered high to very high for southern Utah trout streams (Hepworth and Beckstrom 2004). Additionally, a large amount of spawning habitat for non-native brook trout exists both above and below the East Fork (King's Pasture) Reservoir, as evidenced by the large number of young-of-year and juvenile brook trout found in fish surveys from these areas (Hadley et al. 2008, Hardy et al. 2009a, Hardy et al. 2009b).

The Boulder Creek mainstem has a non-native sport fishery comprised of rainbow trout, brook trout, and brown trout (*Salmo trutta*). Trout biomass has been consistently higher at the monitoring station downstream from the main power plant return flows. Trout biomass upstream from the main power plant return flows has been lower from 2008 through 2010 than it was in 2002 and 2007. Below the main power plant return flow trout biomass has varied, but was highest in 2008. With the exception of the 2009 sampling effort above the main power plant inflow, trout biomass has been average or above average for southern Utah trout streams at both locations (Hepworth and Beckstrom 2004).

The native, non-game mottled sculpin (*Cottus bairdi*) is also present in Boulder Creek; however, their upstream distribution appears to end somewhere between the main power plant return flow and the confluence of East Fork Boulder Creek and West Fork Boulder Creek.

Amphibians

No recent amphibian observations have been recorded on the Forest portions of the two 6th level HUC watersheds overlapped by the UDWR project area. Historical records show a single boreal toad (*Anaxyrus boreas*) observation within the Headwaters Boulder Creek HUC in 1960 (Fridell et al. 2000, UDWR Southern Region Native Aquatics database). Boreal toad was added to the

Intermountain Region's Regional Forester's Sensitive Species List in 2010. UDWR surveys between 1994 and 1998 found no boreal toads in the two watersheds affected by the UDWR activities that would be authorized by the Forest under the Proposed Action. No recent observations of boreal toad have been documented in the Escalante River drainage.

Historical observations of Great Basin spadefoot toad (*Spea intermontana*), red-spotted toad (*Bufo punctatus*), Woodhouse's toad (*Bufo woodhousii*), boreal chorus frog (*Pseudacris maculata*), and tiger salamanders (*Ambystoma tigrinum*) are recorded for adjacent drainages on and off the Forest (UDWR Southern Region Native Aquatics database). Forest Service employees have observed boreal chorus frog in the Lower Pine Creek Watershed (6th level HUC 140700050107) and Woodhouse's toad in the Oak Creek watershed (6th level HUC 140700030408) within the past 10 years. In 2010 Forest personnel conducted amphibian surveys at several locations within East Fork Boulder Creek drainage and did not find any evidence of amphibians (Golden and Mecham 2010a, Golden and Mecham 2010b). It is possible that some individual amphibians occur in the vicinity of the UDWR project area or CEA, but currently there are no known breeding sites or breeding populations in the streams, springs, ponds and reservoirs potentially affected by the proposed UDWR project.

Aquatic macroinvertebrates

The aquatic macroinvertebrate community within the UDWR project area has been inventoried several times in the last 20 years. No aquatic insect species that are classified as having special-status are known to be present in UDWR's proposed treatment area. No rare or endemic species are known to be present in the proposed treatment area.

Total taxa richness and Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa richness are metrics commonly used to assess stream health and community diversity (Barbour et al. 1999). Macroinvertebrate sampling at two locations on Boulder Creek in May and October 1994 showed total taxa richness between 28 and 36 taxa and EPT taxa richness between 14 and 20 taxa (Mangum 1995). Aquatic macroinvertebrate samples collected from West Fork Boulder Creek just upstream from FR30166 by Forest personnel in 2003 and 2010 showed similar richness levels to the 1994 Boulder Creek samples (Vinson 2005, Judson and Miller 2011).

Forest personnel collected macroinvertebrate samples on East Fork Boulder Creek above King's Pasture Reservoir three times in 1996 and Utah Division of Water Quality repeated collections at that site in 2005 (Mangum 1997, STORET station 5989260). Total taxa richness and EPT taxa richness of those samples were lower than that seen in West Fork Boulder Creek and Boulder Creek samples, and the East Fork Boulder Creek community would rank as "fair" based on the predictive model in development by the Utah Division of Water Quality (Ben Holcomb, Utah Division of Water Quality, personal communication). An additional sample collected in East Fork Boulder Creek just upstream from FR30166 in 2011 showed very similar levels of total taxa and EPT taxa richness to the sample collected in West Fork Boulder Creek in 2011 (Judson and Miller 2011).

Cumulative Effects Area and Activities

The potential cumulative effects on fish and aquatic resources from the UDWR proposed project activities, including those that would be authorized by the Forest under the alternatives, are effects to the likelihood of successful conservation of CRCT and effects on fish habitat.

The CEA for conservation of CRCT is the Lower Colorado Geographic Management Unit (GMU).

The CEA for aquatic biota includes Bear Creek-Boulder Creek watershed (6^{th} field HUC140700050210) and the Headwaters of Boulder Creek watershed (6^{th} level HUC140700050209). This area encompasses a total of 62,794 acres, of which 49,440 acres are located on the Escalante Ranger District (see Table 2).

Table 2. Aquatic Biota Cumulative Effects Area.

Watershed	6^{th} Field HUC	Acres	Acres on Escalante R.D.
Bear Creek-Boulder Creek	140700050210	28,822	15,468
Headwaters of Boulder Creek	140700050209	33,972	33,972

3.1.2 Direct and Indirect Effects of the Alternatives

No Action – No Further Treatment Scenario

Fish

Under the No Action - No Further Treatment Scenario, UDWR would not remove or kill fish in the waters described in the treatment area. Non-native brook trout would not be removed; therefore, they would remain the dominant fish throughout the majority of East Fork Boulder Creek. CRCT would remain largely restricted to the small headwater meadow area of the stream, physically and genetically isolated from populations in West Fork Boulder Creek.

Under the No Action - No Further Treatment Scenario, brook trout would remain in East Fork Boulder Creek, which would not allow for any significant expansion of the range of CRCT. Brook trout are prolific breeders and can quickly increase their population size to relatively high densities (Ficke et al. 2009). Once brook trout have invaded an area with native cutthroat, they can reduce cutthroat numbers through a combination of depredation and competition. Brook trout are successful at invading native cutthroat trout habitat and displacing native cutthroat trout through direct impacts to native cutthroat trout recruitment and indirect impacts to adult native cutthroat trout growth and survival (Peterson et al. 2004). Brook trout are also prolific and have

been shown to reach densities and exhibit production twice that of native cutthroat (Benjamin and Baxter, 2010). High densities, combined with more aggressive behaviors can force adult native cutthroat trout from optimum habitats (Buys et al. 2009).

The No Further Treatment Scenario would not expand the self-sustaining CRCT population beyond its current 0.5 km (0.8 mile) headwaters meadow reach. In general, population viability of cutthroat trout is correlated with stream length or habitat size (Hilderbrand and Kershner 2000, Harig and Fausch 2002, Hildebrand 2003, Young et al. 2005). Hilderbrand and Kershner (2000) estimated 8.2 km (5.1 mi) were required to maintain a population of 2,500 cutthroat trout when fish abundance was high (300 fish/km [484 fish/mi]). Adjusting for emigration and mortality and smaller population sizes of 200 fish/km (320 fish/mi) and 100 fish/km (160 fish/mi), increased the corresponding length to 12.5 (7.8 mi) and 25 (15.5 mi) stream km, respectively (Hilderbrand and Kershner 2000). Young et al. (2005) found that to maintain a population of 2,500 cutthroat trout, 8.8 km (5.5 mi) of stream was needed. Under the No Action - No Further Treatment Scenario, the CRCT population in East Fork Boulder Creek would not only be limited to 0.5 km (0.8 mi), but with the exception of stray individuals moving downstream it would also be isolated from the population in West Fork Boulder Creek by approximately 7 miles (11.3 km) of stream, including King's Pasture Reservoir, as well as the fish barriers at the lower end of West Fork Boulder Creek.

The No Action - No Further Treatment Scenario would not eliminate the introduced non-native fish, which often have negative impacts on non-game species. This has certainly been true for non-native trout (Crowl et al. 1992, McDowall 2003). Dunham et al. (2000) found that brook trout consumed significantly larger prey than native Lahontan cutthroat trout. Non-native trout have been shown to negatively affect sculpin growth and abundance (McDonald and Hershey 1992, Ruetz et al. 2003, Zimmerman and Vondracek 2006). Zimmerman and Vondracek (2007) demonstrated that while non-native trout negatively impacted sculpin growth, native trout did not. Any negative impacts on native mottled sculpin by non-native trout within the UDWR project area would continue under the No Further Treatment Scenario.

Under the No Action - No Further Treatment Scenario, current trends in fish distribution abundance and biomass would not be affected. The range of CRCT would not be expanded and the risk of local extirpation of the East Fork Boulder Creek population would remain high.

Aquatic invertebrates

No effects to the current aquatic invertebrate community would occur from UDWR treatment activities under the No Further Treatment Scenario, but any differential impacts from the continued proliferation of non-native brook trout would remain. Non-native trout have the capability to change food web dynamics, which could result in changes in benthic invertebrate diversity and abundance (McNaught et al. 1999, Vander Zanden et al. 1999, Parker et al. 2001, Simon and Townsend 2003, Vander Zanden et al. 2003, Baxter et al. 2004, Baxter et al. 2007, Pope et al. 2009). Studies have shown that brook trout and cutthroat trout can differ in the number and types of prey items they consume (Griffith 1974, Dunham et al. 2000, Hilderbrand and Kershner 2004). As discussed under the potential impacts to fish, brook trout have also been shown to be more prolific than native cutthroat trout. Differential consumption and increased consumption by higher densities of fish may have caused changes to the abundance and/or diversity of the native, historic aquatic community of East Fork Boulder Creek when brook trout replaced CRCT as the top-level predator. These changes would persist under the No Action - No Further Treatment Scenario.

Amphibians

Under the No Action - No Further Treatment Scenario, there would be no UDWR treatment activities that would affect individual amphibians that may be present in the UDWR project area; however, the potential for negative effects to native amphibians from non-native trout would remain. Non-native trout have been implicated in the decline of various amphibian species, particularly in alpine lakes (Fellers and Drost 1993, Hecnar and M'Closkey 1997, Tyler et al. 1998, Knapp and Matthews 2000, Maxell 2000, Pilloid and Peterson 2001, Welsh et al. 2006, Pope 2008). A recent study indicates that in addition to direct mortality via depredation by nonnative trout, amphibians can also suffer from competition for invertebrate food resources with nonnative trout (Joseph et al. 2011). As highlighted in the fish analysis, brook trout are more prolific than native cutthroat trout, allowing them to reach higher densities. The higher densities may result in higher consumption rates of amphibians. This increased consumption may have altered the abundance and/or diversity of the historic, native amphibian community. These changes would persist under the No Action - No Further Treatment Scenario.

Additionally, the potential change in historic prey base caused by non-native trout outlined in the aquatic invertebrate analysis may also have had an effect on the prey base of any historic amphibian populations, and this change would also persist under the No Action - No Further Treatment Scenario.

Proposed Action

Fish

Rotenone is highly toxic to fish. In the aquatic environment, rotenone is readily transmitted across the permeable membranes of the gills. Fish are highly susceptible to low concentrations of rotenone. Potassium permanganate is toxic to gill-breathing organisms at the rate (2 to 6 mg/L) required for neutralization. Application of excess potassium permanganate could

adversely affect downstream fish populations; however, as described in the Proposed Action, UDWR would avoid and minimize any effects of potassium permanganate on fish populations.

The short-term direct effects of the UDWR proposed project, including those activities that would be authorized by the Forest under the Proposed Action, would be the eradication of all fish from the proposed UDWR project waters, as well as the potential elimination of fish a short-distance downstream from the neutralization stations. Fish would be killed as a result of the toxicity of rotenone, as described in Appendix A. Fish may also be killed for 0.25-0.5 miles (0.4-0.8 km) below the neutralization station from the combined effects of the rotenone and potassium permanganate before mixing of the chemicals and neutralization can occur. Any fish species impacted downstream of the fish barriers would be able to repopulate this area from downstream sources, as there are no fish barriers present downstream from the recently constructed barriers.

Effects of the UDWR activities as described for the Proposed Action on CRCT. The UDWR activities as described for the Proposed Action would result in mortality of an unknown but likely low number of CRCT present in the treatment area. Sampling over the past 10 years has shown that few CRCT are present in the proposed UDWR project area. Within the UDWR project waters, native CRCT would be reintroduced by UDWR once the waters were found to be free of non-native trout, or CRCT would be allowed to recolonize naturally from upstream populations. A similar project on West Fork Boulder Creek showed that CRCT biomass in the treated reach recovered to that of the untreated reach within 7 years (Hadley et al. 2008, Williams and Hardy 2010). The CRCT response in the treatment area is expected to be similar; therefore, while the UDWR activities as described for the Proposed Action would result in a short-term, non-significant loss of CRCT, overall the UDWR activities would result substantial benefit to the conservation of CRCT.

Recolonization and reintroduction of CRCT in the treated stream reach would expand the current range, restore the species to some of its historic range, and increase the size of the East Fork Boulder Creek population. Implementation of the UDWR project as described for the Proposed Action would reduce the risk of catastrophic loss of CRCT in the Boulder Creek drainage caused by stochastic events, such as flood or drought. Post-treatment restocking has the potential to increase the CRCT occupied stream miles in the drainage by 13.7 km (8.5 miles).

Non-native trout in the UDWR project area are a threat to the conservation and recovery of native CRCT; therefore, their eradication by UDWR from the project area would be a benefit to CRCT, the MIS for the project area, and their habitat.

In areas below the neutralization station, CRCT may be killed in the mixing zone, although very few would be expected, and they could recolonize quickly from downstream areas, which would be unaffected by the UDWR activities as described for the Proposed Action, and upstream areas after CRCT are reestablished.

Effects of the UDWR activities as described for the Proposed Action on non-native trout. Non-native trout would be eliminated from and not restored to the waters treated with rotenone. Non-native trout, the MIS in Boulder Creek, may be killed in the mixing zone below the

neutralization station. Downstream from the fish barriers, they could recolonize quickly from downstream areas, which would be unaffected by the UDWR activities as described for the Proposed Action. Non-native trout populations across the Forest are stable, and the elimination of non-native trout combined from the UDWR project area would not result in a significant impact to their populations Forest-wide (Rodriguez 2008).

Effects of the UDWR activities as described for the Proposed Action on mottled sculpin. Mottled sculpin are currently thought to occur downstream from the UDWR project area; however any mottled sculpin that may exist within the project area would be eliminated by the UDWR activities as described for the Proposed Action. If mottled sculpin are observed within the UDWR project area during implementation of the UDWR activities as described for the Proposed Action, then fish from downstream would be reintroduced above the fish barriers once the proposed UDWR treatment is completed. Since non-native trout have been shown to have negative impacts on the growth and abundance of sculpin, the UDWR activities as described for the Proposed Action would offer a long-term benefit to any mottled sculpin reintroduced into the UDWR project area. In areas below the neutralization station, mottled sculpin may be killed in the mixing zone, although very few would be expected, and they could recolonize areas downstream from the fish barriers from downstream. If observed above the fish barriers during the UDWR treatment, sculpin could be actively reintroduced by UDWR to upstream areas post-treatment.

Overall effects of the UDWR activities as described for the Proposed Action on fish. Based on the above, the UDWR activities as described for the Proposed Action would have a short-term (2-3 years) negative but not significant impact on fish populations; however, the impact would be temporary, since native CRCT and potentially mottled sculpin would reinhabit the area. The UDWR activities as described for the Proposed Action would have a permanent effect on the brook trout and any rainbow or brown trout in the treatment area, because they would not be restocked. The UDWR activities as described for the Proposed Action would have a long term beneficial impact on CRCT through implementing conservation actions consistent with the Conservation Agreement.

Aquatic invertebrates

The UDWR activities as described for the Proposed Action would directly affect aquatic biota in the UDWR project area, including macroinvertebrates. These impacts may include mortality and differential effects on species assemblages (composition). Macroinvertebrates play a key role in aquatic ecosystem function and are an important food source for trout and terrestrial fauna.

Effects of the chemicals on aquatic invertebrates. Rotenone can harm aquatic macroinvertebrates. In general, benthic macroinvertebrate communities tend to be more tolerant of rotenone than most fishes, but individual macroinvertebrate species have varying ranges of rotenone tolerance (Engstrom-Heg et al. 1978, Chandler and Marking 1982, Mangum and Madrigal 1999, Finlayson et al. 2010b, Vinson et al. 2010). The sensitivity of individual species and life stages to rotenone appears related to their oxygen uptake process (Engstrom-Heg et al. 1978). Smaller invertebrates appear more sensitive than larger invertebrates, and species that use gills to extract aqueous oxygen are more sensitive than species that obtain oxygen through other

means (Vinson et al. 2010). The insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and some Trichoptera (caddisflies) (EPT taxa) are all gill breathers. These EPT taxa are a major component in the trout diet. They are less tolerant to environmental stressors than other aquatic invertebrate groups and have not been found after some rotenone treatments (Mangum and Madrigal 1999). Finlayson et al. (2010a) found that mayflies appeared to be the most susceptible taxa to rotenone. Sensitivity to rotenone can also vary within the same taxonomic order. Whelan (2002) reported that while caddisflies (Trichoptera) had the highest number of species affected by rotenone, many caddisflies were tolerant.

Potassium permanganate is considered toxic to aquatic invertebrates and zooplankton, although there is likely to be a wide tolerance range among various freshwater invertebrates. The mixture of rotenone and potassium permanganate during the neutralization process could adversely affect benthic macroinvertebrates in the neutralization zone, extending approximately 0.25 to 0.5 mile (0.4-0.8 km) below the fish barriers. The macroinvertebrate resources within the neutralization zone would be expected to re-establish within a few months after the neutralization treatment ends. Areas below this point and tributary springs would serve as sources for recolonization. As a result, no taxa are expected to be lost, and re-establishment is expected to occur within a few months, thus resulting in no significant impact.

As described in Appendix A, rotenone formulations contain a variety of constituents other than rotenone. Since liquid rotenone formulations were used in all the lotic water studies discussed below, the effects of these constituents to macroinverebrate communities are represented.

Past field studies of rotenone impacts indicate that under the UDWR activities as described for the Proposed Action macroinvertebrate community recovery may occur within as little as 2 months but could take more than 5 years. Different studies have defined recovery differently, making difficult the comparison among estimated recovery times for the effects of the UDWR activities. Comparison is also confounded by the specifics of the treatment (e.g. rotenone concentration), insufficient pre-treatment monitoring (typically limited to one or two sampling events), the highly variable temporal and spatial nature of macroinvertebrate communities, lack of adequate control and reference sites, and other confounding factors such as dams that altered hydrologic patterns (Binns 1967, Whelan 2002, Vinson et al. 2010). Variability in rotenone impacts on macroinvertebrate communities is probably caused by 1) concentration of rotenone used and duration of the treatment, 2) whether the rotenone formulation used contained a synergist, and 3) the variability in rotenone tolerance among different taxonomic groups.

Rotenone treatment can be considered akin to a severe pulse physical disturbance, such as a large, unpredictable flood (Vinson et al. 2010). Streams such as East Fork Boulder Creek are dynamic environments, and the organisms that inhabit them must be able to cope with disturbances. Flood, drought and fire are natural disturbances that affect streams. Understanding the recovery patterns of macroinvertebrate assemblages in response to natural disturbances provides additional context for interpreting and assessing the potential long-term effects of the proposed rotenone treatment. In a review of 150 case studies of aquatic ecosystem recovery from disturbance (15 of which were in response to rotenone treatments), Niemi et al. (1990) found that most recovery times were less than 3 years. Recovery of macroinvertebrate assemblages to 85% of pre-disturbance densities after pulse disturbances (including rotenone)

occurred in less than 18 months. Assemblage densities recovered much more quickly than individual taxa. They speculated that recovery time was primarily related to generation time, propensity to drift, and distance from colonization source. Downstream drift from unimpacted upstream areas was the critical factor in determining the recovery times for stream ecosystems following pulse disturbances that do not impact the physical characteristics of the habitat. Coincidentally, some of the species most sensitive to rotenone are also highly mobile with short life cycles; thus they may have the ability to repopulate depleted areas rapidly through dispersal and oviposition (Engstrom-Heg et al. 1978).

Determining the recovery of individual aquatic invertebrate taxa is more problematic. Within the Boulder Creek drainage, no pre-treatment data were collected in West Fork Boulder Creek and the presence of individual taxa varied widely among all known collections in the Boulder Creek drainage, so it is difficult to determine whether taxa were gained or lost following the 2000-2001 West Fork Boulder Creek chemical treatments. Presence of individual taxa even varied widely among samples taken at the same location at different times within the same year (Magnum 1995, Mangum 1997, Vinson 2005, USEPA 2010). The October 1994 macroinvertebrate sample collected on Boulder Creek above the main power plant is probably the closest sample in geographic proximity and season to the September 2003 macroinvertebrate collection on West Fork Boulder Creek. A comparison of all taxa found in the three replicate samples at each location showed that, although impossible to ascertain the disposition of individual taxa in West Fork Boulder Creek pre-treatment, it appears as though the macroinvertebrate community in 2003 recovered to a diversity exceeding that of the downstream station on Boulder Creek when it was sampled in 1994. Data interpretation may be confounded by land use changes over the 9-year period, as well as differences in taxonomic resolution between the two laboratories used to identify samples. Similarly, data were collected at the same location just upstream from FR30166 in West Fork Boulder Creek in 2010 along with data collected less than 0.4 miles to the east in East Fork Boulder Creek just upstream from FR30166, sites close in geographic proximity to the 2003 sample from West Fork Boulder Creek. Up to 68 taxa were collected when all three collections are viewed together; however, when just the data from the same location on West Fork Boulder Creek from 2003 and 2010 are examined only 21 of 47 (45%) total taxa collected were found in both 2003 and 2010.

Overall effects of the UDWR activities as described for the Proposed Action on aquatic macroinvertebrates. The UDWR activities as described for the Proposed Action would have an adverse short-term effect on benthic macroinvertebrate density and community composition through mortality of sensitive species. The rotenone treatment would have a stronger effect on the small, gilled EPT taxa species (stoneflies, caddisflies, mayflies) that are typical of cold-water, mountain streams. The impacts of UDWR's proposed rotenone treatment would not be significant, however, because recovery of the community composition would likely occur within 2 years. Several factors support this assessment. Other studies demonstrate that recovery can occur within as little as 2 months, extending to more than 5 years in some streams that received higher rotenone concentrations for longer durations than those under the UDWR activities as described for the Proposed Action.

Several features of the UDWR activities described for the Proposed Action would help to mitigate impacts of applying rotenone formulations to remove non-native trout on the aquatic

invertebrate community. First, the treatment area is of limited geographic range. The UDWR activities as described for the Proposed Action would not involve treating the headwater meadow or fishless portions of tributaries or springs; these areas would remain unimpacted by the UDWR proposed project and would act as important sources for recolonization. Second, liquid formulations proposed for authorization (Chemfish Regular, Prentox Prenfish, CFT Legumine) do not contain a synergist, which should help reduce impacts to aquatic invertebrates. Third, the Proposed Action would require the UDWR to neutralize rotenone by applying potassium permanganate (2 to 6 mg/L) at the downstream end of the UDWR project area, which should limit the impacts of rotenone outside of the UDWR project area. Finally, the headwaters and tributaries upstream of the treatment area would remain untreated, thereby providing ample source populations to recolonize the treated area.

In summary, the UDWR activities as described for the Proposed Action would have a temporary negative effect but not a significant impact on macroinvertebrate community composition. Although unlikely, the UDWR activities as described for the Proposed Action could result in loss of individual macroinvertebrate taxa.

Amphibians

Rotenone is toxic to amphibians but generally less toxic than to fish. Rotenone may be absorbed into both skin and respiratory membranes, but skin may present more of a barrier because it creates a greater distance for the chemical to diffuse across (Fontenot et al. 1994), and a smaller surface area relative to gill structures. Studies suggest that tadpoles and other larval forms of amphibians that utilize gills for respiration are just as sensitive to rotenone as fishes, while adult forms, which no longer utilize gills, are much less susceptible to rotenone. Larval amphibians appear to have resistance roughly equivalent to those of the most tolerant fish species.

Effects of the UDWR activities as described for the Proposed Action on amphibians. Under the UDWR activities as described for the Proposed Action, potential direct impacts to amphibians include absorption of rotenone during UDWR's project implementation. Amphibians in their terrestrial life stage should not be affected by the rotenone treatment; however, those in gill-breathing life stages, if present, would be susceptible. Most amphibians, such as toads, present during a late summer/early autumn treatment would have completed their metamorphosis and would not be affected. Additionally, breeding and rearing habitat for amphibians exists in off channel, fishless areas that would not be treated under the UDWR activities as described for the Proposed Action.

While at least some mortality of aquatic stages of amphibians is probable from UDWR's rotenone application, several studies have shown that population level effects do not occur to amphibian species during rotenone treatments.

Potential indirect impacts on amphibians include loss of prey species from UDWR's rotenone treatments. For example, reductions in emerging aquatic insects could occur over several years, particularly if multiple treatments are required; however, as described above, aquatic insect abundance is expected to recover quickly through drift from untreated upstream areas. Because current populations of non-native trout in the proposed UDWR project area could have adverse

effects on amphibian populations through predation and competition for prey resources, as described in the No Action - No Further Treatment Scenario, UDWR's removal of non-native trout may benefit any amphibians using the project waters over the long term. Several studies have shown the removal of non-native trout can result in an increase in abundance and diversity of amphibian populations (Hoffman et al. 2004, Vrendenberg 2004, Knapp et al. 2007, Pope 2008).

Overall effects of the UDWR activities as described for the Proposed Action on amphibians. Based on the above factors and expected low occurrence, the UDWR activities as described for the Proposed Action may impact individual amphibians but would not lead to significant, population level impacts. UDWR's removal of non-native trout may also benefit any amphibians inhabiting the UDWR project area.

Non-chemical Treatment Alternative

Fish

Effects of the UDWR activities as described for the Non-chemical Treatment alternative on fish. All non-native fish collected from the treatment area would be removed by UDWR from the system and killed. They would not be replaced.

Effects of the UDWR activities as described for the Non-chemical Treatment alternative on CRCT. Direct impacts to CRCT in the form of injury of death could be caused by repeated electrofishing by UDWR. Although the use of electrofishing to remove non-native trout would allow more selectivity in the fish that would be removed and killed, electrofishing itself could kill or injure CRCT. Other harmful effects, such as bleeding at the gills or vent, and excessive physiological stress, are also of concern. Mortality, usually by asphyxiation, is a common result of excessive exposure to tetanizing intensities near electrodes or poor handling of captured specimens. Salmonids are especially susceptible. The use of low-frequency pulsed direct current and specially designed pulse trains would help prevent these types of injuries.

Indirect impacts to CRCT habitat by repeated substrate and bank disturbance could be caused by UDWR's repeated removal efforts.

Little information exists on the potential for repetitive electrofishing efforts to impact stream and riparian habitat through trampling by samplers, who will need to hike and/or wade up and down the treatment reaches multiple times for this method of removal. Loss of vegetation and damage to stream bank soils could increase erosion and cause sediment inputs to the stream. Increased sedimentation can result in the loss of habitat for both aquatic macroinvertebrates and fish through the elimination of the interstitial spaces in the streambed and the filling of pools.

Suspended and deposited sediment directly impact fish and aquatic invertebrates through clogging of the gills or smothering and indirectly affect them by reducing spawning and resting habitat (Waters 1995). Sedimentation can also adversely affect the spawning success of salmonids, by impeding the process of excavating a redd, depleting oxygen flow to the eggs and

sac fry, and blocking the passage of emerging sac fry (Waters 1995). These effects can lead to decreased abundance, diversity, and species composition within the aquatic community. If the UDWR project is successful in eradicating brook trout within a couple years, these impacts from the UDWR activities as described for the Non-chemical Treatment alternative should be small and short-lived; however, if the project continues for a long period of time, trails could become established and more permanent soil compaction and vegetation impacts could occur. In order to have enough time to feasibly complete the non-chemical treatment, UDWR's instream activity would have to be conducted early in the year during CRCT spawning and egg development, which would probably cause egg mortality. Loss would be limited during the initial stages of the UDWR project, since CRCT abundance is low in the project area; however, more substantial losses could occur if the project takes many years to complete.

The effects of UDWR removing non-native trout on conservation of the CRCT are as described for the Proposed Action; however, the potential for not meeting the objective is higher. As described in Appendix B, efforts to completely eradicate non-native fish by non-chemical methods in streams, rivers, lakes, and reservoirs have generally been unsuccessful (Lentsch et al. 1996, Meronek et al. 1996, Thompson and Rahel 1996, Tyus and Saunders 2000, Golden and Holden 2002, Mueller 2005, Koel et al. 2005, Meyer et al. 2006, Birchell 2007, Caudron and Champigneulle 2010, Koel et al. 2010). Specifically, electrofishing efforts to remove non-native trout from streams have met with variable success. East Fork Boulder Creek is a relatively large, complex stream when compared to streams where electrofishing removal has been effective. Approximately 13.7 km of stream are slated for UDWR removal efforts under the proposed UDWR project. The UDWR project area on East Fork Boulder Creek is longer and generally wider than streams where successful electrofishing removal projects have occurred. Additionally, the habitat in a large portion of the UDWR project area is complex with deep riffles and cascades, as well as deep > 1 m pools, undercut banks, and abundant instream cover. Removal of brook trout by UDWR from King's Pasture Reservoir and the pond in King's Pasture also presents a challenge. Based on previous studies it would probably take UDWR at least two years to remove brook trout from King's Pasture Reservoir and the pond in King's Pasture using non-chemical methods. UDWR's electrofishing removal in East Fork Boulder Creek would not be able to be completed until the pond in King's Pasture is free of brook trout, and UDWR's netting removal in King's Pasture Reservoir would not be successful until their electrofishing removal is completed in East Fork Boulder Creek upstream of the reservoir.

Overall effects of the UDWR activities as described for the Non-chemical Treatment alternative to fish. The UDWR activities as described for the Non-chemical Treatment alternative would have a negative impact on fish populations during the removal time period, which would be at least 2 years and possibly considerably longer. The impact should be temporary since the area would be restocked by UDWR with CRCT; however, it is unclear how long this alternative would take for UDWR to achieve complete eradication of brook trout. Brook trout would have to be eradicated by UDWR from East Fork Boulder Creek upstream of King's Pasture Reservoir prior to their beginning removal efforts in the reservoir, but fish removal in East Fork Boulder Creek could not begin until the pond in King's Pasture is free of brook trout. The UDWR activities as described for the Non-chemical Treatment alternative could have a long term beneficial impact on CRCT through implementing conservation actions that would address objectives in the Conservation Agreement; however, the effectiveness of this alternative for

achieving the objective of the complete eradication of brook trout is suspect. Non-chemical removal has not been shown in the past to be successful in a system with the size and complexity present in the proposed UDWR project area. Temporary impacts to fish habitat through increased erosion and sedimentation caused by sampler bank trampling would also be expected. The magnitude of these impacts would depend on the duration of the UDWR project.

Aquatic invertebrates

Effects of the UDWR activities as described for the Non-chemical Treatment alternative on aquatic invertebrates. As described in the effects analysis for fish, the UDWR activities as described for the Non-chemical Treatment alternative would result in substantial disturbance to the stream bed, as the entire stream would be walked on approximately 16 times between June and October for at least 2 years. The stream bed disturbance would result in some direct mortality of aquatic macroinvertebrates through trampling and displacement of some aquatic macroinvertebrates through drift. As described in the effects analysis for fish, stream bank trampling may result in increased levels of erosion and sedimentation. Additionally, application of electric current to the water would result in increased drift and displacement of aquatic macroinvertebrates.

The UDWR activities as described for the Non-chemical Treatment alternative would involve 5-6 people walking in and along the stream bed approximately 16 times during at least two consecutive summers. Continued walking in streams has been shown to displace invertebrates (Shakarjan and Stanford 1998, Caires 2007). Caires (2007) found that hiker impacts were overshadowed and ameliorated by a flash flood, indicating that natural disturbance could have a much greater effect on invertebrate communities than recreational use of the river.

Aquatic invertebrates can be susceptible to being stunned during electrofishing activities (Penczak and Rodriguez 1990, Rabeni et al. 1997, Taylor et al. 2001). Kruzic et al. (2005) recommended that electrofishing later in the season, when most invertebrates have hatched, would likely minimize effects on macroinvertebrates; however, in order to achieve the objective of the purpose and need of the proposed UDWR project, UDWR's non-chemical treatments would most likely have to occur throughout the entire summer.

Overall effects of the UDWR activities as described for the Non-chemical Treatment alternative on aquatic invertebrates. As described in the effects analysis for fish, increased bank trampling could have a negative impact on aquatic invertebrate populations during the removal time period, which would be at least 2 years and possibly considerably longer. The impact would be temporary and short-lived if the alternative only takes 2-3 years to be successful; however, it is unclear how long UDWR activities as described for this alternative would take to achieve complete eradication of brook trout. It may take up to 10 years. The UDWR activities as described for the Non-chemical Treatment alternative could have a long term beneficial impact on aquatic invertebrates through restoring the native top-level predator and eliminating a non-native trout capable of altering food web dynamics, as discussed in the effects analysis for the Proposed Action. The impacts of the UDWR activities as described for the Non-chemical Treatment alternative to aquatic invertebrates would be dependent on the duration of UDWR's non-chemical treatment activities and their effectiveness at eradicating brook trout.

Amphibians

Effects of the Non-chemical Treatment alternative on amphibians. Little published information exists on potential electrofishing impacts to amphibians; however, amphibians are affected by the electric field during electroshocking activities (Whittier et al. 2007). Therefore, impacts to amphibians from electrofishing are probably similar to those described for fish. All life stages could be directly affected by accidental trampling mortality or injury during sampling efforts (Maxell 2000, Bradford 2002, Keinath and Mcgee 2005). Direct injury and mortality can also result from amphibians collected as bycatch during gill netting efforts (Mike Golden, Dixie National Forest, personal observation). Amphibian densities have been shown to be significantly lower in streams with higher sediment loads (Welsh and Ollivier 1998, Gillespie 2002).

As described in the Proposed Action, UDWR's removal of non-native trout could have beneficial impacts to amphibians through restoring the natural food web and removing a non-native predator.

Overall effects of the UDWR activities as described for the Non-chemical Treatment alternative on amphibians. Since no breeding areas for amphibians are known to occur in the UDWR project area, impacts from the UDWR activities as described for the Non-chemical Treatment alternative would be restricted to individual amphibians. As with fish and aquatic invertebrates, the overall impacts of the UDWR activities would be dependent on its duration and effectiveness.

3.1.3 Cumulative Effects

No Action – No Further Treatment Scenario

East Fork Boulder Creek is on an active grazing allotment, and historic timber sales and management have occurred in the watershed. The King's Pasture Reservoir diversion and a similar diversion on West Fork Boulder Creek at the West Fork Reservoir both combine to alter the flow regime in the mainstem of Boulder Creek. During most of the year all flows are diverted from the streams at these reservoirs and used for hydropower and irrigation downstream. The diversions have both formed small impoundments on the channel, reducing instream habitat. Both East Fork Boulder Creek and West Fork Boulder Creek are completely dewatered for approximately 0.5 miles (0.8 km) downstream from the diversion and the remainder of the Boulder Creek system has substantially reduced flows downstream to the main power plant, where some flows go to irrigation and some are returned to the stream. A riparian inventory was conducted on Boulder Creek in August of 1994 (EnviroData Systems, Inc. 1995). This inventory noted that the riparian area was fragile because of existing soil and vegetation conditions but did not specify cause.

There are numerous authorized and unauthorized roads (roads) within the UDWR project area. A culvert where Forest Road 30166 crosses West Fork Boulder Creek within the UDWR project area is an impediment to fish passage and blocks approximately 5.7 miles (9.2 km) of fish habitat (Brazier 2008). A culvert on East Fork Boulder Creek that was previously an impediment to fish passage was replaced in summer 2009. Forest Roads (FR) 30165, 33290, 33289 all have sections that come within 100 m of East Fork Boulder Creek. FR 30165 leads up to FR 30165A, which is an administrative and private road leading from King's Pasture Reservoir to West Fork Reservoir. It crosses East Fork Boulder Creek at the bottom of the King's Pasture Reservoir. Another private road encircles the King's Pasture Reservoir and several private roads have portions that cross springs and tributaries to East Fork Boulder Creek or are within 100m of the stream itself.

Conservation of CRCT. If brook trout are allowed to remain in East Fork Boulder Creek, as under the No Action – No Further Treatment Scenario, the self-sustaining CRCT population would be restricted to 0.5 miles of East Fork Boulder Creek, and the East Fork Boulder Creek CRCT population would be considered at high risk of local extinction during future evaluations of the species status. The West Fork Boulder Creek population would continue to occupy 11.1 km (6.9 miles); however, the West Fork Reservoir splits the population into two segments of 3.4 km (2.1 miles, upstream) and 7.7 km (4.8 miles, downstream). While gene flow and immigration can proceed downstream when the reservoir spills, no upstream transfer can occur without active management.

In addition to non-native species, the CRCT populations of both East Fork Boulder Creek and West Fork Boulder Creek have been negatively impacted by Garkane's hydropower operations de-watering the lower portions of both streams for over 50 years. Anywhere from 0.25-0.5 miles (0.4-0.8 km) of stream can be completely dewatered during base flow periods and the remaining stream contains considerably less water than under the natural flow regime. The low water conditions limit the potential density and biomass of trout populations in the lower portions of these streams.

The continuous release of 2 cfs from King's Pasture Reservoir, which began in November 2010 as a condition of Garkane's operating license (FERC 2007) will increase the potential for trout populations in the lower 3.9 miles (6.3 km) of East Fork Boulder Creek; however, this would not benefit CRCT conservation without the associated removal of non-native fish. Marks et al. (2009) found that both removal of non-native fish and flow restoration resulted in positive impacts to native fish populations in Arizona but that flow restoration in the absence of non-native fish removal would have paid minimal dividends for native fish restoration. In the absence of CRCT restoration flow restoration would still benefit the non-native resident trout population below East Fork Reservoir, as well as stream ecosystem function.

Since the initial identification of CRCT populations in the Escalante River drainage, considerable effort has gone toward expanding their populations in the Escalante drainage and throughout the Lower Colorado GMU. These renovation projects are highlighted in Appendix B. Currently the Lower Colorado GMU only has two populations (combined Right Fork UM and UM Creek population in the Fremont River drainage and the combined West Branch Pine Creek and Pine Creek population in the Escalante River drainage) that are completely connected

and fit both the length of occupied stream and density criteria laid out for persistent CRCT populations (Hilderbrand and Kershner 2000, Hadley et al. 2008). Without the West Fork Reservoir present, the West Fork Boulder Creek population would satisfy both criteria.

A separate condition of the Boulder Creek Hydroelectric Project FERC license indicates that, if CRCT objectives are not met in the Boulder Creek drainage, renovation projects may move forward in one or more of three other creeks: North Creek, Pleasant Creek, and Carcass Creek. Two of these streams have the have the potential to meet the criteria set forth by Hilderbrand and Kershner (2000) on NFS lands; however, it is difficult to determine what the CRCT density would be once restoration efforts are complete. A cumulative effect of the No Action - No Further Treatment Scenario would be that the CRCT conservation may not progress at developing another connected population that satisfies the persistence criteria set forth in Hilderbrand and Kershner (2000). This would leave all but two of the current populations more vulnerable to local extinction.

Aquatic Habitat. The No Action No Further Treatment Scenario would result in no additional disturbance to aquatic habitat; therefore, there would be no cumulative effect on aquatic habitat.

Proposed Action

Conservation of CRCT. The cumulative effects of UDWR activities as described for the Proposed Action and subsequent expansion and stocking of native CRCT would increase the persistence ability of both the East Fork Boulder Creek and West Fork Boulder Creek CRCT populations and expand the occupied habitat of CRCT in the Lower Colorado GMU. Expanding the populations in the Lower Colorado GMU promotes persistence of the species.

The 2000-2001 expansion of the West Fork Boulder Creek population has produced relatively high densities of CRCT in the expansion area (Hadley et al. 2008, Hardy et al. 2009a, Hardy et al. 2009b, Williams and Hardy 2010). This would indicate that similar densities could be achieved in East Fork Boulder Creek. The continuous release of 2 cfs from King's Pasture Reservoir as a condition of Garkane Energy's operating license (FERC 2007) would also increase the potential density of CRCT that could develop in East Fork Boulder Creek. The 2009 removal of the FR 30166 road culvert across East Fork Boulder Creek, along with the planned removal of the fish barriers in West Fork Boulder Creek and the FR 30166 road culvert across West Fork Boulder Creek would create the potential to connect approximately 13.5 km (8.4 miles) of CRCT habitat in the lower East Fork Boulder Creek, West Fork Boulder Creek, and upper portion of Boulder Creek.

The UDWR activities as described for the Proposed Action would not only increase occupied stream mileage but would create a new connected population below both reservoirs that would provide a persistent population according to the criteria outlined in Hilderbrand and Kershner (2000). In addition, the two connected tributaries would create a metapopulation which should significantly decrease the potential for local extinction caused by a stochastic event (Young et al. 1996, Hilderbrand and Kershner 2000). The UDWR activities as described for the Proposed Action would make a significant contribution to CRCT conservation in the Lower Colorado GMU.

Aquatic habitat. In 2008 the Bear Creek Fire burned a total of 1,450 acres within the CEA. The severity of Bear Creek Fire varied widely within the burn perimeter (USFS 2008a). The fire burned approximately 1,068 acres within the Bear Creek drainage and approximately 0.5 miles (0.8km) of Bear Creek were located within a moderate to high severity area. The portions of Bear Creek impacted by the fire have undergone accelerated erosion, which has increased the amount of sediment moving downstream in Bear Creek and eventually into Boulder Creek.

Grazing and recreation use will continue to affect the condition of aquatic biota populations and habitat in the future. The Boulder allotment will continue to be grazed at or below current stocking rates. Road related impacts to aquatic systems in the UDWR project area would be reduced with implementation the Dixie National Forest motorized travel plan, which changes the designation of most of the roads in the UDWR project area. A reduction in traffic volume or elimination of traffic and any subsequent vegetation recovery will reduce the amount of sediment entering streams within the UDWR project area. A reduction in sediment would reduce sediment related impacts to aquatic organisms.

An additional timber harvest is planned within the Bear Creek drainage for private land near Haw's Pasture. This area was not impacted by the Bear Creek Fire and has sufficient wet meadow and other riparian vegetation to ameliorate timber harvest impacts. Additionally, several projects have been proposed to salvage and reforest areas within the Bear Creek fire. Skidding and yarding of logs will result in a loss of ground cover, displacement of soil, and compaction of soils (Chamberlain et al. 1991). This will increase upland erosion rates and fine sediment influx into adjacent stream channels within the UDWR project area. Reviews of the available information on the impacts of postfire logging indicate that the synergistic effect of a fire and subsequent logging on the burned landscape can be greater than either individual action (McIver and Starr 2000, McIver and Starr 2001, Beschta et al. 2004, Karr et al. 2004, Lindenmayer and Noss 2006, Peterson et al. 2009). Studies and literature reviews suggest that timber harvest, especially ground-based skidding, on a burned landscape will create higher rates of soil compaction and disturbance resulting in increased overland flow, erosion, and sediment generation (McIver and Starr 2000, McIver and Starr 2001, Peterson et al. 2009). These impacts should be short-term and wane parallel to vegetation recovery.

Fire, livestock grazing, timber harvest, and roads all have the potential to increase erosion and thereby sediment transport and deposition (Platts 1991, Furniss et al. 1991, Trombulak and Frissell 2000). Impacts from past, present and foreseeable future projects are limited; however, the potential for fire and post-fire debris flows remains.

The UDWR activities as described for the Proposed Action would result in no long-term disturbance to aquatic habitat. It would not add to the existing level of disturbance from other activities; therefore, there would be no cumulative effects on aquatic habitat.

Non-chemical Treatment Alternative

Conservation of CRCT. The cumulative effects from UDWR's activities as described for the Non-chemical Treatment alternative for conservation of CRCT are the same as those described

for the Proposed Action; however, because of the questionable effectiveness of the Non-chemical Treatment alternative in removing the nonnative trout, there is possibility that the establishment of CRCT in the UDWR project area may not occur. The cumulative effect, then, for conservation of CRCT would be the same as for the No Action – No Further Treatment Scenario.

Aquatic habitat. The major impact to aquatic habitat from the UDWR activities as described for the Non-Chemical Treatment alternative is increased erosion and sedimentation which would be additive to sources of sediment from other activities or disturbances in the CEA. The UDWR activities may result in increased erosion and sedimentation; however, additive effects associated with the UDWR activities are expected to be limited in scope and not result in long-term detrimental effects to aquatic biota.

3.1.4 Conclusion

The No Action - No Further Treatment Scenario would have no direct, indirect, or cumulative effects to aquatic habitat; however, maintaining a brook trout fishery in East Fork Boulder Creek would have impacts to CRCT conservation, as well as to the ecosystem function. In the absence of an action to remove nonnative brook trout, CRCT conservation may not advance as readily in the Lower Colorado GMU with less opportunity to create a persistent metapopulation of the species in the Lower Colorado GMU. In addition any ecosystem level effects from the presence of nonnative brook trout would remain.

The UDWR activities as described for the Proposed Action would have short-term negative impacts to fish populations in the UDWR project area. In the short-term, all fish would be eliminated by UDWR within the area above the neutralization stations. Nonnative trout would be completely eliminated by UDWR from East Fork Boulder Creek, but their persistence Forest-wide would not be affected by the UDWR activities. The remnant population of CRCT, a Conservation Agreement and Intermountain Region Sensitive species, as well as the MIS for East Fork Boulder Creek, would be expanded from the headwaters of East Fork Boulder Creek, creating a persistent metapopulation between King's Pasture Reservoir and the West Fork Reservoir; thereby, significantly contributing to CRCT conservation in the Lower Colorado GMU. Mottled sculpin may be reintroduced to the treatment area, although they are not known to be present currently. Any fish species, including nonnative trout, the MIS for Boulder Creek, that may be impacted in the mixing zone below the neutralization site would be able to recolonize that area.

The UDWR activities as described for the Proposed Action would have short-term negative impacts to the density and diversity of aquatic macroinvertebrates within the UDWR project area. Based on similar past projects, macroinvertebrate density would be expected to recover within 1-2 years and macroinvertebrate diversity within 2-5 years. There would be the potential for individual taxa to be lost for longer than that time; however, the variability in detecting individual taxa, especially rare taxa, during macroinvertebrate sampling would make it difficult to determine if individual taxa detected prior to but not after chemical treatment were lost because of the chemical treatment or not detected because of the sampling variability. The UDWR activities as described for the Proposed Action may have negative impacts to individual

amphibians within the UDWR project area during the treatment but would not be expected to have population level effects.

The UDWR activities as described for the Non-chemical Treatment alternative would result in riparian and bank damage, which would increase erosion and sedimentation. The negative effects of erosion and sedimentation from the UDWR activities would be expected to be short-lived; however, their duration is dependent on the effectiveness of the alternative. The UDWR activities as described for the Non-chemical Treatment alternative may have short-term negative impacts to macroinvertebrate density and diversity. These impacts are not expected to be as severe as those described for the Proposed Action, but their severity is dependent on the effectiveness of UDWR's non-chemical treatment. During the UDWR activities as described for the Non-chemical Treatment alternative, individual amphibians may be negatively impacted by electrofishing, gill netting, and/or trampling by workers; however, no population level impacts are expected.

As with the Proposed Action nonnative resident trout would be removed by UDWR from the UDWR project area under the UDWR activities as described for the Non-chemical Treatment alternative, but their persistence would not be affected by the Forest-wide. Any native mottled sculpin and CRCT present would be returned to the stream but could experience lethal or sublethal effects from repeated electrofishing. The negative impacts from repeated electrofishing on CRCT and mottled sculpin are not expected to produce population level effects. Similar to the Proposed Action, the UDWR activities as described for the Non-chemical Treatment alternative have the potential to expand the remnant CRCT population in East Fork Boulder Creek and create a persistent metapopulation; however, the effectiveness of the UDWR removal methods under this alternative is questionable.

3.2 Wildlife

3.2.1 Affected Environment

Information concerning monitoring results, life histories, suitable habitats, threats, population trends, and ecology for certain species that are known or suspected to occur within the UDWR project area (Table 3) can be found within the "Life History and Analysis of Endangered, Threatened, Candidate, Sensitive, and Management Indicator Species of the Dixie National Forest" (Rodriguez 2008). Information concerning migratory birds can be found in "Utah Partners in Flight Avian Conservation Strategy Version 2.0" (Parrish et al. 2002). These documents are located in the Dixie National Forest Supervisor's Office in Cedar City, Utah. Potential effects and determinations are based in part upon the information presented in these documents.

Existing habitat within the UDWR project area provides riparian habitat for many wildlife species. The UDWR project area is approximately 8.5 miles of riparian habitat. Habitats adjacent to the treatment areas consist mainly of aspen, ponderosa pine, and spruce/fir forest.

Table 3. Habitat suitability for Threatened (T), Endangered (E), Sensitive, Management Indicator, and other wildlife species of concern for the East Fork Boulder Creek Native Trout Restoration project on the Escalante Ranger District, Dixie National Forest.

Species	Species occurrence in or near the proposed UDWR project area and justification for consideration or non-consideration in this analysis
Threatened and Endangered Species	
California Condor (E)[a]	Considered. Condors may scavenge incidentally in the area.
Mexican Spotted Owl (T)	Considered. Juvenile dispersal may occur through the area.
Utah Prairie Dog (T)	Not Considered. Suitable grassland and shrub-steppe habitat with deep, well-drained soils does not exist within the project area.
Intermountain Region Sensitive Species	
Bald Eagle	Considered. Eagles may scavenge incidentally in the area.
Desert Bighorn Sheep	Not Considered. Suitable rugged terrain does not exist within the project area.
Flammulated Owl	Considered. Potentially suitable nesting and foraging habitat exists within the project area.
Greater Sage-grouse	Not Considered. Suitable sagebrush habitat does not exist within the project area.
Northern Goshawk [b]	Considered. Known territory exists within the project area.
Peregrine Falcon	Considered. Potential riparian foraging habitat exists within the project area.
Pygmy Rabbit	Not Considered. Suitable sagebrush habitat does not exist within the project area.
Spotted Bat	Considered. Potential cliff roosting habitat is adjacent to the project area. Potential foraging habitat exists within the project area.
Three-toed Woodpecker	Considered. Potentially suitable nesting and foraging habitat exists within the project area.
Townsend's Big-eared Bat	Considered. Potential cavern roosting habitat does not exist within the project area. Potential foraging habitat exists within the project area.
Yellow-billed Cuckoo	Not considered. Suitable riparian habitats of cottonwood and willow galleries below 6000 feet in elevation do not exist within the project area.
Dixie National Forest Management Indicator Species	
Mule Deer	Considered. Entire project area is within useable habitat boundaries.
Rocky Mountain Elk	Considered. Entire project area is within useable habitat boundaries.
Northern Flicker	Considered. Suitable habitat exists within the project area.
Wild Turkey	Considered. Suitable habitat exists within the project area.
Other Species of Concern	
Broad-tailed Hummingbird	Considered. Suitable riparian habitat exists within the project area.
American Dipper	Considered. Suitable riparian habitat exists within the project area.

[a] This is a non-essential, experimental population (Endangered west of I-15)

[b] This species is also an MIS for the Dixie National Forest

Listed Species

California condor. No condors are known to nest on the Forest. Condors may fly over the area and scavenge incidentally.

Mexican spotted owl. No Mexican spotted owls are known to nest on the Forest. The nearest known suitable nesting habitat is nearly 10 air miles from the UDWR project area. Movement through the area would occur at night, between September and April, if owls were to use the area.

Sensitive Species

Bald eagle. No bald eagles are known to nest on the Escalante Ranger District. Open habitats with available carrion could exist within the UDWR project area. Bald eagles may fly over the area and roost or perch incidentally, mainly from November through March.

Flammulated owl. Flammulated owls have been detected within the UDWR project area and surrounding areas.

Northern goshawk. The East Fork Boulder goshawk territory is located within the UDWR project area. The territory has been active or occupied all seven years since it was located in 2004.

Peregrine falcon. The nearest known peregrine falcon eyrie is over 13 air miles from the UDWR project area. The nearest potentially suitable cliff habitat bounds the UDWR project on the north. The UDWR project area consists of riparian habitat, which may provide prey for foraging falcons.

Spotted bat. Potential cliff roosting habitat for spotted bat bounds the UDWR project on the north. Foraging may occur throughout the riparian area of the UDWR project area.

Three-toed woodpecker. Coniferous habitat for three-toed woodpecker above 8000 feet elevation exists within the UDWR project area.

Townsend's big-eared bat. Potential cavern roosting habitat for Townsend's big-eared bat is not known within the UDWR project area. Foraging may occur throughout the riparian area of the UDWR project area.

Management Indicator Species

Mule deer and Rocky Mountain elk. Mule deer and elk use the UDWR project area during much, if not all, of the year.

Northern flicker. Suitable nesting and foraging habitat for northern flicker exists within the UDWR project area.

Wild turkey. Suitable nesting and foraging habitat for wild turkey exists within the UDWR project area.

Other Species of Concern

On August 1, 2007, the National Forests in Utah formalized an updated state-wide strategy for addressing migratory birds in Forest Service planning and project documents (USFS 2007). Species selected for this analysis were chosen based on the process identified in this strategy. Bird species selected for this analysis were derived from a compilation of species included in the Utah Partners in Flight Conservation Strategy (UPFCS) (Parrish et al. 2002), the Utah Comprehensive Wildlife Conservation Strategy (Gorrell et al. 2005), and the Fish and Wildlife Service Birds of Conservation Concern lists (USFWS 2008). Birds included in these publications include those at higher risk due to habitat loss or degradation, with highest-risk species given priority status in the UPFCS listing (Parrish et al. 2002). Species identified above that fit these criteria are the California condor, Mexican spotted owl, bald eagle, flammulated owl, northern goshawk, peregrine falcon, and three-toed woodpecker.

For this analysis, the broad-tailed hummingbird was selected as an additional representative species to analyze the effects of the proposed UDWR project. The FWS was informed of the selection of these species for the project analysis on August 31, 2010. The American dipper was identified as a species of concern during scoping.

Broad-tailed hummingbird. Broad-tailed hummingbird is common in Utah, and suitable breeding habitat could occur along portions of the UDWR project area.

American dipper. American dipper is found in Utah year-round and likely occurs within the UDWR project area.

Cumulative Effects Area and Analysis

The CEA for this analysis includes predominantly aspen, ponderosa pine, spruce/fir, and pinyon-juniper habitats with the Deer Creek, Bear Creek-Boulder Creek, and Headwaters Boulder Creek 6th level HUCs (see Figure 5). The CEA was selected based on topography and vegetation, indicating the region of habitat that would have an influence on species evaluated in this assessment. This area encompasses approximately 93,537 total acres, but only 77,136 acres (82%) are administered by the Forest Service. 16,401 acres (18%) are private or administered by the BLM. Due to the lack of information on private and BLM-administered lands, it was assumed that actions occurring beyond the Forest boundary would be similar to those described on the Forest.

The species included in this analysis would likely use all or part of this CEA during all or part of their life cycles. The CEA represents a landscape surrounding the UDWR project area where past, present, and future management actions have and/or will occur with special reference to: vegetation management (e.g., timber harvest, timber stand improvement, prescribed burning), utilities, oil and gas, livestock grazing, recreation use (e.g., OHV use, camping, and hunting), special uses (e.g., firewood collection, outfitters, and guides), and motorized access.

3.2.2 Direct and Indirect Effects of the Alternatives

No Action - No Further Treatment Scenario

No effects to terrestrial wildlife would occur with the No Action - No Further Treatment Scenario.

Proposed Action

The UDWR activities as described for the Proposed Action could affect terrestrial wildlife through direct disturbance from human presence in treatment areas. Terrestrial habitats would not be altered. Temporary disturbance may occur during one day of reconnaissance and one day of treatment in each year treatment occurs. Temporary displacement of some species may occur due to disturbance but would be short-term. Exposure to rotenone could occur through direct contact, ingestion of treated water, and consumption of aquatic organisms killed by rotenone. Rotenone "is highly toxic to fish and other aquatic life, but has low toxicity to birds and mammals" (Ling 2003). Ling (2003) also states, "Most mammal species are relatively resistant to rotenone," "rotenone is not easily absorbed in higher animals and does not accumulate in the body," and "Birds and mammals are much less sensitive to rotenone than are fish and aquatic invertebrates and poisoning caused by drinking treated water or eating poisoned fish is extremely unlikely" (ibid.).

Abundance and diversity of aquatic invertebrates may be impacted as disclosed in the Aquatic Biota Report. Indirect impacts to wildlife may include temporary displacement of some birds feeding on fish or aquatic invertebrates, such as the American dipper. These effects would be short term and are considered minor due to the abundance of terrestrial insects and other alternate prey, the fall timing of the UDWR project, the mobility of terrestrial vertebrates, and the proximity of similar aquatic habitats and prey sources to the treated waters.

Listed Species

California condor. The UDWR project area is within a forested landscape, which provides little adequate open terrain for foraging condors. Open areas adjacent to the creek would not provide carrion to feed on; dead fish would "bloat and sink below the surface of the water where they disintegrate and are not available for terrestrial animal consumption" (US EPA 2007). In the event that condors did forage on the dead fish, it is "unlikely that [they] will consume enough fish to result in a lethal dose" (ibid.). Condors may fly over the UDWR project area but would likely not remain in areas with disturbance from treatment activities. The Proposed Action and UDWR activities as described for the Proposed Action would not adversely impact condors.

Mexican spotted owl. The nearest known Mexican spotted owl Protected Activity Center (PAC) is more than 9 air miles away from the UDWR project area, and the nearest designated Critical Habitat is over 11 air miles away. Suitable habitat exists in canyons and uplands near the PAC

and within the boundaries of Critical Habitat. Dispersing Mexican spotted owls may pass through the UDWR project area at night, and would likely not be disturbed by daytime project activities. Nighttime project activities would occur at neutralization stations, which would be operated continuously as long as necessary to prevent the movement of rotenone into non-target waters. The neutralization stations would be located at specific point locations, and have a very small area of disturbance. If owls were to pass through the area at night, they would likely not be disturbed by the UDWR activities as described for the Proposed Action. The Proposed Action and UDWR activities as described for the Proposed Action would not adversely impact Mexican spotted owls.

Sensitive Species

Bald eagle. The UDWR project area is within a forested landscape, which provides little adequate open terrain for foraging eagles. Open areas adjacent to the creek would not provide carrion to feed on; dead fish would "bloat and sink below the surface of the water where they disintegrate and are not available for terrestrial animal consumption" (US EPA 2007). In the event that bald eagles did forage on the dead fish, it is "unlikely that [they] will consume enough fish to result in a lethal dose" (ibid.). Bald eagles may fly over the UDWR project area but would likely not remain in areas with disturbance from the UDWR activities as described for the Proposed Action. The UDWR activities as described for the Proposed Action would not adversely impact bald eagles.

Flammulated owl. Flammulated owls have been known to occur within the UDWR project area and CEA. Disturbance may occur but is unlikely, as the proposed activities would occur during the day, when these nocturnal owls are roosting. Nighttime project activities would occur at neutralization stations, which would be operated continuously as long as necessary to prevent the movement of rotenone into non-target waters. The neutralization stations would be located at specific point locations, and have a very small area of disturbance. If owls were to pass through the area at night, they would likely not be disturbed by the UDWR activities as described for the Proposed Action. The UDWR activities as described for the Proposed Action would not adversely impact flammulated owls.

Northern goshawk. The East Fork Boulder goshawk territory has nest area, post-fledgling area (PFA), and foraging habitat within the UDWR project area. There are two known nests within the UDWR project area, and goshawks have occupied the area continuously since 2004. Nesting activity has been observed each year with the exception of 2005. If the territory is active, disturbance from the proposed activities may impact goshawks but would not cause nest abandonment as all young should be fledged and highly mobile by the time treatment occurs in September. Disturbance to foraging goshawks would be minimal, as there is abundant available foraging habitat within the remaining 93,537 acres of the CEA. The UDWR activities as described for the Proposed Action would not adversely impact northern goshawks.

Peregrine falcon. The nearest potentially suitable cliff habitat bounds the UDWR project on the north; however, the nearest known peregrine falcon eyrie is over 13 air miles from the UDWR project area. Most peregrine falcons forage within 1 mile of their eyrie, making it unlikely that the UDWR project area would be used for foraging unless an active eyrie were located in the

nearby cliffs (USFWS 1984). Disturbance from the proposed activities could impact falcons if they happened to be nesting nearby but would not cause nest abandonment, as all young should be fledged and highly mobile by the time treatment occurs in September. In the event that a peregrine falcon was foraging in the area, suitable foraging habitat does exist. Disturbance to foraging peregrine falcons could occur as a result of the proposed activities but is unlikely as peregrine falcons would avoid areas where the UDWR project activities were occurring, and there is abundant available habitat within the remaining 93,537 acres of the CEA. The UDWR activities as described for the Proposed Action would not adversely impact peregrine falcons.

Spotted bat and Townsend's big-eared bat. Bats may forage within the UDWR project area. Suitable foraging habitat exists along the extent of the riparian area of the UDWR project area. Insects that bats feed on would likely not be impacted by the treatment (Durkin 2008). Poisoning from drinking treated water is "extremely unlikely," as rotenone "has low toxicity to birds and mammals" and "most mammal species are relatively resistant to rotenone" (Ling 2003).

There is little risk of disturbance from the UDWR activities as described for the Proposed Action because these bats are nocturnal, and the proposed activities would occur during the day. Nighttime project activities would occur at neutralization stations, which would be operated continuously as long as necessary to prevent the movement of rotenone into non-target waters. The neutralization stations would be located at specific point locations, and have a very small area of disturbance. If bats were to pass through the area at night, they would likely not be disturbed by UDWR's project activities. The UDWR activities as described for the Proposed Action would not adversely impact spotted or Townsend's big-eared bats.

Three-toed woodpecker and northern flicker. Disturbance from the UDWR activities as described for the Proposed Action could impact woodpeckers in the area but is unlikely, as both species are relatively tolerant of humans (Leonard 2001, Wiebe and Moore 2008). In addition, abundant available habitat remains within the 93,537 acres of the CEA. The UDWR activities as described for the Proposed Action would not adversely impact three-toed woodpeckers or northern flickers.

<u>Management Indicator Species</u>

Mule deer and Rocky Mountain elk. Mule deer and elk use the UDWR project area during much, if not all, of the year. The UDWR has delineated useable winter and summer habitats within the UDWR project area. Mule deer and elk may be temporarily displaced by disturbance associated with the UDWR activities as described for the Proposed Action; however, this impact would be temporary and minimal, as there is abundant available habitat within the remaining 93,537 acres of the CEA. Mule deer and elk would be expected to return to the area shortly after implementation. Poisoning from drinking treated water is "extremely unlikely," as rotenone "has low toxicity to … mammals" and "most mammal species are relatively resistant to rotenone" (Ling 2003). The UDWR activities as described for the Proposed Action would not adversely impact mule deer or elk.

Northern flicker. Effects to northern flicker are described above.

Wild turkey. Wild turkeys are known to be in the UDWR project area. Turkeys may be temporarily displaced by disturbance associated with the UDWR activities as described for the Proposed Action; however, this impact would be temporary and minimal, as there is abundant available habitat within the remaining 93,537 acres of the CEA. Turkeys would be expected to return to the area shortly after implementation. Poisoning from drinking treated water is "extremely unlikely," as rotenone "has low toxicity to birds" (Ling 2003). The UDWR activities as described for the Proposed Action would not adversely impact wild turkey.

Other Species of Concern

Broad-tailed hummingbird. Potential foraging and riparian nesting habitat for broad-tailed hummingbird may occur within the UDWR project area. In the event that a broad-tailed hummingbird did nest in the UDWR project area, it is unlikely that the nest would be disturbed, as the UDWR activities as described for the Proposed Action would occur in September, and "breeding usually ends by mid-August" (Parrish et al. 2002). Disturbance from the UDWR activities may impact foraging hummingbirds but is unlikely, as most observations of broad-tailed hummingbirds in Utah have been recorded in July, and treatment will occur in the fall (ibid.). The UDWR activities as described for the Proposed Action would not adversely impact broad-tailed hummingbirds.

American dipper. Potential foraging and nesting habitat for American dipper likely exist within the UDWR project area. Because dippers forage mainly on aquatic insects, a decrease in abundance and diversity of aquatic invertebrates due to treatment could impact dipper feeding habits (Kingery 1996). Dippers have been known to disperse when "food biomass at lower elevations declined in summer" and would likely be able to disperse if such a decrease occurred with the UDWR activities as described for the Proposed Action (ibid.). An additional 208 miles of perennial and intermittent stream exist within the CEA and would likely provide sufficient feeding opportunities until treated segments recovered (1 to 36 months, Aquatic Biota Report). In the event that an American dipper did nest in the area, it is unlikely that the nest would be disturbed, as the UDWR activities as described for the Proposed Action would occur in September, and even second broods should be completed by then (Kingery 1996). The UDWR activities as described for the Proposed Action would not adversely impact American dippers.

Non-chemical Treatment Alternative

Effects of the UDWR activities as described for the Non-chemical Treatment alternative include disturbance from electro-fishing, gill-netting, and fish barrier building activities. Disturbance would be greater in duration and frequency with the UDWR activities as described for the Non-chemical Treatment alternative than with those for the Proposed Action, as disclosed in Appendix B. Such disturbance would occur over the duration of the UDWR project, possibly up to 10 years. Greater disturbance may lead to a decrease in habitat effectiveness and long-term displacement of some species. The increased duration and timing of disturbance associated with this alternative would likely lead to greater impacts to aquatic biota abundance and diversity, resulting in sustained predator displacement from the treated areas.

Listed Species

California condor. Condors that may fly over the UDWR project area would likely not remain in areas with disturbance from the UDWR non-chemical removal activities. The UDWR activities a described for the Non-chemical Treatment alternative would not adversely impact condors.

Mexican spotted owl. Dispersing Mexican spotted owls may pass through the area but would likely not be disturbed by UDWR's daytime non-chemical removal activities. The UDWR activities as described for the Non-chemical Treatment alternative would not adversely impact Mexican spotted owls.

Sensitive Species

Bald eagle. Bald eagles that may fly over the UDWR project area would likely not remain in areas with disturbance from UDWR's non-chemical removal activities. The UDWR activities as described for the Non-chemical Treatment alternative would not adversely impact bald eagles.

Flammulated owl. Potential for disturbance is greater with the increased time and number of people spent in the area but is unlikely, as the UDWR's non-chemical removal activities would occur during the day, when these nocturnal owls are roosting. The UDWR activities as described for the Non-chemical Treatment alternative would not adversely impact flammulated owls.

Northern goshawk. If the territory is active, disturbance from the UDWR's non-chemical removal activities would likely impact goshawks, and could cause nest abandonment. Nestlings have been observed in July in nearby territories on the Forest. Activities in June and July that cause disturbance near active nests "can cause abandonment, even with [20-day- old] nestlings present" (Squires and Reynolds 1997). The timing and duration of disturbance expected from UDWR activities as described for this alternative could likely cause nest abandonment if the territory was active. Such impacts from the UDWR activities as described for the Non-chemical Treatment alternative would adversely affect the northern goshawk.

Disturbance to foraging northern goshawks could occur as a result of the UDWR activities as described for the Non-chemical Treatment alternative but is unlikely, as goshawks would avoid areas where UDWR project activities were occurring, and there is abundant available foraging habitat within the remaining 93,537 acres of the CEA.

Peregrine falcon. Disturbance from UDWR's non-chemical removal activities could impact falcons if they happened to be nesting nearby, particularly in June, July, and August. General protective measures in the Recovery plan include "restricting human activities and disturbances between February 1 and August 31 which occur within one mile of the nesting cliff" (USFWS 1984). If an active peregrine falcon eyrie were located within one mile of the UDWR project area, the timing and duration of disturbance expected with the UDWR activities as described for the Non-chemical Treatment alternative could be detrimental to nesting success and would

conflict with the protective measures described above. Such impacts would adversely affect the peregrine falcon if an active nest were located in the UDWR project area.

Spotted bat and Townsend's big-eared bat. Disturbance is unlikely, as the UDWR's non-chemical removal activities would occur during the day, when the nocturnal bats are roosting. The UDWR activities as described for the Non-chemical Treatment alternative would not adversely impact spotted or Townsend's big-eared bats.

Three-toed woodpecker and northern flicker. Potential for disturbance from UDWR's non-chemical treatment removal activities is greater with the increased time and number of people spent in the area but is unlikely, as both species are relatively tolerant of humans (Leonard 2001, Wiebe and Moore 2008). In addition, abundant available habitat remains within the 93,537 acres of the CEA. The UDWR activities as described for the Non-chemical Treatment alternative would not adversely impact three-toed woodpeckers or northern flickers.

Management Indicator Species

Mule deer and Rocky Mountain elk. The timing and duration of disturbance expected with the UDWR activities as described for the Non-chemical Treatment alternative would likely decrease habitat effectiveness for mule deer and elk, and cause persistent displacement while personnel are implementing the non-chemical treatment; however, abundant available habitat remains within the 93,537 acres of the CEA. The UDWR activities as described for the Non-chemical Treatment alternative would not adversely impact mule deer or elk.

Northern flicker. Effects to northern flicker are addressed above.

Wild turkey. The timing and duration of disturbance expected with the UDWR activities as described for the Non-chemical Treatment alternative would likely decrease habitat effectiveness for wild turkey and cause persistent displacement; however, abundant available habitat remains within the 93,537 acres of the CEA. The UDWR activities as described for the Non-chemical Treatment alternative would not adversely impact wild turkey.

Other Species of Concern

Broad-tailed hummingbird. UDWR's non-chemical removal activities may occur in June and July, when broad-tailed hummingbirds are more likely to be in the area (Parrish et al. 2002). The timing and duration of disturbance expected with the UDWR activities as described for the non-chemical Treatment alternative could likely cause nest abandonment if a nest were located in the UDWR project area. Though the UDWR activities as described for the Non-chemical Treatment alternative may impact individuals, it would likely not have an adverse effect on the species, as the broad-tailed hummingbird is described as "the most common species in Utah" (ibid.).

American dipper. A decrease in abundance and diversity of aquatic invertebrates due to UDWR treatment activities would likely occur with the activities as described for the Non-chemical Treatment alternative, as described in the Aquatic Biota report. Though most dippers have completed first broods by May, second broods may be impacted by a reduction of food during

the treatment period (Kingery 1996). Nest sites are typically inaccessible, which would reduce the risk of nest disturbance, but fledgling dippers could be disturbed by treatment activities (ibid.). The timing and duration of disturbance expected with this alternative would likely decrease habitat effectiveness and cause persistent displacement while personnel are implementing the UDWR treatment. Though the UDWR activities as described for the Non-chemical Treatment alternative may impact individuals, it would likely not have an adverse effect on the species, as abundant available habitat remains within the additional 208 miles of perennial and intermittent stream within the CEA.

3.2.3 Cumulative Effects

No Action - No Further Treatment Scenario

The No Action - No Further Treatment Scenario would have no effect to any species, which precludes cumulative effects for the alternative.

Proposed Action

The majority of timber harvest within CEA occurred in the 1980s. Thinning has focused on removing understory conifers for overall timber stand improvement to manage for maximum growth. In 2008, the Bear Creek Fire burned a total of 1,450 acres within the CEA. Several projects have been proposed to salvage and reforest areas burned in the Bear Creek Fire. Timber harvest is also planned within the Bear Creek drainage for private land near Haw's Pasture. Oil and gas is limited to one lease at the north end of the CEA. Utilities consist of a powerline associated with the main power plant. Livestock grazing occurs throughout the UDWR project area and CEA. Recreational use includes OHV use, camping, hunting, and fishing. Special uses such as firewood collection, outfitting, and guiding also occur within the area. The Forest-wide Travel Management Plan will be implemented throughout the CEA presently and in the foreseeable future and addresses road access, maintenance, and closures that would protect hydrological and wildlife resources.

Through the analysis disclosed above, the direct and indirect effects of the UDWR activities as described for the Proposed Action and the Non-chemical Treatment alternative predominantly result in disturbance; however, it is the magnitude of the disturbance that differs. Likewise, the magnitude of habitat effectiveness varies inversely with the level of disturbance. Adverse effects of increased disturbance from past, present, or reasonably foreseeable future activities such as vegetation management, utilities, oil and gas, livestock grazing, recreation use, special uses, and motorized access would add cumulatively to direct or indirect effects of disturbance from either of the action alternatives.

Given the timing and duration of the UDWR activities as described for the Proposed Action, adverse cumulative effects from disturbance, if any, would be unlikely for all species analyzed due to the low likelihood of disturbance from the UDWR activities as described for the Proposed Action. Cumulative effects to abundance and diversity of aquatic biota as prey species would not be expected, as an abundance of similar suitable foraging habitat remains within the CEA, and most predatory species would be able to move to more productive areas.

Non-chemical Treatment Alternative

The UDWR activities as described for the Non-chemical Treatment alternative would result in potential disturbance of greater duration and frequency than those for the Proposed Action. Adverse cumulative effects from disturbance associated with other management activities would likely not occur for the California condor, Mexican spotted owl, bald eagle, flammulated owl, three-toed woodpecker, northern flicker, spotted bat, and Townsend's big-eared bat due to the already low likelihood of disturbance to these species from the UDWR activities as described for the Non-chemical Treatment alternative.

Adverse cumulative effects from disturbance associated with other management activities would likely occur for northern goshawk and peregrine falcon if active nests were located within the UDWR project area during UDWR activities as described for the Non-chemical Treatment alternative.

Adverse cumulative effects with the UDWR activities as described for the Non-chemical Treatment alternative would likely not occur for the broad-tailed hummingbird and American dipper due to high abundance of individuals and habitat, though nesting individuals may be impacted due to the overlap of UDWR's treatment activities with sensitive nesting periods.

Adverse cumulative effects from disturbance associated with other management activities would likely not occur for mule deer, elk, and wild turkey due to these species' highly mobile nature and the abundance of undisturbed habitat remaining in the CEA.

3.2.4 Conclusion

Implementation of the No Action - No Further Treatment Scenario would not affect individuals or habitat of any species analyzed in this document.

UDWR implementation of activities as described for the Proposed Action may affect but would not likely adversely impact individuals or habitat of any species analyzed.

UDWR implementation of activities as described for the Non-chemical Treatment alternative may adversely affect the northern goshawk and peregrine falcon. UDWR activities as described for this alternative may affect but would not likely adversely impact individuals or habitat of the other species analyzed.

UDWR activities under either the Proposed Action or Non-chemical Treatment alternative would not contribute to a trend toward Federal listing or cause a loss of persistence to these populations or species.

3.3 Floodplains, Wetlands, and Water Quality

3.3.1 Affected Environment

Floodplains and Wetlands

The proposed UDWR treatments would take place within floodplains and wetlands of the UDWR project area. The wetlands are generally confined to a small area adjacent to the streams. There are also a number of springs and seeps in the various drainages.

Water Quality

The proposed UDWR project area waters are in East Fork Boulder Creek, Boulder Creek, and West Fork Boulder Creek. The Utah Department of Environmental Quality (UDEQ) designations (Rule R317-2; Standards of Quality for Waters of the State; As in effect on March 1, 2010) for the UDWR project area waters are listed in Table 4 below.

Table 4. Utah Department of Environmental Quality designations for the proposed UDWR project area waters.

Category*	Use Designations**
Category 1	2B, 3A, 4

*High Quality Waters - Category 1. Waters of high quality which have been determined by the Board to be of exceptional recreational or ecological significance or have been determined to be a State or National resource requiring protection.

**Use Designations.

- Class 2 -- Protected for recreational use and aesthetics.
  Class 2B -- Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.
- Class 3 -- Protected for use by aquatic wildlife.
  Class 3A -- Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.
- Class 4 -- Protected for agricultural uses including irrigation of crops and stock watering.

Water quality sampling for chemical and physical characteristics (STORET) of the water has been evaluated by the UDEQ Division of Water Quality and is in compliance with state water quality standards for the use designations of East Fork Boulder Creek and its tributaries.

East Fork Boulder Creek, West Fork Boulder Creek, and Boulder Creek are not listed on the most recent Utah 303(d)) List of Impaired Waters by UDEQ Division of Water Quality.

There are no drinking water surface protection zones or municipal watersheds directly within the East Fork Boulder Creek, West Fork Boulder Creek, and Boulder Creek watersheds from data received from the UDEQ Division of Drinking Water.

The closest irrigation water use associated from this UDWR project is 0.28 miles downstream of the terminus of the treatment area. Other irrigation water intakes and uses are farther than 0.5 miles downstream from the UDWR project.

Management of the UDWR project area waters is also subject to the State's Antidegradation Policy, as follows:

> *Maintenance of Water Quality*. Waters whose existing quality is better than the established standards for the designated uses will be maintained at high quality unless it is determined by the Board, after appropriate intergovernmental coordination and public participation in concert with the Utah continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. However, existing instream water uses shall be maintained and protected. No water quality degradation is allowable which would interfere with or become injurious to existing instream water uses. In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with Section 316 of the Federal Clean Water Act.
>
> *Category 1 Waters*. Waters which have been determined by the Board to be of exceptional recreational or ecological significance or have been determined to be a State or National resource requiring protection shall be maintained at existing high quality through designation, by the Board after public hearing, as Category 1 Waters. New point source discharges of wastewater, treated or otherwise, are prohibited in such segments after the effective date of designation. Protection of such segments from pathogens in diffuse, underground sources is covered in R317-5 and R317-7 and the Regulations for Individual Wastewater Disposal Systems (R317-501 through R317-515). Other diffuse sources (nonpoint sources) of wastes shall be controlled to the extent feasible through implementation of best management practices or regulatory programs. Projects such as, but not limited to, construction of dams or roads will be considered where pollution will result only during the actual construction activity, and where best management practices will be employed to minimize pollution effects. Waters within this UDWR project area are listed as state designated Category 1 Waters.

Cumulative Effects Area and Activities

The CEA for floodplains and wetlands will be the proposed UDWR project areas. This area represents past, present and foreseeable activities which may have a cumulative effect on flood plains and wetlands.

The CEA for water quality will be three (HUC 6) watersheds, Headwaters Boulder Creek, Bear Creek – Boulder Creek, and Deer Creek. This area represents past, present, and foreseeable activities which may have a cumulative effect on water quality.

3.3.2 Direct and Indirect Effects of the Alternatives

No Action - No Further Treatment Scenario

Floodplains and Wetlands

The No Action - No Further Treatment Scenario would not have any direct or indirect effects to floodplains or wetlands.

Water Quality

There would be no direct or indirect effects to water quality under the No Action - No Further Treatment Scenario. Rotenone would not be used to treat the UDWR project area waters. None of the Beneficial Uses designated for the UDWR project area waters would be affected.

Proposed Action

Floodplains and Wetlands

There would be no filling or obstruction of floodplains or wetlands during the treatments under the UDWR activities as described for the Proposed Action. Rotenone does not affect aquatic or riparian vegetation.

Water Quality

Under the UDWR activities described for the Proposed Action, there would be short-term direct effects to water quality relating to the Utah State Use Designation Class 2B designation of beneficial uses as a result of the UDWR chemical treatment with rotenone. The primary direct effect would be to infrequent primary contact recreation, which includes secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing. The design criteria would be followed to mitigate for human recreational exposure to rotenone and also provide an operating protocol for public notification of treatment area restrictions prior to, during, and following application of rotenone. Rotenone dissipates in flowing waters relatively rapidly (often less than 24 hours) due to dilution and increased rates of hydrolysis and photolysis (Finlayson et al. 2000, Brown 2010).

Rotenone is non-toxic to mammals, including humans. At the concentrations used to kill fish, it has been estimated that a 132-lb person would have to consume over 60,000 liters of treated water at one sitting to receive a lethal dose (Sousa et al, 1987). In addition, extensive testing has not shown rotenone to be carcinogenic (Bradbury 1986). Municipal drinking water supplies have been treated with rotenone in at least seven states including Utah.

There would be short-term direct effects to water quality relating to the Utah State Use Designation Class 3A designation of beneficial uses as a result of UDWR's chemical treatment with rotenone as described for the Proposed Action. The primary direct effect would be the

toxicity of rotenone to aquatic organisms including fish and invertebrates. Rotenone dissipates in flowing waters relatively rapidly (often less than 24 hours) due to dilution and increased rates of hydrolysis and photolysis (Finlayson et al. 2000, Brown 2010).

Numbers of aquatic invertebrates, important to the aquatic ecosystem, would be temporarily suppressed. Areas upstream from the target waters or refugia left in the fishless portions of target waters would provide a source for rapid recolonization. Off-stream ponds, bogs, seeps and springs would be left untreated by UDWR, serving as refugia for aquatic invertebrates. This would help insure the recolonization of the treated portions of the streams. The natural, downstream drift of aquatic insects generally results in the rapid recolonization of streams following their removal by natural or man-made events (Hynes 1972).

Whelan (2002) reviewed aquatic macroinvertebrate literature for both rotenone treatments and natural disturbances. Rotenone treatments at low concentrations for short treatment times are likely less impacting to aquatic macroinvertebrates than major natural events. Whelan (2002) summarized mechanisms that aquatic macroinvertebrates have evolved to live in dynamic environments that make them potentially able to survive or persist through rotenone treatments. These include resistant egg stages, multiple overlapping generations, life stages that live deep in the in the gravel of the stream (hyporheic zone) with upwelling groundwater, life stages that live in silt or aquatic vegetation that binds up rotenone, and dispersal by winged adults from areas of refugia. Some taxa, especially those with low oxygen requirements, are relatively resistant to rotenone even as nymphs or adults.

The mobility of rotenone in soil is low. In fact, the leaching distance of rotenone is only 2 cm in most types of soils. This is because rotenone is strongly bound to organic matter, making it unlikely that it would enter groundwater. At the same time, rotenone breaks down quickly into temporary residues that would not persist as pollutants of groundwater. Ultimately rotenone breaks down into carbon dioxide and water.

A secondary indirect effect of the UDWR treatment would be a temporary increase in the nutrient input to the water as a result of decomposition of fish that are killed. This effect would occur for a period of approximately 2 weeks while decomposition occurred. However, natural mortality has always occurred in the target waters and the increase would be negligible with respect to the ecosystem. Some of the nutrients would likely be rapidly assimilated by rebounding aquatic macroinvertebrate populations.

The EPA approves rotenone for the use intended in this UDWR project, and it would be applied by UDWR according to label instructions by personnel certified as Non-Commercial Pesticide Applicators. Changes in water quality during the UDWR project would not impair other uses. Rotenone would not affect plants and would still be of suitable quality for use by livestock, other mammals and birds.

Potassium permanganate would be used by UDWR to detoxify rotenone during treatments at some of the UDWR project waters. Potassium permanganate would degrade to nontoxic, common compounds within an hour of application at the concentrations that would be used. The detoxification is not immediate in space but requires a short mixing zone where the potassium

permanganate is in contact with and oxidizes the rotenone. Below this mixing zone both fish and aquatic macroinvertebrates would survive (Brown 2010).

Drinking water supplies would not be affected by the use of potassium permanganate, because it rapidly breaks down into potassium, manganese, and water. In addition, no target streams are used directly as municipal or culinary water sources.

There would not be direct effects to water quality relating to the designation of irrigation water and stock water (Utah State Use Designation Class 4) beneficial uses as a result of the UDWR chemical treatment with rotenone as described for the Proposed Action. The irrigation water uses are greater than 0.25 miles from this UDWR project. Design criteria include application in accordance with regulations and policy, such as mitigation measures outlined in the EPA rotenone re-registration document (EPA 2006). This would mitigate for irrigation and stock water exposure to rotenone.

Non-chemical Treatment Alternative

Floodplains and Wetlands

There would be no filling or obstruction of floodplains or wetlands during the UDWR activities as described for the Non-chemical Treatment alternative. The UDWR activities as described for the Non-chemical Treatment alternative would not affect aquatic or riparian vegetation. A small pool would be created by the migration barrier to be installed by UDWR on private property as part of the UDWR project. The UDWR would need to comply with regulations governing alteration of stream channels, including approval from the State Engineer and Army Corps of Engineers prior to construction of the barrier.

Water Quality

There would be a temporary increase in turbidity immediately downstream from the barrier construction site and with the stream electrofishing reaches from human foot traffic. The most increase would be limited to a moving disturbance, short duration for any one place at a time, along the entire length of stream channel, with some disturbance occurring over the course of 80 days (four 20 day treatments) per year.

A secondary indirect effect of the UDWR treatment would be a temporary increase in the nutrients from fish burial as a result of decomposition of fish that are killed. This effect would occur for a period of approximately 2 to 6 weeks while decomposition occurred. The burial sites from nonnative fish would be 300 feet from the stream channel and be dispersed and negligible with respect to the ecosystem.

3.3.3 Cumulative Effects

No Action - No Further Treatment Scenario

Floodplains and Wetlands

The No Action - No Further Treatment Scenario would have no direct or indirect effects and, therefore, no cumulative effects to floodplains or wetlands.

Water Quality

The No Action - No Further Treatment Scenario would have no direct or indirect effects and, therefore, no cumulative effects to floodplains or wetlands.

Proposed Action

Floodplains and Wetlands

There would be no filling or obstruction of floodplains or wetlands during the treatments under the UDWR activities as described for the Proposed Action, and rotenone does not affect aquatic or riparian vegetation; therefore, there would be no cumulative effects on floodplains or wetlands as a result of this alternative.

Water Quality

Past activities have occurred in the CEA that affect water quality. These include 9,780 acres of past timber sales (Bear Creek, Deer Mountain, Garkane, Side Hollow and Dry Lakes Aspen Timber Sale) harvested within the last 30 years along with approximately 2,500 acres of non-commercial thinning. The effects of these projects in regards to water quality were non-detectable. Water quality observations for streams associated with these projects have met Utah State Use Classification standards.

Four past fires (Deer Mountain, Short Neck, Steep Creek and Bear Creek) fires have burned 1,860 acres in the Deer Creek and Bear Creek – Boulder Creek watersheds. These wildfires have had short term negative water quality affects to the streams but have stabilized within 2 years after the fires due to the limited acres of these fires and revegetation potential of the immediate stream buffers. No exceedences of Utah State Use Classification standards were documented.

Present activities are occurring that affect water quality in the CEA. Numerous grazing permits are within the CEA (15,500 acres in the Bear Creek-Boulder Creek Watershed, 33,972 acres in the Headwaters Boulder Creek watershed and 27,693 acres in the Deer Creek watershed). Grazing that does occur on the district is managed under proper use guidelines to protect water quality standards.

Road and trails within the CEA are approximately:

- 42 miles of High Clearance Vehicle Roads (ML2)

- 1 mile of Suitable for Passenger Cars Road (ML3)
- 5 miles of Seasonal Closed Roads
- 35 miles of Administrative Roads (ML1)
- 61 miles of Roads Designated to be Closed
- 39 miles of Non-Motorized Trails
- 17 miles of Highway (Utah Hwy 12)
- 16 miles of Private Roads

Current road maintenance within the CEA has only occurred after the Bear Creek wildfire and on Forest Road 165 (Kings Pasture Road) and 166 (Haws Pasture Road) road resurfacing projects which have assisted in maintaining proper water drainage. Additional work has just been completed on Forest Road 166 with the bridge construction over East Fork Boulder Creek and has re-established the constricted channel to proper width configuration and streams pool dynamics acceptable for aquatic passage.

Foreseeable activities may occur that can affect water quality in the CEA. Two timber sales/vegetation management projects are within the foreseeable future. The Sawmill Aspen Vegetation Management (815 acres) and Road Draw Salvage Sale (82 acres) projects have effectively buffered any treatments from streams in the area to protect the water quality.

Road closures within the next five years are also expected, and this UDWR project would also protect water quality in the CEA.

There would be no cumulative effects to water quality as a result of the UDWR activities as described for the Proposed Action. Stream flows would flush rotenone from streams or channels which are treated in approximately 12 hours after the application. None of the other activities in the CEA have had a long term effect on water quality, and the UDWR activities as described for the Proposed Action would not contribute any lasting effects.

Non-chemical Treatment Alternative

There would be no cumulative effects to water quality as a result of the UDWR activities as described for the Non-chemical Treatment alternative. None of the other activities in the CEA have had an effect on water quality, and the UDWR activities under this alternative would not contribute any lasting effects.

3.3.4 Conclusion

The No Action - No Further Treatment Scenario would not have any direct, indirect, or cumulative effects to wetlands or floodplains. It would have no direct, indirect, or cumulative effect to water quality. None of the beneficial uses designated for the UDWR project area waters would be affected.

There would be no effects to floodplains or wetlands or aquatic or riparian vegetation under the UDWR activities as described for the Proposed Action or the Non-chemical Treatment

alternative. A small pool would be created by the fish barrier to be installed by UDWR on private property as described for the Non-chemical Treatment alternative.

There would be short-term direct effects to water quality relating to the Utah State Use Designation Class 2B designation of beneficial uses, infrequent primary contact recreation, from the UDWR activities as described for the Proposed Action. Design criteria would reduce human recreational exposure to rotenone as well as provide an operating protocol for public notification of treatment area restrictions prior to, during, and following application of rotenone. There would be short-term direct effects to water quality relating to the Utah State Use Designation Class 3A designation of beneficial uses from the UDWR activities as described for the Proposed Action through toxicity of rotenone to aquatic organisms including fish and invertebrates. There would be short term secondary indirect effect from a temporary increase in the nutrient input to the water as a result of decomposition of fish that are killed from the UDWR activities as described for the Proposed Action.

Under the UDWR activities as described for the Non-chemical Treatment alternative, there would be a temporary increase in turbidity immediately downstream from the barrier construction site and in the stream electrofishing reaches from human foot traffic. There would be a secondary temporary increase in nutrients from fish burial.

Under the UDWR activities as described for the Proposed Action and Non-chemical Treatment alternative, drinking water supplies would not be affected, there would not be direct effects to Utah State Use Designation Class 4 designation of beneficial uses -- irrigation water and stock water, and there would be no cumulative effects to water quality.

3.4 Range; Livestock Grazing; Threatened, Endangered, Proposed, Candidate, and Sensitive Plants

3.4.1 Affected Environment

The UDWR project area includes the Boulder Allotment, administered by the Forest Service. The treatment streams are used as a water source for the livestock on the allotment. Riparian and upland vegetation are used as forage by livestock.

The overall area of analysis for direct and indirect effects on livestock grazing is the Between the Creeks Unit (pasture) of the Boulder Allotment (see Figure 6). This pasture is expected to be grazed from approximately July 1 thru August 14 during years 2011 and 2013 and August 15 thru October 1 during years 2012 and 2014. The alternating periods of use is expected to continue.

The potential cumulative effects on livestock grazing would be availability of water and vegetation. The CEA for for livestock grazing is the Boulder Allotment.

There are no known locations of threatened, endangered, proposed, candidate, or sensitive plant species in the UDWR project area. This topic will not be discussed further.

3.4.2 Direct and Indirect Effects of the Alternatives

No Action - No Further Treatment Scenario

Under the No Action - No Further Treatment Scenario, there would be no treatment; therefore, there would be no change in and thus no effect to water quality or quantity, vegetation for forage, or range vegetative communities.

Proposed Action

The UDWR activities as described for the Proposed Action would result in rotenone application to 7.4 miles of stream within the Between the Creeks pasture of the Boulder Allotment. As described in the Floodplains, Wetlands, and Water Quality section, there would be no effect to water quality relating to irrigation water and stock water; therefore, there would be no effect to water availability for livestock. As described in the Forest Service risk assessment of rotenone, "there is no basis for asserting that adverse effects are plausible in large or small mammals when rotenone is applied at the highest application rate considered in this risk assessment, 200 ppb" (Durkin 2008). UDWR's rotenone application as described for the Proposed Action is expected to be less than the maximum and would decrease as the chemical degrades, often in less than 24 hours, as described in the specialist report on Floodplains, Wetlands, and Water Quality.

Livestock would also be exposed to potassium permanganate in the 0.25 to 0.5 miles below the neutralization site at decreasing concentration until the potassium permanganate oxidizes the rotenone. At the rate it would be applied by UDWR, potassium permanganate would not affect water quality for livestock and would be decreasing in concentration through the neutralization zone until it oxidizes the rotenone. No adverse acute effects to livestock are expected from the chemical. Because potential exposure of livestock to the chemicals would occur only if UDWR's treatment were to occur prior to October 1, either 1 or 2 years out of the potential 3 years of treatment, and for only 24 hours, no chronic exposure or effects would occur. Other water is also available for livestock in the area.

The UDWR activities as described for the Proposed Action would involve access by personnel setting up application and neutralization sites. Because access to application sites would be by foot, and application would be done with drip stations, the effects on riparian and upland vegetation would be minimal. Access to neutralization sites may be by motorized vehicle and potentially affect vegetation if cross-country travel is needed, but this would be minimal and occur at only the lower end of the treatment areas. Overlap in period of use by livestock and disturbance to forage would be for short duration, and vegetation is available for livestock elsewhere in the pasture.

The effects to range vegetative communities under the UDWR activities as described for the Proposed Action are as described for effects to livestock forage availability. It would be short duration and minimal. Design criteria require application procedures to be in accordance with policy, which includes the Forest Noxious Weed strategy, and UDWR would be expected to follow the Utah Noxious Weed Act requirements regarding treatment of machinery in Utah State

Code R68-9-4; therefore, there would also be no expected increase in noxious weeds to affect range vegetative communities from the UDWR activities as described for the Proposed Action.

Non-chemical Treatment Alternative

As described in the specialist report on Floodplains, Wetlands, and Water Quality, the UDWR activities as described for the Non-chemical Treatment alternative would result in short term fine sediment in the 7.4 miles of stream within the Between the Creeks pasture of the Boulder Allotment. This would not affect the quality of water for livestock. Water quality and quantity for livestock would not be affected.

The Non-chemical Treatment alternative would involve multiple passes of personnel conducting electrofishing that includes hiking along edges and sweeping through streambank and aquatic vegetation with electrofishing equipment. Riparian vegetation could be disturbed in the process along the 7.4 miles of stream in the pasture. Effects would be short-term, because the vegetation should recover by the following growing season. Overlap in period of use by livestock and disturbance to vegetation would be for short duration in any one location as crews move through. Overall presence would be approximately 40 days per year, based on an assumption that only two removal efforts would occur during the period the pasture would be in use. This may occur for up to 10 years. Other forage would be available for livestock elsewhere in the pasture.

The effects to range vegetative communities from UDWR activities as described for the Non-chemical Treatment alternative are as described for effects to livestock forage availability. It would be short duration and minimal. UDWR would be expected to follow the Utah Noxious Weed Act requirements regarding treatment of machinery in Utah State Code R68-9-4; therefore, there would be no expected increase in noxious weeds to affect range vegetative communities from the UDWR activities as described for the Non-chemical Treatment alternative.

3.4.3 Cumulative Effects

Under all alternatives, the effects to water availability and forage availability would be either non-existent, too small to be measured, or of too short duration relative to the pasture use period to have measurable effect; therefore, there would be no cumulative effects to water availability for livestock.

Under all alternatives, the effects to vegetation would be either non-existent, too small to be measured, or of too short duration relative to the pasture use period to have measurable effect; therefore, there would be no cumulative effects to vegetation for livestock forage or range vegetation communities.

3.4.4 Conclusion

There would be no direct, indirect, or cumulative effects to range resources, livestock, and noxious weeds from the No Action - No Further Treatment Scenario.

There would be non-existent, too small to measure, or of too short duration relative to the pasture use period to have measurable direct effects to range resources and livestock under the UDWR activities as described for the Proposed Action and Non-chemical Treatment alternative. There would be no indirect or cumulative effects.

3.5 Recreation, Draft Unroaded/Undeveloped Areas, Inventoried Roadless Areas, and Suitable Wild and Scenic River Segments

3.5.1 Affected Environment

Recreation

Forest Roads 165, 166 and 508 provide recreation access to the area. Recreation activities which occur in the area include, fishing, hunting, pleasure driving, dispersed camping, ATV riding, horseback riding and hiking. Of these activities, only fishing would be affected by the UDWR activities as described for either of the action alternatives. Consequently, the analysis area for the recreation resource only includes the UDWR project treatment area.

The CEA for the recreation resource is that portion of the Boulder Creek-Escalante River 5th field watershed, located on the Escalante Ranger District. This area was chosen because lakes and streams within this area are close enough that they could easily attract the same fishermen, and they are located in a forested mountain environment (see Figure 7).

Boulder Top Draft Unroaded/Undeveloped Area

The purpose of this analysis is to disclose the effects of the UDWR project on wilderness qualities or attributes within the Boulder Top Unroaded/ Undeveloped Area (DU/UA) which was identified on a 2005 draft map produced during LRMP revision efforts as part of a required inventory and evaluation of areas with wilderness potential (Forest Service Handbook 1909.12(70)).

The Boulder Top DU/UA is located 7 miles north of Boulder, Utah, and is approximately 69,200 acres in size (Figure 8). Approximately 2 miles of East Fork Boulder Creek is located within this DU/UA. Access to this area is by Utah Highway 12 as well as dry weather gravel and dirt roads. Wilderness attributes are characterized as follows:

> **Natural Integrity (Untrammeled):** Signs of old timber harvest are evident above the rim. The area contains approximately 6 miles of open roads, 38 miles of closed roads and 1.5 miles of motorized trails. The natural integrity of this area is medium.
>
> **Undeveloped Character or Natural Appearance:** Roads, motorized trails, timber harvest and past uses are evident throughout the area. The undeveloped character or natural appearance of this area is medium.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation: Recreational opportunities within the Boulder Top DU/UA area include hiking, mountain biking, fishing, and hunting. The Boulder/Swale ATV trail and cherry stem roads are open to trail riding. The area is interlaced with developed hiking trails. While the area presents a lot of recreational opportunities, primitive recreation requires a degree of challenge and risk that is not required in this area. Recreationists using this area could be isolated from the sights and sounds of civilization.

Special Features: Special features include, roughly 15 fishable lakes, Blue Bell Knoll which is the highest point on Dixie NF, Jubilee Guard Station (one of the oldest guard stations in the nation) and CRCT (present in East Fork Boulder Creek).

Manageability: The north and west boundaries are defined by roads. Most of the southern boundary is defined by management activities and is not easily identifiable. Above the rim, many roads cherry stem into the area. Overall manageability of the area is medium. Below the rim, the narrow western arm is bisected by the Boulder/Swale ATV trail.

The CEA for wilderness attributes in the Boulder Top DU/UA is the DU/UA itself.

Inventoried Roadless Areas

Portions of the UDWR project area are located in the Boulder Mountain/Boulder Top/Deer Lake Inventoried Roadless Area (BM/BT/DL IRA) and New Home Bench Inventoried Roadless Area (NHB IRA). The purpose of this analysis is to disclose the effects of the UDWR project on roadless area qualities or attributes within the IRAs. The roadless attributes that will be considered are:

Soil, water and air resources
Sources of public drinking water
Diversity of plant and animal communities
Habitat for TES and species dependent on large undisturbed areas of land
Primitive and semi-primitive classes of recreation.
Reference landscapes for research study or interpretation
Landscape character and integrity
Traditional cultural properties and sacred sites
Other locally unique characteristics

The BM/BT/DL IRA is 57,440 acres and is located on the Fremont River and Escalante Ranger Districts. This IRA includes most of the slopes immediately below the Boulder Rim and all of the Boulder Top. The NHB IRA is 10,240 acres and is located on the Escalante Ranger District between Nazer Draw and Salt Gulch.

The CEA for each IRA is the IRA area itself (Figure 9).

Suitable Wild and Scenic River Segments

The Forest has no suitable Wild and Scenic River segments in the UDWR project area or downstream of the UDWR project area. A portion of East Fork Boulder Creek was considered eligible; however, it was determined to be not suitable in the Wild and Scenic River Suitability Study for National Forest System Lands in Utah (ROD 11/12/08). That segment will not be discussed further in this analysis.

The Grand Staircase-Escalante National Monument (GSENM) Management Plan's determination of river segments found suitable for recommendation for Congressional designation for inclusion into the National Wild and Scenic River System includes Lower Boulder Creek (downstream of T34S-R4E-S11 to the Escalante River at T35S-R5E-S22) and the Escalante River (from downstream of private property east of Highway 12 to the Monument boundary at T36S-R6E-S4; BLM 1999). These segments are downstream of the UDWR project area and the area of analysis for direct and indirect effects.

Analysis of effects is based on the characteristics to be managed for under the Wild and Scenic Rivers Act, which are outstandingly remarkable values, free-flowing condition, and water quality (Public Law 90-541, 1968).

Because both segments are described in the GSENM Management Plan as part of the Escalante River System, the Escalante River System, as described in the GSENM Management Plan, is the CEA.

3.5.2 Direct and Indirect Effects of the Alternatives

No Action - No Further Treatment Scenario

Recreation

The conditions described in the affected environment would persist. All target waters would continue to be fishable.

Boulder Top Draft Unroaded/Undeveloped Area

Natural integrity (untrammeled). The No Action - No Further Treatment Scenario would not affect the natural integrity of the area. Conditions described in the affected environment would persist.

Undeveloped character or natural appearance. The No Action - No Further Treatment Scenario would not change the Undeveloped Character or Natural Appearance of the Boulder Top DU/UA.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation. There would be no change in opportunities for solitude or a primitive and unconfined type of recreation

if no further treatment were implemented. The conditions described in the existing conditions would persist.

Special features: ecological, geologic, scenic or historical. CRCT could be considered an ecological special feature. Under the No Action - No Further Treatment Scenario, non-native fish would remain in the UDWR project area. None of the other identified special features would be affected.

Manageability (as wilderness). The No Action - No Further Treatment Scenario would not affect the areas manageability as Wilderness. The size of the area would not change.

Inventoried Roadless Areas

If no further treatments were implemented, the existing conditions would persist. There would be no direct or indirect effects.

Suitable Wild and Scenic River Segments

The GSENM Management Plan considered several river segments as the Escalante River System. Recommendation of the system was based on the following outstandingly remarkable values: scenic, recreational, geological, riparian, and historic. For the specific two segments of the analysis area, the identified "characteristics which make the area a worthy addition to NWSRS" are as follows:

- Lower Boulder Creek: high quality scenery, high recreational use, part of the Escalante Canyons Outstanding Natural Area and prehistoric sites

- Escalante River-3: high scenic quality, high recreational use, numerous geologic features, important fish and wildlife habitat, prehistoric sites, historic homestead and routes, riparian area, fossil tracks, petrified wood.

The GSENM Management Plan describes the riparian values as follows:

> The river segments provide unique riparian corridors through an otherwise arid region. A variety of wildlife species, both aquatic and terrestrial, rely upon the river for habitat. The riparian area contains occupied or suitable habitat for numerous sensitive or special status animal and plant species. The Escalante River System is home to 8 amphibian species, 190 bird species, 54 mammal species, 20 fish species, and 20 reptile species. Among these are the threatened and endangered southwestern willow flycatcher, Mexican spotted owl, and wintering bald eagles (BLM 1999).

Escalante River-3 is the furthest downstream of the three Escalante River segments. Under the No Action - No Further Treatment Scenario, there would be no effects on scenic, recreational, geological, prehistoric, historic values or characteristics. There would be no effect on fossil tracks, petrified wood, or riparian values; therefore, there would be no effects to the outstanding

remarkable values of those segments on the GSENM. Additionally, there would be no effect to the free-flowing condition or water quality of the GSENM suitable segments.

Proposed Action

Recreation

All fish would be temporarily eliminated from target waters. After treatment some locations would be stocked with sterile hybrids of nonnative trout. Target waters would not be usable for sport fishing from the time of treatment until successful restocking. Kings Pasture Reservoir could be fishable at an earlier date if restocked with sterile hybrids.

Boulder Top Draft Unroaded/Undeveloped Area

Natural integrity (untrammeled). The UDWR activities as described for the Proposed Action would improve the natural integrity of the area by removing nonnative fish from the treated water bodies and replacing them with native CRCT. Nonnative trout would still be prevalent in the remaining fishable lakes and streams within the area.

Undeveloped character or natural appearance. The UDWR activities as described for the Proposed Action would not change the Undeveloped Character or Natural Appearance of the Boulder Top DU/UA.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation. Implementation of the UDWR activities as described for the Proposed Action would cause increased human activity during UDWR's project implementation. This increased activity would occur on approximately 2.3 miles of East Fork Boulder Creek within the Boulder Top DU/UA and would be minor. The same 2.3 miles of creek would not be fishable for an unknown period of time. The UDWR activities as described for the Proposed Action would cause a slight increase in activity in the immediate UDWR project area. The increase in activity would be temporary. The UDWR project would not affect opportunities for solitude or a primitive and unconfined type of recreation on the remainder of the 69,200 acre DU/UA.

Special features: ecological, geologic, scenic or historical. CRCT could be considered an ecological special feature. Under the UDWR activities as described for the Proposed Action, CRCT would be temporarily removed from the treated areas. After UDWR's project implementation, CRCT would be reintroduced and the population would become self sustaining. This alternative would increase the presence of CRCT as a special feature in the area. None of the other identified special features would be affected.

Manageability (as wilderness). The UDWR activities as described for the Proposed Action would not affect the areas manageability as Wilderness. The size of the area would not change.

Inventoried Roadless Areas

Soil, water and air resources. The UDWR activities as described for the Proposed Action would not have any effect on soil or air.

Sources of public drinking water. Drinking water supplies would not be affected by the use of potassium permanganate, because it rapidly breaks down into potassium, manganese, and water. In addition, no target streams are used directly as municipal or culinary water sources.

Diversity of plant and animal communities. The UDWR activities as described for the Proposed Action would not affect diversity of plant or terrestrial wildlife communities. The UDWR activities as described for the Proposed Action could have short term negative effects on invertebrate and amphibian species within the treated waters as some individuals would be killed. In the long term diversity of amphibian species would likely improve because of a reduction of predation due to the expected lower density of restored CRCT as compared to the current density of brook trout. Habitat for invertebrates would not change.

Habitat for TES and species dependent on large undisturbed areas of land. The UDWR activities as described for the Proposed Action would not affect habitat for any threatened or endangered species. Habitat for CRCT, a sensitive species, would improve in the treated waters due to the elimination of brook trout. The UDWR activities as described for the Proposed Action would not affect any species dependent on large undisturbed tracts of land.

Primitive and semi-primitive classes of recreation. While the proposed activities are taking place, the sights and sounds of man would be more apparent. These effects would be temporary and only occur in the direct UDWR project area. After UDWR's project implementation, the opportunities for solitude would return to normal. Opportunities for primitive and semi-primitive recreation would not be affected.

Reference landscapes for research study or interpretation. None have been identified in the BM/BT/DL or NHB IRAs.

Landscape character and integrity. The UDWR activities as described for the Proposed Action would not change the landscape character of the area.

Traditional cultural properties and sacred sites, other locally unique characteristics. No traditional cultural properties, sacred sites or other locally unique properties would be affected by the UDWR activities as described for the Proposed Action.

Suitable Wild and Scenic River Segments

Effects of the UDWR activities as described for the Proposed Action on scenic, recreational, geological, prehistoric, historic values or characteristics, fossil tracks or petrified wood would be the same as those for the No Action - No Further Treatment Scenario.

Although the UDWR activities as described for the Proposed Action may affect wildlife and fish species as described in the wildlife and fisheries specialist reports, the effects are not expected to extend to either Lower Boulder Creek or the Escalante River; therefore, there would be no direct effects to the outstanding remarkable values of those segments on the GSENM. The wildlife specialist report also indicates no effect on foodwebs, and the fisheries report indicates potential improvement of foodwebs within the UDWR project area; therefore, no indirect effects are expected on the outstanding remarkable values of the segments on the GSENM.

Additionally, for all alternatives, there would be no effect to the free-flowing condition from UDWR activities. Although the UDWR activities as described for the Proposed Action may affect water quality as described in the water quality report, the effects are not expected to extend to the suitable segments on the GSENM; therefore, there would be no direct or indirect effects to water quality of the GSENM suitable segments.

Non-chemical Treatment Alternative

Recreation

The effects of the UDWR activities as described for this alternative would be similar to those for the Proposed Action; however, target waters may remain fishable due to the ineffectiveness of the treatment method.

Boulder Top Draft Unroaded/Undeveloped Area

Natural integrity (untrammeled). The UDWR activities as described for the Non-chemical Treatment alternative would likely reduce the number of nonnative trout but not eliminate them completely. The natural integrity of the stream would stay the same.

Undeveloped character or natural appearance. The UDWR activities as described for the Non-chemical Treatment alternative would not change the Undeveloped Character or Natural Appearance of the Boulder Top DU/UA

Outstanding opportunities for solitude or a primitive and unconfined type of recreation. The UDWR activities for the Non-chemical Treatment alternative would also cause increased human activity on approximately 2.3 miles of East Fork Boulder Creek during UDWR's project implementation. The duration of the increased UDWR activity would be longer than for the Proposed Action but would not be lasting. The effects of the UDWR activities as described for the Non-chemical Treatment alternative would be similar to those for the Proposed Action.

Special features: ecological, geologic, scenic or historical. CRCT could be considered an ecological special feature. The UDWR activities as described for the Non-chemical Treatment alternative would decrease the likelihood of eliminating nonnative fish from the treated waters and creating a self sustaining population of CRCT. None of the other identified special features would be affected.

Manageability (as wilderness). The UDWR activities as described for the Non-chemical Treatment alternative would not affect the areas manageability as Wilderness. The size of the area would not change.

Inventoried Roadless Areas

Soil, water and air resources. The UDWR activities as described for the Non-chemical Treatment alternative would not have any effect on air. There would be a temporary and localized increase in soil nutrients in the areas where the killed fish are buried. This effect would occur for a period of approximately 2 to 6 weeks while the fish are decomposing.

Both UDWR's barrier construction and electro-shocking activities would cause disturbance to the bottom of the stream. This disturbance would cause an increase in stream turbidity. The increase would be limited to a short reach directly below activities and be limited in duration to the period of actual UDWR activities.

Sources of public drinking water. Drinking water supplies would not be affected by the UDWR activities as described for the Non-chemical Treatment alternative. No target streams are used directly as municipal or culinary water sources.

Diversity of plant and animal communities. The UDWR activities as described for the Non-chemical Treatment alternative would not have any effect on plants or plant habitat. Diversity of terrestrial animal communities would not change.

In the long term habitat for amphibian species would likely improve because of a reduction of predation due to the expected lower density of restored CRCT as compared to the current density of brook trout. Habitat for invertebrates would not change.

Habitat for TES and species dependent on large undisturbed areas of land. The UDWR activities as described for the Non-chemical Treatment alternative would not affect habitat for any threatened or endangered species. Habitat for CRCT which is a sensitive species would improve in the treated waters due to the reduction of brook trout. Because total elimination of brook trout in the treated waters is unlikely, habitat for CRCT would not improve to the same degree as is expected if the UDWR activities as described for the Proposed Action are implemented. This alternative would not affect any species dependent on large undisturbed tracts of land.

Primitive and semi-primitive classes of recreation. The effects of the UDWR activities as described for the Non-chemical Treatment alternative would be similar to those for the Proposed Action. The sights and sounds of man would be more apparent during UDWR's project implementation and would be evident over a longer period of time than of those described for the Proposed Action. Opportunities for primitive and semi-primitive recreation would not be affected.

Reference Landscapes for Research Study or Interpretation. None have been identified in the BM/BT/DL or NHB IRA.

Landscape Character and Integrity. The UDWR activities as described for the Non-chemical Treatment alternative would not change the landscape character of the area.

Traditional Cultural Properties and Sacred Sites, other Locally Unique Characteristics. No traditional cultural properties, sacred sites or other locally unique properties would be affected by the UDWR activities as described for the Non-chemical Treatment alternative.

Suitable Wild and Scenic River Segments

Effects from the UDWR activities as described for the Non-chemical Treatment alternative on scenic, recreational, geological, prehistoric, historic values or characteristics, fossil tracks or petrified wood would be the same as for the No Action - No Further Treatment Scenario. Effects on riparian values from the UDWR activities would be the same as for the Proposed Action.

There would be no effect to the free-flowing condition. Although the UDWR activities as described for the Non-chemical Treatment alternative may affect water quality, the effects are not expected to extend to the suitable segments on the GSENM; therefore, there would be no direct or indirect effects to water quality of the GSENM suitable segments.

3.5.3 Cumulative Effects

No Action - No Further Treatment Scenario

Recreation

There would be no effects to recreation from the No Action - No Further Treatment Scenario; therefore, there would be no cumulative effects.

Boulder Top Draft Unroaded/Undeveloped Area

No past, present or reasonably foreseeable activities have been identified which would cumulatively affect wilderness attributes; therefore, there would be no cumulative effects.

Inventoried Roadless Areas

No past, present or reasonably foreseeable activities have been identified which would cumulatively affect the roadless area attributes described above; therefore, there would be no cumulative effects.

Suitable Wild and Scenic River Segments

Because there would be no direct or indirect effect to the outstanding remarkable values, free-flowing characteristic, or water quality of the GSENM suitable segments, there would be no cumulative effects.

Proposed Action

Recreation

The CEA contains 63 miles (101 km) of trout bearing streams and 93 acres of trout bearing lakes. Within this area 2.9 mi (4.6 km) of East Fork Boulder Creek and Kings Pasture reservoir (2.5 acres) were treated with rotenone in 2009. UDWR's retreatment of these waters is part of the UDWR activities as described for the Proposed Action. No other past, present, or reasonably foreseeable actions have been identified which would affect sport fishing within the CEA; therefore, there would be no cumulative effects.

Boulder Top Draft Unroaded/Undeveloped Area

The cumulative effects are the same as for the No Action - No Further Treatment Scenario.

Inventoried Roadless Areas

The cumulative effects are the same as for the No Action - No Further Treatment Scenario.

Suitable Wild and Scenic River Segments

The cumulative effects are the same as for the No Action - No Further Treatment Scenario.

Non-chemical Treatment Alternative

Recreation

Cumulative effects for the UDWR activities as described for the Non-chemical Treatment alternative would be similar to those for the Proposed Action.

Boulder Top Draft Unroaded/Undeveloped Area

The cumulative effects are the same as for the No Action - No Further Treatment Scenario.

Inventoried Roadless Areas

The cumulative effects are the same as for the No Action - No Further Treatment Scenario.

Suitable Wild and Scenic River Segments

The cumulative effects are the same as for the No Action - No Further Treatment Scenario.

3.5.4 Conclusion

In the long term, all target waters would remain fishable under all alternatives, although fish would be temporarily eliminated by UDWR from target waters under the UDWR activities as

described for the Proposed Action and Non-chemical Treatment alternative. Target waters would not be usable for sport fishing from the time of treatment until successful restocking, although after the UDWR treatment some locations would be stocked with sterile hybrids of nonnative trout.

The UDWR activities as described for the alternatives would not change the Undeveloped Character or Natural Appearance or size of the Boulder Top DU/UA. Neither UDWR's implementation of the activities as described for the Proposed Action nor the Non-chemical Treatment alternative would preclude the Boulder Top DU/UA for consideration as an area of wilderness potential in the future.

The UDWR activities as described for the alternatives would not affect the roadless area qualities or attributes of either the BM/BT/DL or NHB IRAs except that the UDWR activities as described for the Proposed Action and Non-chemical Treatment alternative would improve the diversity of plant and animal communities attribute by improving long term habitat for amphibian species. Also, under the UDWR activities as described for the Proposed Action and Non-chemical Treatment alternative, the attribute of habitat for TES species dependent on large undisturbed areas of land would improve, because habitat for CRCT would improve, although to a lesser degree under the UDWR activities as described for the Non-chemical Treatment alternative than for the Proposed Action because of the difference in effectiveness of the treatments.

None of the UDWR activities as described for the alternatives would affect the outstanding remarkable values, free-flowing characteristic, or water quality of the GSENM suitable Wild and Scenic River segments.

3.6 Climate

3.6.1 Affected Environment

The affected environment is the UDWR project area as described in Chapter 2 and the surrounding airshed.

3.6.2 Direct and Indirect Effects of the Alternatives

No Action - No Further Treatment Scenario

Under the No Action - No Further Treatment Scenario, there would be no activities affecting vegetation or using machinery; therefore, there would be no direct or indirect effects to carbon sequestration or greenhouse gas emissions.

Proposed Action

Under the UDWR activities as described for the Proposed Action, there would be no activities affecting vegetation; therefore, there would be no effects to carbon sequestration. There would be short term emissions associated with transport of personnel and equipment and the

neutralization equipment. Because greenhouse gases mix readily into the global pool of greenhouse gases, it is not currently possible to ascertain the indirect effects of emissions from this single UDWR project.

Non-chemical Treatment Alternative

Under the UDWR activities as described for the Non-chemical Treatment alternative, there may be short-term disturbance to riparian vegetation associated with electrofishing methods, but quick recovery is expected with no measurable effects to carbon sequestration. There would be short term emissions associated with transport of personnel and equipment and machinery required for the barrier construction. Although more greenhouse gasses may be generated under the UDWR activities as described for the Non-chemical Treatment alternative than for the Proposed Action, greenhouse gases mix readily into the global pool of greenhouse gases, and it is not currently possible to ascertain the indirect effects of emissions from this single UDWR project.

3.6.3 Cumulative Effects

This UDWR project is extremely small in the global atmosphere CO2 context; therefore, it is not presently possible to conduct quantitative analysis of actual cumulative effects on climate based on this single project.

3.6.4 Conclusion

Site specific quantitative measurements for a project of this small size would be both time consuming and expensive. The results would be meaningless to a reasoned choice by the Responsible Official.

3.7 Public Health: Chemical Exposure

3.7.1 Affected Environment

The affected environment includes members of the public who may be exposed to chemicals applied during the proposed UDWR project. Exposure would be directly or indirectly through the water in streams that would be potentially affected by the proposed UDWR project: East Fork Boulder Creek, West Fork Boulder Creek, and Boulder Creek. Lakes and reservoirs affected by activities connected to the proposed UDWR project include King's Pasture Reservoir and the pond in King's Pasture. Additionally, irrigation water fed by these streams and the Garkane penstock may be also be affected by the proposed UDWR project.

The UDWR project area is within an active cattle allotment (Boulder Allotment). One pasture within the allotment (Between-the-Creeks) contains flowing portions of streams within the UDWR project treatment area. A second pasture, Nazer Draw, contains portions of streams that may be affected by water flowing from the proposed treatment area. In addition to livestock

management, people also use the UDWR project area for hunting, fishing, hiking, camping and other recreation.

Irrigation ditches leaving the area treated under the proposed UDWR project on the Boulder Irrigation Company's irrigation system were marked using a Garmin Rhino Global Position System (GPS) on May 27, 2010 with Loch Wade, the water master for Boulder Irrigation Company. In addition to the points of diversion, the points of entry to private property for actual use of the irrigation water were also marked using a Garmin Rhino GPS. With one exception, irrigation water is used for irrigating pastures for livestock consumption, as well as watering livestock in the first 5 miles (8 km) downstream from the penstock and the main power plant outflows. The exception is that some pasture vegetation on one private pasture is harvested for resale.

The municipal water supply of Boulder, Utah, comes from wells that are approximately 2 miles (3.2 km) straight line distance south of the main power plant pond.

Boulder Creek passes by Boulder approximately 0.4 miles (0.6 km) east (straight line distance) of town and at this point is approximately 7 miles (11.3 km) downstream from the fish barrier on Boulder Creek at the lower end of the UDWR project area and 7.1 miles (11.4 km) downstream from the main power plant pond outflow.

3.7.2 Direct and Indirect Effects of the Alternatives

No Action - No Further Treatment Scenario

Under the No Action - No Further Treatment Scenario, no rotenone formulation or potassium permanganate neutralizer would be applied; therefore no direct or indirect effects to human health relating to chemical exposure would occur.

Proposed Action

Under the UDWR activities as described for the Proposed Action, rotenone formulations and potassium permanganate would be applied as described in Appendix A and the specialist report for Chemicals and Application.

In 2008 the Forest Service completed an independently prepared risk-assessment for the use of rotenone and completed an analysis of public health effects as part of that assessment (Durkin 2008). Durkin (2008) was used as the primary reference for evaluating the human health risks of the UDWR activities as described for the Proposed Action. Durkin (2008) noted that in addition to toxicity studies that are relatively standard for pesticides, there is a large body of literature available on the neurotoxicity of rotenone with particular emphasis on the use of rotenone as an animal model for Parkinson's disease. Additional literature supporting the contention that rotenone can have neurological effects has emerged since the Durkin (2008) assessment; therefore, these studies were also reviewed and incorporated into the potential impacts to human health from the UDWR activities as described for the Proposed Action.

As described in Appendix A, the liquid piscicidal formulations of rotenone that would be used by UDWR for activities as described for the Proposed Action contain inerts, adjuvants, metabolites, impurities, and contaminants in addition to the active ingredient rotenone. Durkin (2008) examined the potential negative effects of these compounds on humans and concluded that metabolites, a breakdown product of rotenone, did not increase the risk of human health effects associated with the use of rotenone formulations. Similarly, he concluded that available data indicate that the inerts are not present in amounts that would increase the risks associated with the proposed formulations. The impact of impurities, such as degeulin and the "other associated resins," are considered in Durkin (2008). As such, these other non-active ingredients are not further discussed separately.

Effect of rotenone

The mechanism by which rotenone acts is that it interferes with oxidative phosphorylation, a fundamental process in living cells in which nutrients are oxidized and the energy of oxidation is stored by the conversion of adenosine diphosphate to adenosine triphosphate (Durkin 2008). The net result of rotenone poisoning at the cellular level is similar to oxygen deprivation and leads to anaerobic metabolism with the formation of lactic acid leading to acidosis.

Acute toxicity. Data on acute oral toxicity of rotenone was reviewed in both the EPA and Forest Service Assessments of rotenone (EPA 2006, EPA 2007, Durkin 2008). For characterizing the acute risks associated with oral exposures to mammalian wildlife, the EPA (2006) uses acute oral LD50 values of 102 mg/kg body weight in male rats and 39.5 mg/kg body weight in female rats. Per EPA, an LD50 represents the individual dose required to kill 50 percent of a population of test animals (http://www.epa.gov/oecaagct/ag101/pestlethal.html). In these and other studies, female rats appear to be somewhat more sensitive than male rats.

De Wilde et al. (1986) provide a relatively well-documented case report of a fatal accidental poisoning of a 3-year-old girl from a rotenone containing product, Galicide. Galicide's intended use was as an insecticide on animals. The girl ingested 10 ml of Galicide, which contains 6% rotenone. Assuming a bulk density of 1 g/mL as an approximation, 10 mL of a 6% rotenone solution corresponds to 600 mg of rotenone. The body weight of the child is reported by De Wilde et al. (1986) as 15 kg; thus, they calculated a lethal dose of 40 mg rotenone/kg body weight (kg bw). This dose is virtually identical to the oral LD50 of 39.5 mg/kg bw of rotenone in female rats (EPA 2006). The correspondence between the rotenone oral LD50 for female rats and the lethal dose in a young girl may be coincidental, but the overall patterns in the acute lethal potency of rotenone do not suggest substantial species differences. Additionally, Wood et al. (2005) report on the fatality of a 47 year old female with extenuating health issues who died after consuming approximately 200 ml of another rotenone-containing product, Bio Liquid Derris Plus (0.8% rotenone solution). If the rotenone poisoning was the sole cause of death, the estimated dose was 25 mg rotenone/kg bw.

Systemic and chronic toxicity. The most significant study in terms of assessing human health affects was the chronic toxicity/oncogenicity study on which the EPA bases the chronic Reference Dose (Durkin 2008). The lowest dose, 0.375 mg/kg bw/day, is classified by EPA as a

"no observed adverse effect level" (NOAEL). EPA classifies the dose of 1.88 mg/kg bw/day as the "lowest observed adverse effect level" (LOAEL).

Durkin (2008) found no studies suggesting that rotenone may have an effect on pathogen resistance with in vivo exposures. Alam and Schmidt (2004) reported a decrease in plasma testosterone, which, although attributed to diminished bioenergetics, would be regarded as a disruption in the endocrine system. Durkin (2008) cites several studies showing potential for developmental impacts in rats and mice including: decreased body weight gain, increased unossified sternabrae, increased resorptions, and decreased fetal survival. Similarly, Durkin (2008) cites studies indicating the potential for reduced litter sizes and pup weights for rats.

Parkinson's disease and neurologic effects. Inden et al. (2007) showed adverse neurological effects, whether or not they are directly related to Parkinson's disease, may occur at oral doses of rotenone as low as 10 mg/kg bw/day (LOAEL) with an apparent NOAEL of 5 mg/kg bw/day. Durkin (2008) used the more conservative acute and chronic reference doses of 0.015 mg/kg bw/day and 0.0004 mg/kg bw/day derived in the recent EPA re-registration eligibility document for the use of rotenone (EPA 2007). EPA uses an uncertainty factor of 1000 in the derivation of the reference doses to address three factors considered as contributing to uncertainty: inter-species variability, intra-species variability, and uncertainties in the available data on rotenone. The factor for uncertainties in the available data reflects concern for the potential of rotenone to cause essentially permanent neurotoxic damage in pre-natal or early post-natal exposures, which might not induce observable adverse effects until late in life.

Durkin (2008) acknowledges a substantial body of literature concerning the use of rotenone to develop animal models for Parkinson's disease; however, all of the early studies involve routes of exposure that are not directly relevant to a human health risk (e.g. subcutaneous infusion, intravenous administration, or direct instillation into the brain) or to the UDWR activities as described for the Proposed Action. Durkin (2008) discusses there is also scientific debate on the use of rotenone as an animal model for Parkinson's disease because of the broader spectrum of neurological effects induced by rotenone relative to the neurological effects seen in Parkinson's disease, and the debate continues (Cicchetti et al. 2009, Cicchetti et al. 2010, Greenamyre et al. 2010).

Studies and reviews have also been released since the Durkin (2008) assessment supporting much of the earlier work showing that rotenone is a neurotoxin. Many involve routes of exposure not relevant to the human health risk from UDWR activities as described for the Proposed Action (Allen et al. 2009, Drolet et al. 2009, Klintworth et al. 2009, Meurers et al. 2009). The most germane studies are studies where the exposure route mimics those likely under from UDWR application as described for the Proposed Action, as well as epidemiological studies of environmental risk factors elevating the risk of Parkinson's disease. Pan Montojo et al. (2010) offer information on a relevant exposure route, administering a rotenone solution to mice intragastrically with a stomach tube at a concentration of 5mg/kg bw 5 days a week for 1.5 to 3 months. They found that mice treated with rotenone produced alpha-synuclein accumulation in a number of nervous system structures. They also observed inflammation and alpha-synuclein phosphorylation in the enteric nervous system and the dorsal motor nucleus of the vagus. Finally, the mice treated with rotenone showed motor system impairment in a rotorod test.

While oral administration was able to reproduce some of the neurological effects seen with subcutaneous and intravenous administration in test animals, Rojo et al. (2007) found that the same was not true for a study examining potential inhalation effects. Rojo et al. (2007) inoculated mice intranasally with a 2.5 mg/kg dose of rotenone for 30 days. They found that rotenone did not produce any obvious motor alteration or damage to the nigrostriatal system.

Since the release of Durkin (2008), several epidemiological studies have been published postulating a link between rotenone exposure and Parkinson's like symptoms in humans but with different conclusions and each with issues on design and bias (Hancock et al. 2008, Dhillon et al. 2008, Tanner et al. 2009, Tanner et al. 2011). Conclusions differed among studies. For example, Dhillon et al. (2008) and Tanner et al. (2011) claimed a highly significant relationship between rotenone exposure and an elevated risk of Parkinson's disease, while Hancock et al. (2008) were unable to establish a significant relationship between botanical pesticide exposure and an elevated risk of Parkinson's disease and Tanner et al. (2009) did not find a relationship between rotenone use and elevated risk of Parkinson's disease. Raffaele et al. (2011) discuss the benefits of and barriers to using epidemiological data in environmental risk assessments, using studies of pesticide exposure contributing to the increased risk of Parkinson's disease as a specific example of barriers. In particular they cite inconsistent findings between studies, generic categorization of pesticide exposure, and the use of dichotomous exposure categories (e.g. ever versus never) as reasons for difficulty in applying the findings of these studies to environmental risk assessments. They also note the difficulty in using epidemiological studies to evaluate a disease such as Parkinson's where multiple causal factors (genetic susceptibility, age, and environmental exposures) are present.

Effect of potassium permanganate

Potassium permanganate is a strong oxidizing agent, is irritating to the skin and respiratory tract, and can cause severe eye damage on direct contact (Durkin 2008). Excessive oral exposures to potassium permanganate can cause irritation to the gastrointestinal tract. Latent symptoms similar to Parkinson's disease were reported in a single case study; however, that case study used a concentration of potassium permanganate 230 to 455 times the concentration of potassium permanganate that would be used in the UDWR activities as described for the Proposed Action. Additionally, as discussed in Appendix A, potassium permanganate will not persist in the water, because the oxidation reaction it has with rotenone will reduce it to potassium and manganese.

Effects of from post-oxidation elements

Durkin (2008) considered the potential human health effects of increased potassium and manganese concentrations in water following the oxidation reaction with rotenone. Both manganese and potassium are essential elements; however, excessive exposure to manganese can also cause neurological issues termed manganism or manganese-induced Parkinsonism. Durkin (2008) found that this neurotoxicity was well documented for inhalation exposure but less so for ingestion exposure. The studies that were available suggested that in the absence of very high levels of background manganese levels, the small increase (generally 140-280 µg/l) in

manganese associated using potassium permanganate as a neutralization agent by UDWR should not elevate human health risks.

Potential for public exposure

Under the UDWR activities as described for the Proposed Action, public exposure routes to rotenone, the associated chemicals in rotenone formulations, and the potassium permanganate neutralizer consist of the following:

1. Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators within the UDWR project area.

2. Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators outside of the UDWR project area.

3. Ingestion exposure to non-pesticide applicators from consumption of fish, wildlife, livestock, and/or crops exposed to rotenone within or downstream from the UDWR project area.

Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators within the UDWR project area. Of several scenarios assessed, Durkin (2008) found only one that exceeded the level of concern, and it involved a child drinking water from a treated water body. At the maximum active ingredient concentration (0.1 mg/l active ingredient) to be used under the UDWR activities as described for the Proposed Action, an 18.1 kg (40 pound) child would have to drink approximately 2.5 liters of water from the treated area during the treatment to reach the most conservative acute Reference Dose (0.015 mg/kg) for acute toxicity offered by the EPA and accepted in the Forest Service Risk Assessment (EPA 2007, Durkin 2008). However, to reach the lowest level for observable neurological effects (5 mg/kg, Pan Montojo et al. 2010), the child would have to drink 913 liters (241 gal) of water from the treated area during the time of treatment. To reach the lowest level observed to cause mortality in a human (25 mg/kg in association with other chemicals and health issues, DeWilde et al. 1986), the child would have to drink 4,563 liters (1,205 gal) of water from the treatment area during the UDWR treatment activities.

It seems unlikely that the general public, including an 18.1 kg (40 pound) child, would suffer ill effects unless a large amount of water was consumed directly from the UDWR treated area. Such water consumption by the public would be highly unlikely under the UDWR activities as described for the Proposed Action. Design criteria requiring public news releases prior to the treatment will inform the general public to avoid the treatment area during the treatment. Design criteria also include EPA's recommendation of placarding to instruct the public not to enter the treatment area (EPA 2007). Under the UDWR activities as described for the Proposed Action, rotenone exposure to the general public within the treatment area should be limited and consumption levels sufficient to cause ill effects unlikely; thus, the public health risk would be low.

The chronic toxicity reference dose is not germane. Rotenone has not been shown to persist in flowing water, and potassium permanganate will be used to neutralize the rotenone (Finlayson et al. 2001, Finlayson et al. 2010b); therefore, the public would not be exposed to the chemicals for an extended period of time.

Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators outside of the UDWR project area. Rotenone would leave the UDWR project area from three distinct places: Boulder Creek below the fish barriers, Garkane's penstock at the upper power plant, and the main power plant facility. As described for the Proposed Action, UDWR would use potassium permanganate to neutralize rotenone at all three of these locations to oxidize rotenone and reduce potassium permanganate into less bioavailable compounds. Because this reaction can often take 30 minutes to complete, the area potentially affected extends 0.25-0.5 miles (0.4-0.8 km) downstream from the UDWR neutralization stations.

Rotenone persistence in flowing waters has been shown to be relatively short, as sunlight and water turbulence caused by substrate, slope, and velocity all work to make rotenone persistence in running waters a function of travel time (Finlayson et al. 2001, Robertson and Smith-Vaniz 2008, Brown 2010). Combining the natural degradation rate of rotenone with the fact that, under the activities as described for the Proposed Action, UDWR would use potassium permanganate to neutralize the rotenone formulation at all areas where water can exit the treatment area makes exposure limited to nonexistent for the general public outside of the treatment area and the 0.25 to 0.5 miles immediately downstream from the neutralization stations. To reduce the potential for exposure even further, contingency potassium permanganate stations will be used in the event that the main stations malfunction. Additionally, to ensure that neutralization is preceding properly, the sentinel fish monitoring procedures highlighted in Finlayson et al. (2010a) will be used.

With the exception of the pasture fed by the upper power plant outflow, all private lands receiving water during the UDWR treatment are over 0.5 miles downstream from neutralization sources and would not contain concentrations of rotenone or potassium permanganate high enough to be a public health concern (Finlayson 2001, Durkin 2008, Finlayson et al. 2010b). The private property pasture fed by the upper power plant outflow is approximately 0.3 miles (0.5 km) downstream from the neutralization. It is possible that the entire oxidation reaction may not be complete when water enters this property, meaning a small concentration of rotenone and or potassium permanganate may remain in the irrigation water on private property for a short distance. Sentinel fish would be deployed at the property line to determine if concentrations of rotenone remain elevated. When trout can survive in treated water, rotenone concentrations are less than 0.04 mg/l, which is considerably below any concentrations thought to have potential human health impacts (Finlayson et al. 2010a). It would be expected that concentrations of rotenone and potassium permanganate would both be well below the level of concern by this point.

Levels of elemental manganese and potassium may be temporarily elevated downstream from the UDWR project area but not to a level that would increase human health risks (Durkin 2008).

There are no drinking water surface protection zones or municipal watersheds directly within East Fork Boulder Creek and Boulder Creek (Utah Department of Environmental Quality Division of Drinking Water data). Drinking water supplies would not be affected by UDWR's use of potassium permanganate, because it rapidly breaks down into potassium, manganese, and water, and no target streams are used directly as municipal or culinary water sources. Rotenone is strongly bound to organic matter, making it unlikely that it would enter groundwater; therefore, it should not enter private or municipal well sources that supply drinking water to the local community.

Ingestion exposure to non-pesticide applicators from consumption of fish, wildlife, livestock, and/or crops exposed to rotenone within or downstream from the UDWR project area. Durkin (2008) examined the potential bioconcentration of rotenone in fish exposed within a treatment area and found that the level of risk through human consumption of these fish was low. Under the UDWR activities as described for the Proposed Action, any risk would be further ameliorated by informing the public and restricting public access during and shortly after the treatment. The public would be warned against consuming the fish, not just because of the rotenone but also because of hazards from bacterial growth in the dead fish. In addition to studies cited in Durkin (2008), Robertson and Smith-Vaniz (2008) also note that ill effects to humans through consumption of rotenone treated fish are highly unlikely.

It is possible that game animals or livestock that may be consumed by humans may consume water that has been treated by UDWR with rotenone. Game animals use the area, the treatment area is in a Forest Service livestock grazing allotment, and the private land irrigation immediately downstream is used for livestock pasture (Loch Wade, Boulder Irrigation Company, personal communication with Mike Golden, Dixie NF, 5/27/2010). Potential chemical ingestion by the livestock would be very low, because the overlap in period of use by livestock and presence of rotenone or potassium permanganate in the water would occur only until October 1. In the allotment, exposure would occur during at most 2 non-consecutive years, and other water would be available for livestock. Durkin (2008) reviewed literature regarding the absorption and excretion of ingested rotenone, and the literature suggested that bioaccumulation is not likely in exposed animals. With potential exposure of animals limited, potential for bioaccumulation in animals not likely, and human consumption of exposed animals low, human exposure to bioaccumulated chemicals in animals is not likely. In addition at the concentrations to be used by UDWR under the activities as described for the Proposed Action, an enormous volume of water from the treated area would have to be ingested during the 6-8 hour treatment time frame in order for a significant concentration of chemical to undergo uptake in any exposed animal.

Areas in Boulder that might use irrigation water to irrigate personal or commercial crops for human consumption are over 5 miles (8 km) downstream from the closest neutralization station, which is well downstream of the area where active chemicals may still be present.

Non-chemical Treatment Alternative

Under the Non-chemical Treatment alternative, no rotenone formulation or potassium permanganate neutralizer would be applied; therefore no direct or indirect effects to human health relating to chemical exposure would occur.

3.7.3 Cumulative Effects

No Action - No Further Treatment Scenario

No direct or indirect effects would occur to public health from chemical exposure under the No Action - No Further Treatment Scenario; therefore there are no cumulative effects.

Proposed Action

Rotenone has been used within the CEA several times in the last 10-15 years (Table 5). In each case UDWR used a similar concentration of active ingredient rotenone and for a similar duration of treatment to that specified for UDWR activities as described under the Proposed Action (Hepworth et al. 2000, Hepworth et al. 2001c, Chamberlain and Ottenbacher 2008, Ottenbacher et al. 2009). Chronic exposure to rotenone has been shown to produce neurological effects; however, using exposure routes similar to what could be expected in the proposed UDWR project neurological effects have only been seen from repeated exposures over the course of 4-6 weeks. Each past treatment in the CEA occurred for one day in four of the last 11 years, resulting in potential acute exposure but not chronic exposure. Because there would be no chronic exposure from the UDWR activities as described for the Proposed Action, there would be no added effects and, thus, no cumulative effects to public health are expected.

Table 5. Water bodies treated with piscicidal formulations of rotenone within the CEA and the years they were treated.

Water body	Treatment year
West Fork Boulder Creek	2000, 2001
Short Lake	2007
East Fork Boulder Creek	2009

Non-chemical Treatment Alternative

No direct or indirect effects would occur to public health from chemical exposure under the Non-chemical Treatment alternative; therefore there are no cumulative effects.

3.7.4 Conclusion

Potential impacts to human health from exposure to rotenone have been recently reviewed by both the EPA during the re-registration process for rotenone use and by the Forest Service in relationship to the use of rotenone as a piscicide (EPA 2006, EPA 2007, Durkin 2008). Rotenone has been shown to have acute and chronic impacts to laboratory animals, and there are two documented cases of fatal poisoning in humans attributed to rotenone-containing products. Rotenone has been shown to be a neurotoxin in test animals when administered at certain amounts for certain time periods, in some cases producing symptoms similar to certain forms of

Parkinsonism, although in most cases the routes of exposure and/or concentrations differ from those of the UDWR activities as described for the Proposed Action. Recent epidemiological studies claim to show a link between rotenone and Parkinsonism in humans; however, issues of potential areas of bias, study design, and data interpretation confound the conclusions of these studies and their applicability to the UDWR activities as described for the Proposed Action (Dhillon et al. 2008, Tanner et al. 2011, Rugbjerg et al. 2011). Furthermore, only 2 out of a total 184 case and control studies involved possible use of rotenone in a fish management context.

While rotenone and potassium permanganate have been shown to have potential impacts to human health the concentrations to be used, duration of application, and potential exposure routes from the UDWR activities as described for the Proposed Action limit the potential for human health impacts. Additionally, neutralizing rotenone with potassium permanganate, informing the public of treatment timing and location, and restricting public access to the treatment area would further ameliorate potential human health risks through reducing chemical exposure.

With no direct effects, including no chronic effects, there would be no cumulative effects from any of the alternatives. Although there is the potential for acute exposure to rotenone from the UDWR activities as described for the Proposed Action, under the application schedule, there would not be chronic exposure that could affect public health; therefore, there would be no cumulative effects from the UDWR activities as described for the Proposed Action.

3.8 Local Socioeconomic Character

3.8.1 Affected Environment

Pristine Environment

A topic of concern raised during the scoping and comment period was about effects to the businesses that provide goods and services to tourists who may not visit the area if they believe that UDWR's application of chemicals to the water under their proposed project alters the "pristine" environment. *Pristine*, as defined by Webster's Online Dictionary (http://www.websters-online-dictionary.org), is as follows:

1. Completely free from dirt or contamination;
2. Immaculately clean and unused;
3. Belonging to the earliest period or state; original; primitive; primeval;
4. Being original, primitive, primordial, authentic or initial;
5. Being primeval or primaeval;
6. Being primary, primal, prime or foremost;
7. Being ancient or old;
8. Being fresh, new or unused;
9. Being antique, antiquated or obsolete.

The direct effect will be analyzed by a qualitative comparison of changes due to actions of the alternatives relative to area characteristics per the definition of *pristine*. The potential direct effect of the proposed treatment would be changes in the pristine characteristics of the UDWR project area and surrounding landscape on Forest Service lands above Boulder, Utah. The area of analysis will be the three (HUC 6) watersheds, Headwaters Boulder Creek, Bear Creek – Boulder Creek, and Deer Creek.

Social Value of Pristine Environment

The Forest cannot determine how many people moved to Boulder because of the pristine characteristic of the area; therefore, the analysis assumes that all Boulder residents did. The U.S. Census Bureau data indicate the community of Boulder had an estimated population of 180 in 2000 and 189 in 2009 (www.factfinder.census.gov). The Forest also cannot determine or analyze how each individual "values" the pristine characteristic of the area, including the spiritual, cultural, or psychological value of the area to an individual; therefore, the indirect effect will be analyzed by the qualitative comparison of changes due to the actions of the alternatives relative to area characteristics per the definition of *pristine*.

Tourist-based Businesses

Potential changes to the perception of a pristine environment or access to the treatment area could potentially indirectly affect businesses that provide goods and services to tourists who may not visit the area if they believe that the UDWR's proposed application of chemicals to the water alters the pristine environment or that the access restrictions for the treatment area would affect their experience. Analysis of the effects will be a qualitative comparison of numbers and types of businesses in Boulder that may be affected. The affected environment is the group of businesses identified in the U.S. Census Bureau County Business Patterns database for the Boulder zip code, 84716 (http://censtats.census.gov).

Boulder Town Vision and Goals

Potential changes to the environment or perception of pristine environment could potentially indirectly affect the ability of Boulder to move towards its vision or goals as stated in the Boulder Town General Plan. Analysis of effects will be based on the potential effects to the goals and vision statements of the 2009 Boulder Town General Plan.

Organic Certification

Comments indicated that there are organic growers or producers in the area. The Forest does not know how many there are, if they are certified organic operations, or if they operate under the Organic Crop Improvement Association, International (OCIA), US Department of Agriculture (USDA), or state of Utah organic standards; therefore, for the purpose of this analysis, the assumption is made that any of the growers may be or may seek to be certified under any or all three programs.

Downstream water users may be or may apply to be certified as organic growers or producers. The potentially affected would be the downstream irrigators. The potential effect on these users would be indirect relating to UDWR's proposed project's effects on the water in the treatment area relative to the organic certification standards under the OCIA, USDA, and Utah organic certification programs and as they relate to rotenone, water quality and potassium permanganate.

Beekeeping

Because concern was raised about effects of the actions of the alternatives on beekeeping, the direct effect that will be analyzed is the effect on bees from the UDWR actions as described for the alternatives. The area of analysis will be the subwatersheds of the UDWR project area and estimated 0.25 to 0.50 mile downstream that could be affected by the UDWR activities as described for the Proposed Action. The Forest does not know how many beekeeping businesses are in Boulder; therefore, this analysis assumes any landowner in the area of analysis could have or potentially start a beekeeping business.

Cumulative Effects

In addition to the U.S. Census Bureau information, the 2009 Boulder Town General Plan was also reviewed to characterize the local economy. Because the potential changes are to specific types of local businesses, the cumulative effect will be on the potential change to the overall businesses in Boulder. The measure will be a qualitative comparison of effects. The CEA is the town of Boulder.

3.8.2 Direct and Indirect Effects of the Alternatives

No Action - No Further Treatment Scenario

Pristine Environment

Under the No Action - No Further Treatment Scenario, there would be no changes to the management that has been occurring on NFS lands. The existing management impacts the area's character relative to Webster's definition of *pristine*.

The NFS portion of the UDWR's treatment area itself is in Management Area 9A (Riparian Emphasis); however, adjacent management areas include 2A (Semi-Primitive Recreation), 6A (Livestock Grazing), and 7A (Wood Production and Utilization), as displayed in Figure 10. Management activities that have occurred and would continue to occur within the area in the foreseeable future include the presence and operation of the Boulder Creek Hydroelectric Project, livestock grazing, timber harvest, timber stand management, and aspen stand management. The area has existing open, closed, and administrative roads and non-motorized trails and would continue to do so under the Dixie National Forest Motorized Travel Plan. Even the 9A acres include stream crossings.

The 6A and 7A management areas that surround most of the treatment area would not meet the Webster's definitions 1, 2, or 8. They are actively managed. Signs of human use are throughout, including roads, range structures, facilities of the Boulder Creek Hydroelectric Project, the buildings and range structures on private lands, the dam that forms Kings Pasture Reservoir, and the penstock.

In that the UDWR's treatment area has been planted with nonnative trout, it would not meet the definitions 3 through 6.

Relative to definitions 7 and 9, the area is no older or antiquated than any other on the District.

Management Area 2A, Semiprimitive Recreation, is defined as a setting "dependent upon a perception of remoteness" (LRMP IV-63). There would be no changes to the existing activities to affect the perception under the No Action - No Further Treatment Scenario.

Social Value of Pristine Environment

The No Action - No Further Treatment Scenario would make no changes to the existing environment. None of the Boulder residents would be affected. The existing pristine character of the area would be as described above.

Tourist-based Businesses

The No Action - No Further Treatment Scenario would have no effects on the pristine state of the treatment area or adjacent Forest Service managed areas; therefore, it would have no effect on tourist perceptions of pristine and tourist-based business reliant on tourists with such perception.

Boulder Town Vision and Goals

The No Action - No Further Treatment Scenario would have no actions and thus no effects on Boulder's ability to move towards its Vision and Goals.

Organic Certification

Under the No Action - No Further Treatment Scenario, there would be no treatments that would change conditions on downstream users who may have or may apply in the future for organic certification.

Beekeeping

Because the No Action - No Further Treatment Scenario would not make any changes to the environment, there would be no potential effects on beekeeping businesses in Boulder.

Proposed Action

Pristine Environment

The effects of the UDWR activities as described for the Proposed Action would be the same as those for the No Action - No Further Treatment Scenario. There would be the temporary addition of the chemicals by UDWR to the stream and presence of application personnel during treatment periods, affecting definitions 1, 2, and 8, but those effects would not be long-term, and they would not affect the existing state. Presence of personnel would be estimated to be up to 62 people for 3 days per year for up to 3 consecutive years for the UDWR removal effort (see Appendix B).

The temporary planting of hybrid sterile trout until the native CRCT can be re-established would not alter the existing state of having nonnative trout. Even when the CRCT is re-established, only those that came from recolonization for the existing population would meet definitions 3 through 6, although the CRCT would be the species that would have been in the pristine state.

Social Value of Pristine Environment

Changes to the pristine character from the UDWR activities as described for the Proposed Action would be as described above. This could potentially impact the population of Boulder, estimated at 189 in 2009, if all the residents perceive the area as currently pristine, hold pristine as a value, and believe any changes as described are an impact.

Tourist-based Businesses

The industries generally viewed as related to tourism-sensitive employment include retail trade; passenger transportation; arts, entertainment and recreation; and accommodation and food services (Marcouiller and Xia 2008). It is not known, without additional research, such as surveys, what exact proportion of the jobs in these sectors is attributable to expenditures by visitors, including business and pleasure travelers, versus by local residents. Tourism probably has an effect mostly on the Accommodation and Food Service industry in Boulder. Tourists may also influence the Recreation industry, for example, local guide services, and the Retail industry, for example, small stores providing artwork, groceries, or souvenirs. Passenger transportation is not an identified industry for Boulder.

The data indicate that the Accommodation and Food Service industry is only a small proportion of the total businesses (4 of 17). The employees in the Accommodation and Food Service industry could range from 22 to 33. Although the data are limited to 2008 information, and thus may not accurately reflect the current situation in Boulder, the data indicate that although low in proportion of businesses (24%), the Accommodation and Food Service industry provides employment for a disproportionately large number of employees (38 to 57%).

Businesses in the Retail Trade and Arts, Entertainment, and Recreation industries also have the potential of being affected. They account for 6 establishments, with the number of employees in these two industries ranging from 6 to 17.

It is not known if the employees are local residents. This analysis assumes they are in order to provide the worst case scenario of effects to the Boulder population. Overall potential effects could be to 59% of the businesses, 48 to 67% of the workforce, and 15 to 21% of the Boulder population (see Table 6). Because the US Census Bureau data are based on employees on payroll on March 12, it is unknown how well these employment figures reflect other times of the year.

Table 6. Proportions of busineses, workforce, and Boulder, Utah, population of potentially affected industries, based on business pattern information for zip code 84716 (Boulder, UT) from 2008 and 2008 census (ZIP Code Business Patterns (North American Industry Classification, U.S. Census Bureau, http://censtats.census.gov/cbpnaic/cbpnaic.shtml and www.factfinder.census.gov).

Industry	# of businesses	% of businesses	# of employees	% of workforce	% of Boulder population**
Accommodation and Food Service	4	24	22 to 33	38 to 57	12 to 18
Retail Trade and Arts, Entertainment, and Recreation	6	35	6 to 17	10 to 29	3 to 9
Combined	10	59	28 to 39*	48 to 67	15 to 21

*Combined maximum is capped at 39 due to combined minimum of other industries.
**It is unknown if employees are residents of Boulder. Percentages assume they are to provide worst case scenario of effect to Boulder population.

Specific changes in tourism and thus changes in businesses due to perceived changes in the pristine character of the area cannot be determined. Changes would depend on actual perception of the potential tourists, their reaction to the changes, and how the changes may be described by the businesses that solicit the tourists. An extreme effect would be that all Accommodation and Food Service, Retail Trade, and Arts, Entertainment, and Recreation businesses would become non-viable, affecting 10 of 17 businesses and employment of up to 39 people. The extreme effect is not expected, however, because the analysis area has received rotenone treatment in 2000-2001, 2007, and 2009 and the potentially affected industries did not change much at the time of that treatment or since then.

Boulder Town Vision and Goals

The 2009 Boulder Town General Plan includes the following Vision Statement:

> The primary objectives of the community are (1) to preserve the ranching and agricultural lifestyle and heritage of the area and the rural spirit of Boulder; (2) to preserve the open space, clean air, dark skies, and quiet country-style atmosphere that our families have enjoyed for over 100 years and (3) to promote a balance of conserving resources and development/growth. In addition to these primary objectives, Boulder wants to remain economically sound by promoting appropriate commercial and cottage industry growth on a small scale.

The UDWR activities as described for the Proposed Action would have no actions that affect the Town's balance of conserving resources and development/growth; therefore, the third part of the Vision Statement will not be discussed further.

The only environmental factor that the UDWR activities as described for the Proposed Action would affect that relates to the first Vision statement would be the water quality that leaves the treatment area and is used for ranching and agriculture. The potentially affected area could be 0.25-0.5 miles (0.4-0.8 km) downstream from the neutralization stations. Only one private landholding, used as pasture for livestock, is in this area. As discussed in the Floodplains, Wetlands, and Water Quality section, there would be no direct effects to water quality relating to the designation of irrigation water and stock water (Utah State Use Designation Class 4) beneficial uses as a result of the chemical treatment with rotenone; therefore, the UDWR activities as described for the Proposed Action would not affect the environment in such a way that it would negatively affect the current "ranching and agricultural lifestyle" of the downstream irrigators.

Relative to the second Vision statement, the UDWR activities as described for the Proposed Action would not change how Boulder manages its open space. It would have no effects on air quality or dark skies. The UDWR activities would affect the quiet atmosphere of the area due to disturbance caused by the presence of an estimated 62 people for 3 days per year for up to 3 consecutive years for the removal effort.

Of 12 community goals in the 2009 Boulder Town General Plan, 5 are not related to potential changes in the environment relating to the proposed UDWR project. The UDWR activities as described for the Proposed Action could indirectly affect the other 7 as follows:

> Goal 1. To preserve Boulder's rural agricultural atmosphere and cultural resources. As discussed above, the UDWR activities as described for the Proposed Action would not affect the ranching and agricultural uses of private property in Boulder. The Forest Archeologist has determined that the UDWR activities would have no effect to cultural resources.
>
> Goal 2. To promote farming, ranching and the conservation of open lands to support agricultural endeavors. As discussed above, the UDWR activities as described for the Proposed Action would not affect the ranching and agricultural uses of private property in Boulder Town. The UDWR activities would not affect Boulder's management of its open lands.
>
> Goal 3. To preserve the natural beauty, open space, clean air and water and quiet atmosphere. As discussed above, the UDWR activities as described for the Proposed Action would have no effects to air quality or dark skies. Except for the disturbance caused by the presence of an estimated 62 personnel, 1.5 to 3 days a year, for up to 3 consecutive years, the UDWR activities would not affect the quiet atmosphere of the area. The natural beauty and clean water in the treatment area could be affected for up to 4 days per year, up to 3 consecutive years, due to dead but not removed fish and chemical presence during UDWR's chemical treatment.

Goal 4. To keep agricultural fields open, watered, and productive. As discussed above, the UDWR activities as described for the Proposed Action would not affect the ranching and agricultural uses of private property in Boulder.

Goal 9. To foster economic viability of the community by promoting small community and cottage industry compatible with the above goals. As discussed above, the UDWR activities as described for the Proposed Action would not affect the ranching and agricultural uses of private property in Boulder. As discussed below, it would also not affect the beekeeping operation. The UDWR activities would not affect how Boulder manages businesses to maintain small community and cottage industry businesses in the community.

Goal 11. To control and limit noise. As discussed above, the UDWR activities as described for the Proposed Action would result in disturbance associated with the UDWR's chemical application for 1.5 to 3 days a year, for up to 3 consecutive years.

Goal 12. To protect the dark skies and natural nighttime visual environment. The UDWR activities as described for the Proposed Action would have no effect on dark skies or the nighttime visual environment.

Organic Certification

Under the UDWR activities as described for the Proposed Action, the chemicals applied by UDWR would be neutralized, either chemically or naturally, approximately 30 minutes travel time (0.25-0.5 miles) downstream of the fish barriers in Boulder Creek. This would occur at most for 1 day a year for up to 3 consecutive years. Neutralization would also occur before the waters reach any irrigators, except for one private parcel, which holds a water right for irrigation for livestock watering. It is not known if this operation holds or seeks organic certification but for the purpose of this analysis is assumed to do so. Rotenone or potassium permanganate concentrations would not reach properties of other irrigators.

OCIA, USDA, and Utah standards were reviewed for those that are applicable to rotenone, water quality, and potassium permanganate. Of those, six could potentially pertain to the UDWR activities as described for the Proposed Action. None would be affected by the UDWR activities as described for the Proposed Action, as described below.

OCIA Standard 3.5. Feed, 3.5.10 Water for livestock must be free of contamination from hazardous substances. Because neutralization would have been occurring, the concentration level would be lower than the application concentration, and it would continue to lower over time and distance through natural degradation. Even at the maximum application concentration, the risks to mammals are "far below the level of concern" and "there is no basis for asserting that adverse effects are plausible in large and small mammals when rotenone is applied at the highest application rate considered in the risk assessment (200 ppb)" (Durkin 2008). The acute hazard quotient (i.e. for acute

toxicity) for birds would also be below the level of concern (Forest Service 2008). Chronic exposure would not be expected because of the short duration of the application.

OCIA standard 4.2 Honey. 4.2.4 Foraging Areas. b. Beekeeper must provide clean water . . . to feed the bees throughout the season. The UDWR activities as described for the Proposed Action would not affect water quantity. Neither the UDWR activities nor the Proposed Action would not determine how private landowner provides water to animals. Rotenone, as would be applied by the UDWR, is considered "practically non-toxic" to honeybees (Forest Service 2008).

OCIA standard 4.4 Shiitake and Oyster Mushrooms. 4.4.5 Water. Well, stream and pond water used for soaking logs and blocks must be tested to determine if concentrations of nitrates and coliforms are acceptably low. . . . Use of water known to be contaminated with toxic substances . . . is prohibited. The UDWR activities as described for the Proposed Action would not affect nitrate or coliform concentration. Because neutralization would have been occurring, the concentration level would be lower than the application concentration. If the effect were to occur, it would be for an extremely short duration in a very limited area.

OCIA standard 4.5. Sprouts. 4.5.1. . . b. Water used for watering and rinsing must be consistent with OCIA processing water standards. It must meet government regulations, e.g. potable water. The Proposed Action would require the UDWR to meet regulatory requirements. Analysis indicates that under the UDWR activities as described for the Proposed Action it is possible that rotenone may reach one private landowner prior to it being neutralized. This would occur at most for 1 day a year for up to 3 consecutive years. The water right in this area is for livestock watering, not drinking water.

OCIA standard 3.0 Animal Certification Standards. 3.9 Herd Health. 3.9.2 Cleaning agents and disinfectants should be chosen from among . . . 1% potassium permanganate solutions, ... Under the UDWR activities as described for the Proposed Action application of potassium permanganate would be 400 to 800 ppb, which is equivalent to .004% to .008% potassium permanganate.

OCIA standard 9.0 Materials List. 9.3 Crop Production Materials List. Manganese Products, prohibited. Class: Fertilizers, Plant Foods, and Soil Amendments (F). Status: Prohibited (P) - materials may not be used on land in the certification program, or in the production of any crops grown on land in the certification program. At least three years must pass after the use of any prohibited substances before land, which has received that substance, may be certified. . . . potassium permanganate [is] prohibited. . . . As described for the Proposed Action, the chemical would not be applied by UDWR for this purpose and not applied by UDWR to soil or plants. At maximum, application would be equivalent to .004% to .008% potassium permanganate.

Of the USDA standards, 9 could potentially pertain to the UDWR activities as described for the Proposed Action. None would be affected, as described below:

§205.202 Land requirements. Any field or farm parcel from which harvested crops are intended to be . . . "organic," must: . . . (b) Have had no prohibited substances, as listed in §205.105 applied to it for a period of 3 years immediately preceding harvest of the crop; and . . . prevent the unintended application of a prohibited substance to the crop or contact with a prohibited substance applied to adjoining land that is not under organic management. Chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on the lists or prohibited substances referenced in §205.105.

§205.270 Organic handling requirements . . . A volatile synthetic solvent or other synthetic processing aid not allowed under §205.605. . . . Chemicals of the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on the §205.605 or §205.606 lists.

§205.272 Commingling and contact with prohibited substance prevention practice standard. The handler of an organic handling operation must implement measures necessary to . . . protect organic products from contact with prohibited substances. The UDWR activities as described for the Proposed Action would not affect handling operations. Chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on the §205.602 or §205.604 lists of prohibited substances.

§205.601 Synthetic substances allowed for use in organic crop production. Chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on this list.

§205.602 Nonsynthetic substances prohibited for use in organic crop production. Chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on this list.

§205.603 Synthetic substances allowed for use in organic livestock production. Chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on this list.

§205.604 Nonsynthetic substances prohibited for use in organic livestock production. Chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on this list.

§205.605 Nonagricultural (nonorganic) substances allowed as ingredients in or on processed products labeled as "organic" or "made with organic (specified ingredients or food group(s))." Chemicals that would be authorized by the Forest for use by UDWR

under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on this list.

§205.606. Nonorganically produced agricultural products allowed as ingredients in or on processed products labeled as "organic." Chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action, their formulations, and their byproducts post neutralization or degradation are not on this list.

Because the Utah Agriculture and Food organic standards (Utah Administrative code R68-20-1) adopted and incorporated by reference "CFR, June 7, 2006 edition, Title 7 Part 205, National Organic Program Final Rule," which were the USDA standards at that time, amendments to the National Organic Program issued after June 7, 2006, were also reviewed. No changes were made that would alter the determination made above for organic certification under the current USDA National Organic Program; therefore, the UDWR activities as described for the Proposed Action and the chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action would have no effect on organic certification under the Utah organic standards.

Beekeeping

Honey bees may be exposed to the liquid formulation of rotenone in the UDWR project treatment area, including approximately 0.25 to 0.5 miles below the neutralization sites through which the rotenone may not have been fully oxidized by the potassium permanganate or degraded naturally. If the treatment area provides the best sources or location of pollen and nectar at the time of treatment, honey bee exposure to chemicals that would be authorized by the Forest for use by UDWR under the Proposed Action would be for 1 day per year for at most 3 consecutive years. According to the EPA review of effects of rotenone on honey bees, rotenone is "classified as "practically non-toxic to honey bees on an acute contact and oral exposure basis" (EPA 2006). With the limited time of exposure under the UDWR activities as described for the Proposed Action and "practically non-toxic" nature of rotenone relative to honey bees, the effects to honey bees and, thus, beekeeping businesses would be practically non-existent.

Non-chemical Treatment Alternative

Pristine Environment

The effects of the UDWR activities as described for the Non-chemical Treatment alternative would be the same as those for the Proposed Action, except that there would be no temporary addition by UDWR of chemicals to the treatment area and the duration of the temporary presence of personnel and equipment would be higher, although the number of personnel during any one treatment would be lower. Disturbance from presence of personnel would be at least 20 people for 20 days for 4 times a year, for at least 4 and up to 10 consecutive years for the removal effort for the stream; 5 people for 30 days for spring inflows and tributaries for at least 4 and up to 10 consecutive years; 2 people, 18 days per year for at least 4 consecutive years for the netting effort of the private pond and reservoir; and additional personnel and equipment for the construction of the added barrier on private land.

Social Value of Pristine Environment

Under the UDWR activities as described for the Non-chemical Treatment alternative, the effects would be the same as those for the Proposed Action except that the changes in the pristine characteristics would be as described above for the Non-chemical Treatment alternative.

Tourist-based Businesses

Under the UDWR activities as described for the Non-chemical Treatment alternative, the effects would be the same as those for the Proposed Action.

Boulder Town Vision and Goals

Under the UDWR activities as described for the Non-chemical Treatment alternative, there would be no changes to water quality that would affect the downstream water users; therefore, there would be no effect on the first vision statement of the 2009 Boulder Town General Plan.

Relating to the second vision statement, the effects of the UDWR activities as described for the Non-chemical Treatment alternative would be the same as those for the Proposed Action except that the disturbance to the quiet atmosphere of the area would be by the presence of up to 20 people (3 or 4 crews) for 16-21 days, 3-4 times in a single year, for up to 10 years of UDWR's removal effort.

Indirect effects to the character of Boulder, as defined by its community goals in the 2009 Boulder Town General Plan, as a result of changes in the environment from the Non-chemical Treatment alternative are as follows:

> Goal 1. To preserve Boulder's rural agricultural atmosphere and cultural resources. The effect would be the same as under the Proposed Action.
>
> Goal 2. To promote farming, ranching and the conservation of open lands to support agricultural endeavors. The effect would be the same as for the Proposed Action.
>
> Goal 3. To preserve the natural beauty, open space, clean air and water and quiet atmosphere. As discussed above, the UDWR activities as described for the Non-chemical Treatment alternative would have no effects to air quality or dark skies. Disturbance to the quiet atmosphere of the area would result from the presence of up to 20 people (3 or 4 crews) for 16-21 days, 3-4 times in a single year, for up to 10 years of removal effort. The natural beauty in the treatment area could be affected for several days per year, for up to 10 years, due to dead but not yet removed fish. There would be no effect to clean water.
>
> Goal 4. To keep agricultural fields open, watered, and productive. The effect would be the same as for the Proposed Action.

> Goal 9. To foster economic viability of the community by promoting small community and cottage industry compatible with the above goals. The effect would be the same as for the Proposed Action.
>
> Goal 11. To control and limit noise. As discussed above, the UDWR activities as described for the Non-chemical Treatment alternative would result in disturbance to the quiet atmosphere of the area due to the presence of up to 20 people (3 or 4 crews) for 16-21 days, 3-4 times in a single year, for up to 10 years of removal effort.
>
> Goal 12. To protect the dark skies and natural nighttime visual environment. The effect would be the same as for the Proposed Action.

Organic Certification

One OCIA standard could potentially pertain to the UDWR activities as described for the Non-chemical Treatment alternative. The alternative would have no effect on the standard, as described below:

> OCIA standard 4.4 Shiitake and Oyster Mushrooms. 4.4.5 Water. Well, stream and pond water used for soaking logs and blocks must be tested to determine if concentrations of nitrates and coliforms are acceptably low. . . . Use of water known to be contaminated with toxic substances. . . is prohibited. The UDWR activities as described for the Non-chemical Treatment alternative would not affect water quantity, and would add no substances or chemicals; therefore, it would not affect nitrate or coliform concentration.

One USDA standard may pertain to the UDWR activities as described for the Non-chemical Treatment alternative, as follows:

> §205.202 Land requirements. Any field or farm parcel from which harvested crops are intended to . . . "organic," must: . . . (b) Have had no prohibited substances, as listed in §205.105 applied to it for a period of 3 years immediately preceding harvest of the crop; and . . . prevent the unintended application of a prohibited substance to the crop or contact with a prohibited substance applied to adjoining land that is not under organic management. No chemicals, thus no prohibited substances, would be applied under the UDWR activities as described for the Non-chemical Treatment alternative.

No changes to the rules were made after June 7, 2006, that would alter the determination made above for organic certification under the current USDA National Organic Program; therefore, the UDWR activities as described for the Non-chemical Treatment alternative would have no effect on organic certification under the Utah organic standards.

Beekeeping

Under the UDWR activities as described for the Non-chemical Treatment alternative, potential disturbance to riparian vegetation may occur as crews move up the streambanks and electrofish along edges; however, this effect would be short-term and minimal, because the vegetation

would be expected to recover quickly and other vegetation in the area would be available for the honey bees. Overall, the UDWR activities as described for the Non-chemical Treatment alternative would have no effects on honey bees and, thus, no effects on beekeeping businesses in Boulder, Utah.

3.8.3 Cumulative Effects

No Action - No Further Treatment Scenario

For the No Action - No Further Treatment Scenario, there would be no direct or indirect effects; therefore, there would be no cumulative effects.

Proposed Action

The UDWR activities as described for the Proposed Action would not influence the three major factors identified in the 2009 Boulder Town General Plan as the reason for the increased tourist visitation to the area – completion and All-American Highway designation of Utah Highway 12, "world-class scenery of the area," and Garfield County's "mapping and promotion of OHV/ATV trails will further attract tourists to utilize designated motorized trails on [the Grand Staircase-Escalante National Monument] and Dixie National Forest lands around Boulder." It would not affect the designation of Utah Highway 12, the scenery of the area, nor Garfield County's promotion of OHV/ATV trails. Although the UDWR activities as described for the Proposed Action would result in short-term effects on the pristine character of the area, the existing character of the area already includes multiple human alterations and disturbances that would preclude the area from meeting the dictionary definition of *pristine*; therefore, there would be no effects on the tourist-based businesses based on the perception that the area would move from a pristine character to one that is not. Because there would be no changes that would influence the major factors identified in the 2009 Boulder Town General Plan that would affect businesses in Boulder, there would be no cumulative socioeconomic effects from the UDWR activities as described for the Proposed Action.

Non-chemical Treatment Alternative

The effects of the UDWR activities as described for the Non-chemical Treatment alternative would be the same as those for the Proposed Action.

3.8.4 Conclusion

The No Action - No Further Treatment Scenario would have no environmental effects; therefore, it would have no direct effects on the pristine character of the landscape. The existing condition is that the landscape has had numerous other activities that would not be considered pristine, per the dictionary definition of *pristine*. The No Action - No Further Treatment Scenario would have no indirect effects to the social values, including the spiritual, cultural, or psychological values, of some or all of the residents of Boulder The No Action - No Further Treatment Scenario would also have no indirect effects on the tourist-based businesses in Boulder, no indirect effect on the ability of Boulder to meet its vision or goals as described in its 2009

General Plan, no indirect effect on the ability of irrigators of Boulder to meet organic certification standards, and no indirect effect on beekeeping businesses.

The UDWR activities as described for the Proposed Action would have short-term environmental effects on the pristine character of the landscape and, thus, may result in short-term changes that could impact social values, including spiritual, cultural, or psychological values, of some or all of the residents of Boulder, estimated at 189 in 2009. Also, based on 2008 business data, most recent available, if changes to the landscape were to affect tourist-based businesses, out of 17 total businesses, the UDWR activities as described for the Proposed Action could affect up to 4 businesses in the Accommodation and Food Service industry, 3 in the Retail Trade industry, and 3 in the Arts, Entertainment, and Recreation industry. This could possibly affect up to 39 employees, which would represent 21 percent of the population, based on 2008 population estimates, if all of the employees were from Boulder. Extreme effects are not expected, based on minimal changes that have occurred since implementation of a similar rotenone treatment in West Fork Boulder Creek in 2000 and 2001. The UDWR activities as described for the Proposed Action would not affect the ability of Boulder to meet its vision or goals, except that there would be short-term disturbance to the "quiet" lifestyle. The UDWR activities as described for the Proposed Action would have no effects on the ability of downstream irrigators to meet organic certification standards or local beekeeping businesses.

The UDWR activities as described for the Non-chemical Treatment alternative would have similar effects to those for the Proposed Action; however, there would be no temporary addition of chemicals to the treatment area, and the duration of the temporary presence of personnel and equipment would be longer, although the number of personnel during any one treatment would be lower. The UDWR activities would have longer-term effects on the "quiet lifestyle" of the Boulder vision and goals because of the higher overall effort (number of people X number of implementation days) and longer duration of the UDWR project. It would not include UDWR's chemical additions to the water. The UDWR activities as described for the Non-chemical Treatment alternative would have no effects on the ability of downstream irrigators to meet organic certification standards or local beekeeping businesses.

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Figures

Figure 1. UDWR project area and project vicinity.

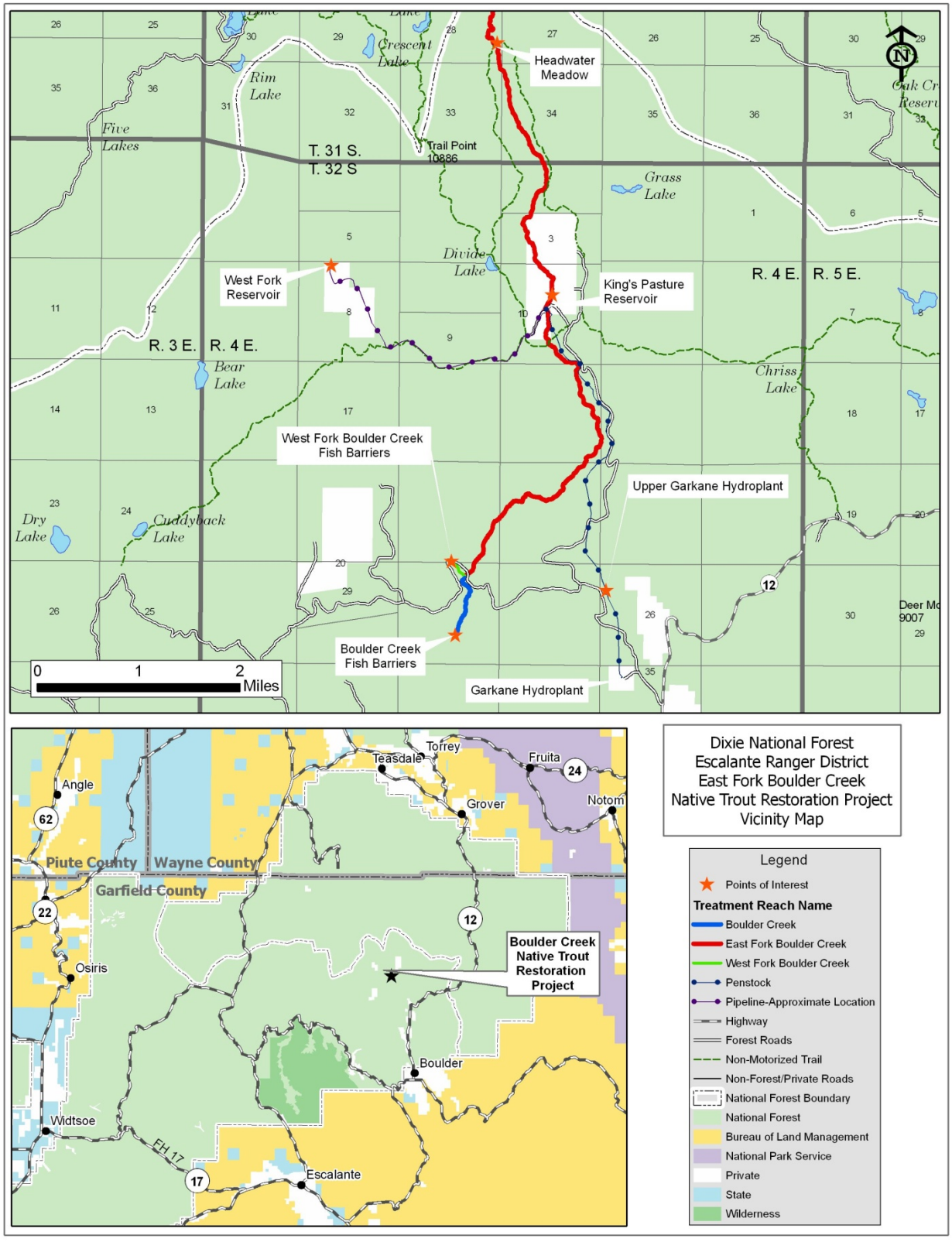


Figure 2. Proposed Action rotenone application area

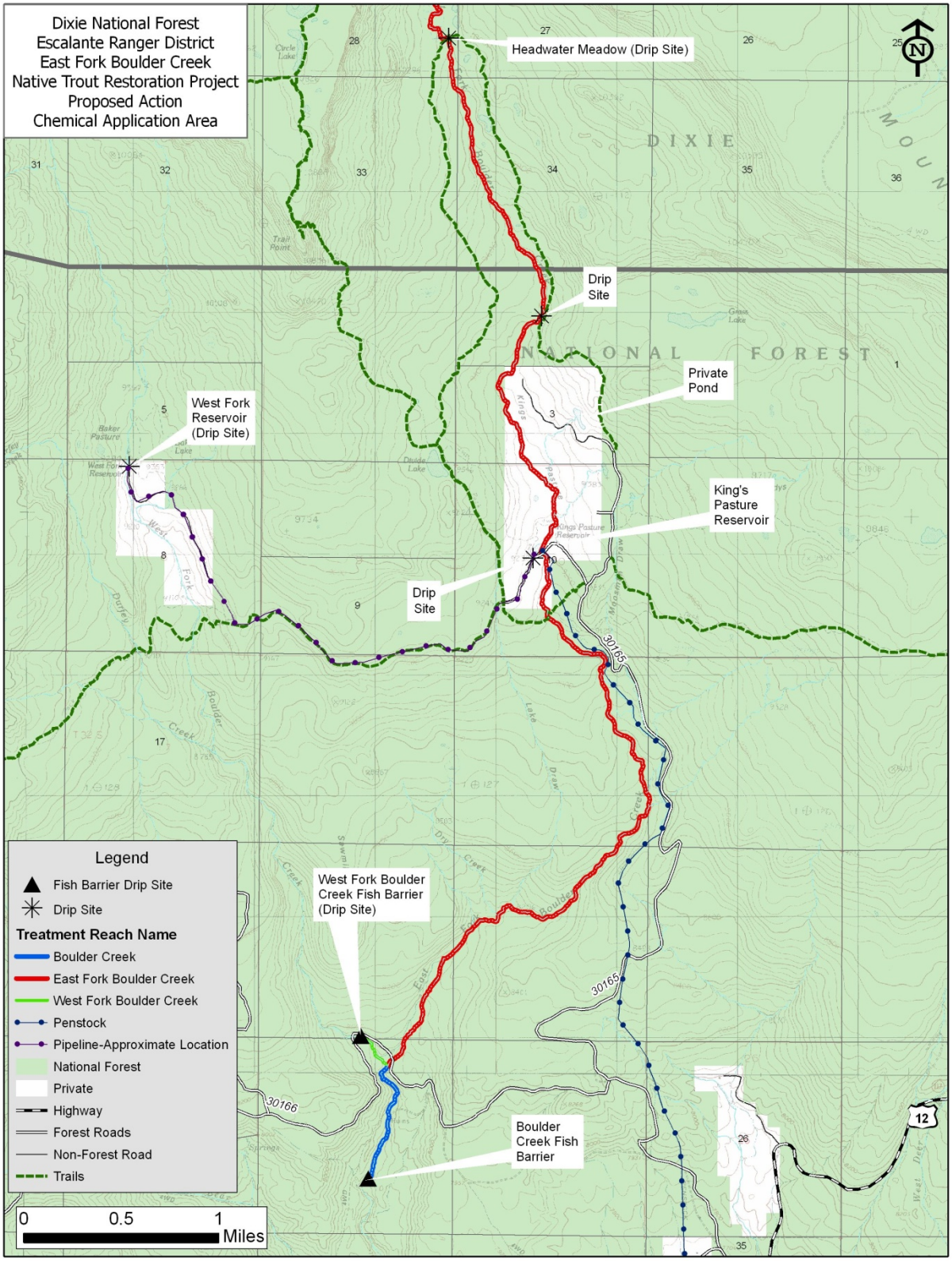


Figure 3. Proposed Action neutralization sites

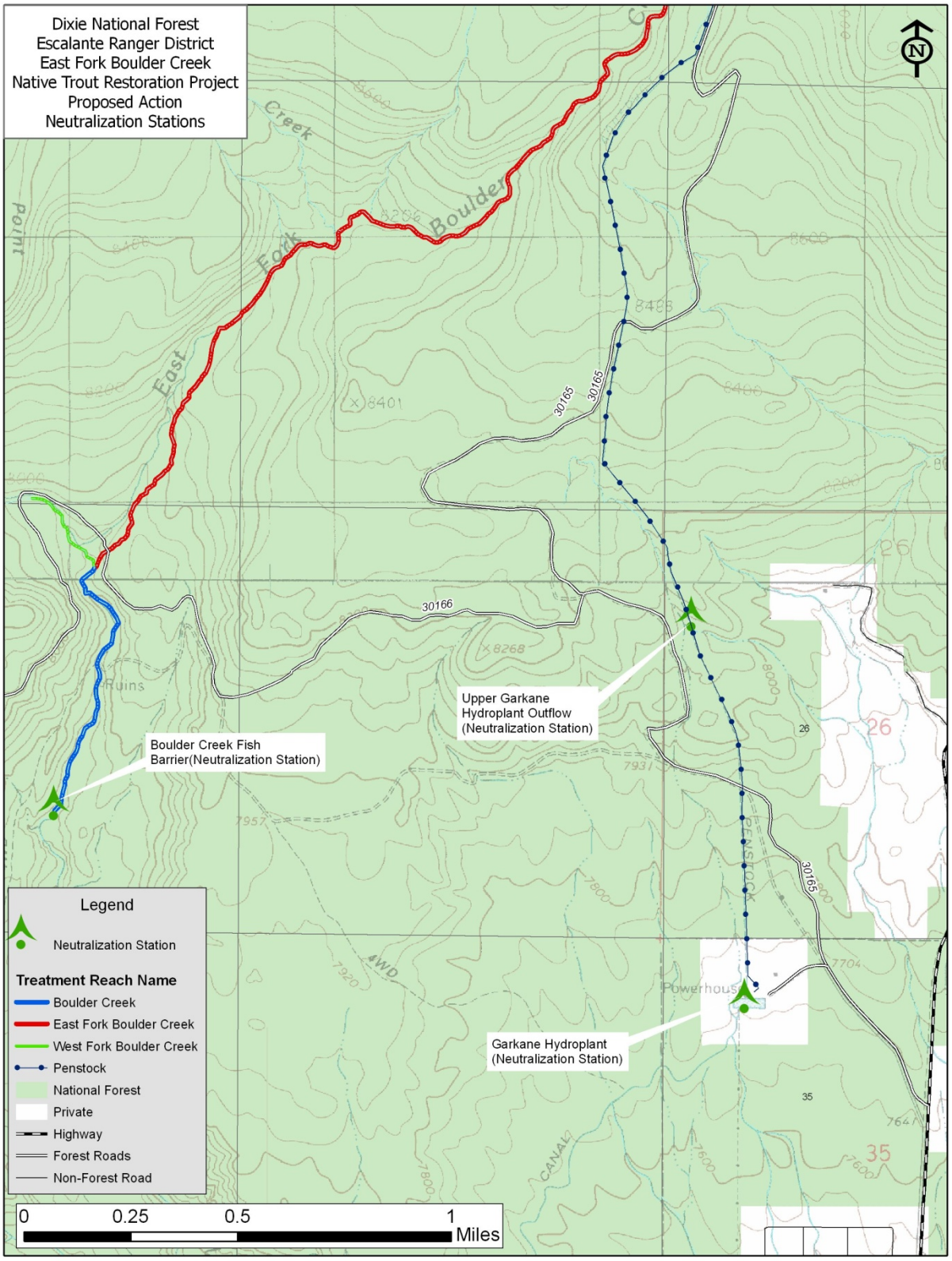


Figure 4. Non-chemical treatment area and barrier location

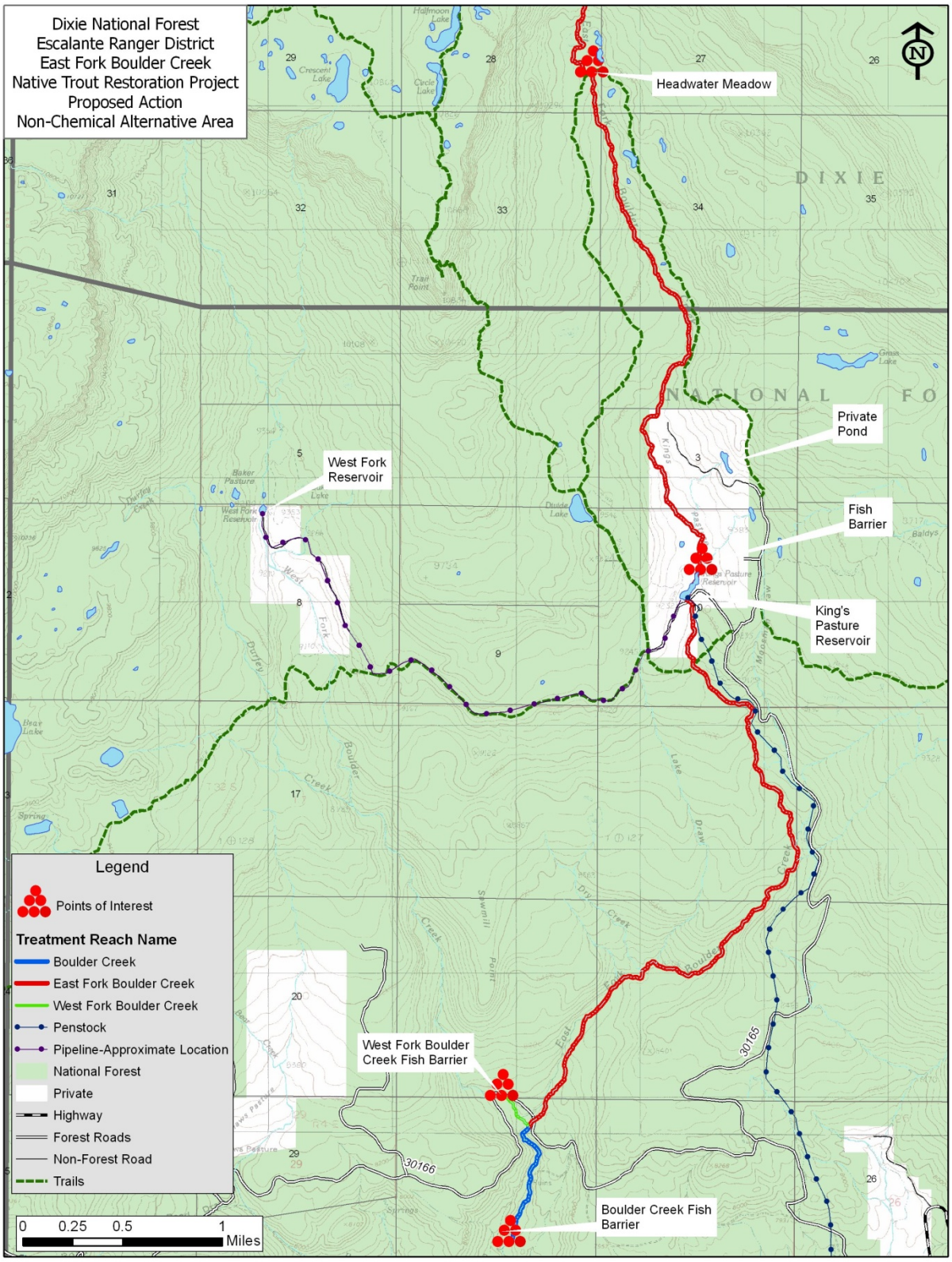


Figure 5. Cumulative effects area for terrestrial wildlife

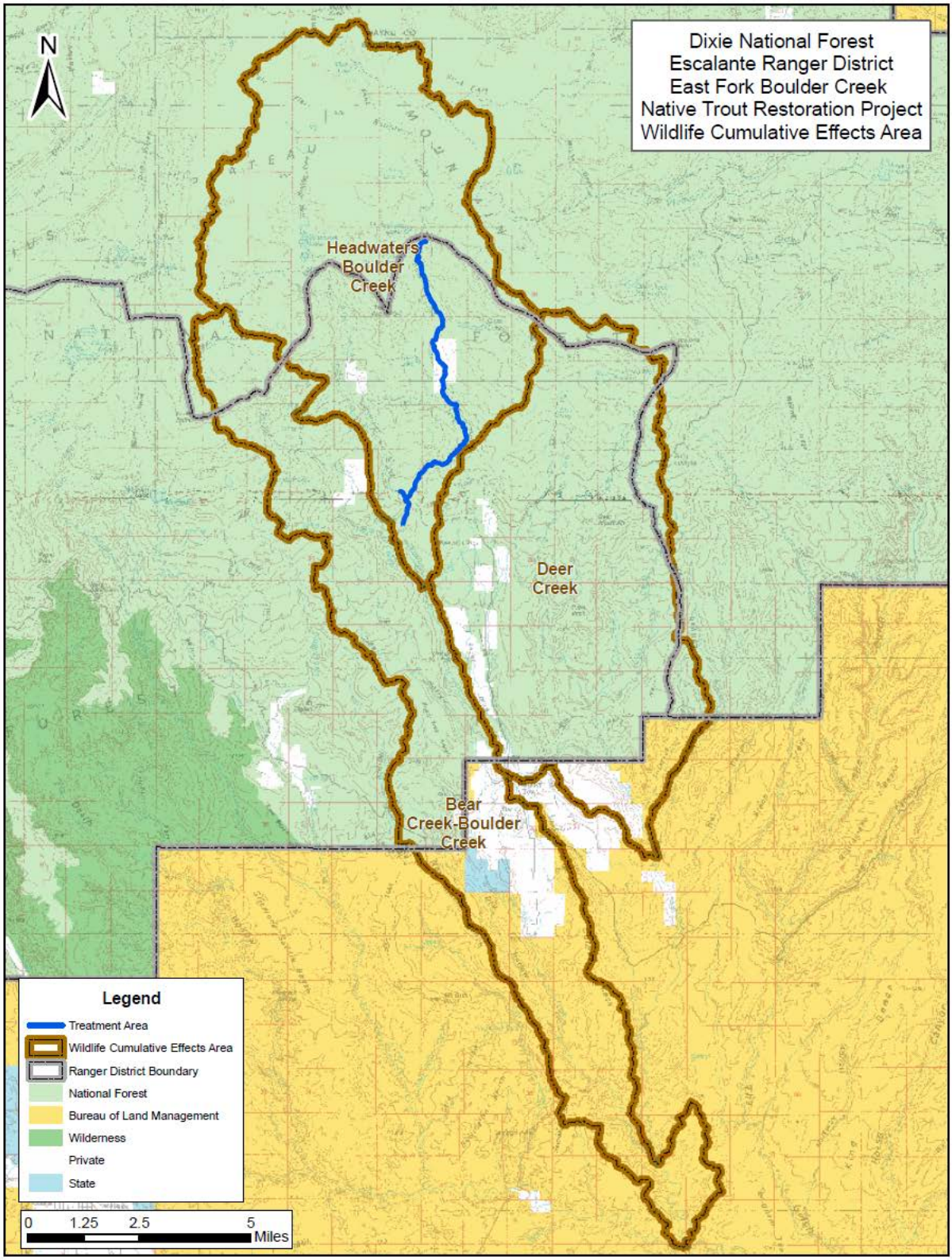


Figure 6. Livestock grazing allotments in vicinity of UDWR's proposed East Fork Boulder Creek Native Trout Restoration Project

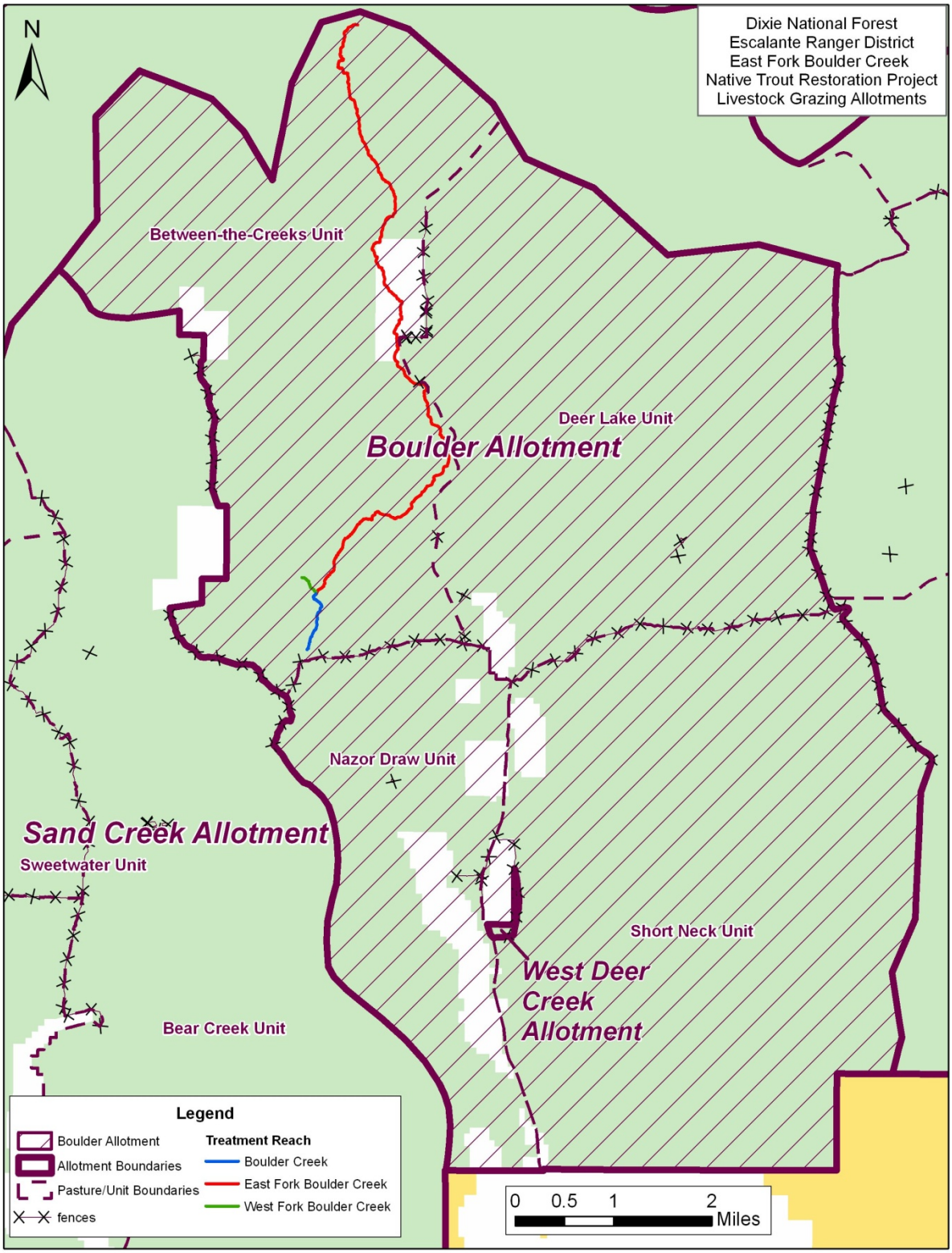


Figure 7. Cumulative effects area for recreation.

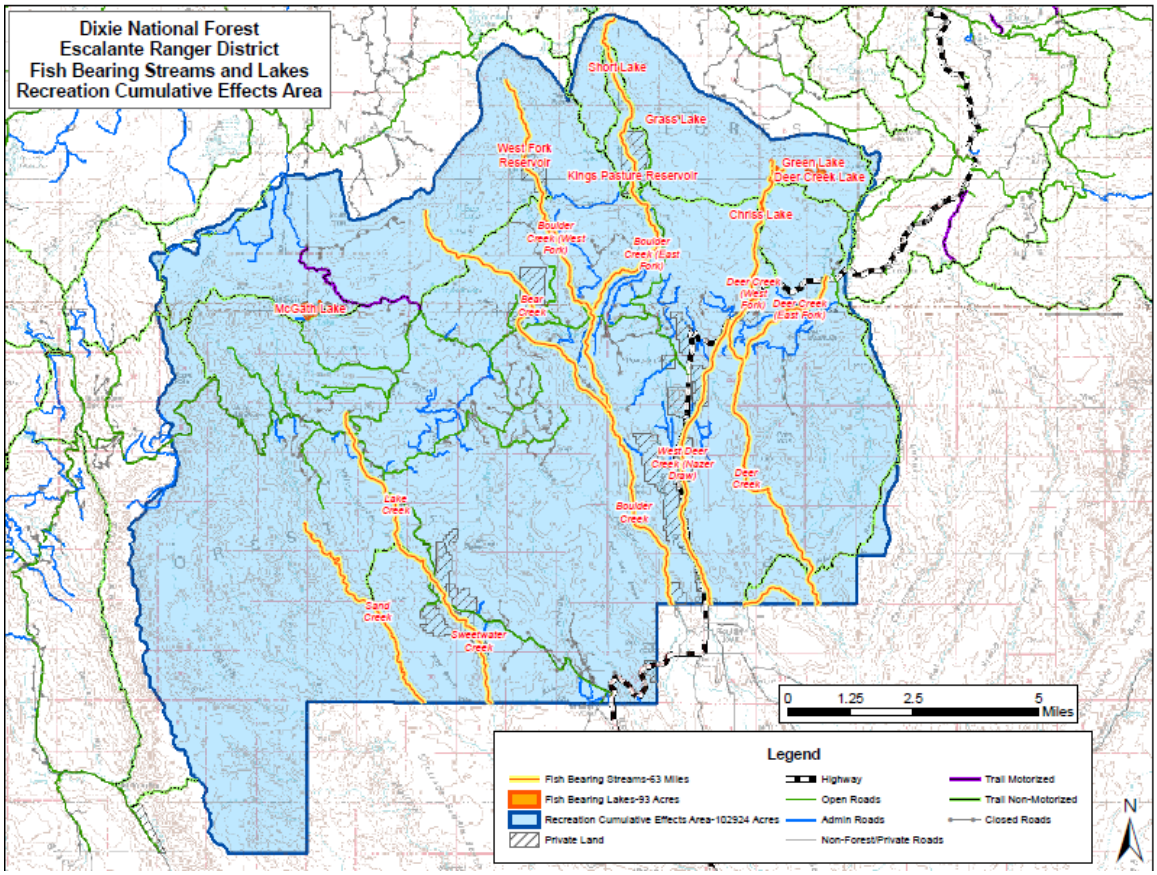


Figure 8. Boulder Top unroaded and undeveloped area which was identified on a 2005 draft map produced during the forest plan revision processas part of a required inventory and evaluation of areas with wilderness potential (Forest Service Handbook 1909.12(70)).

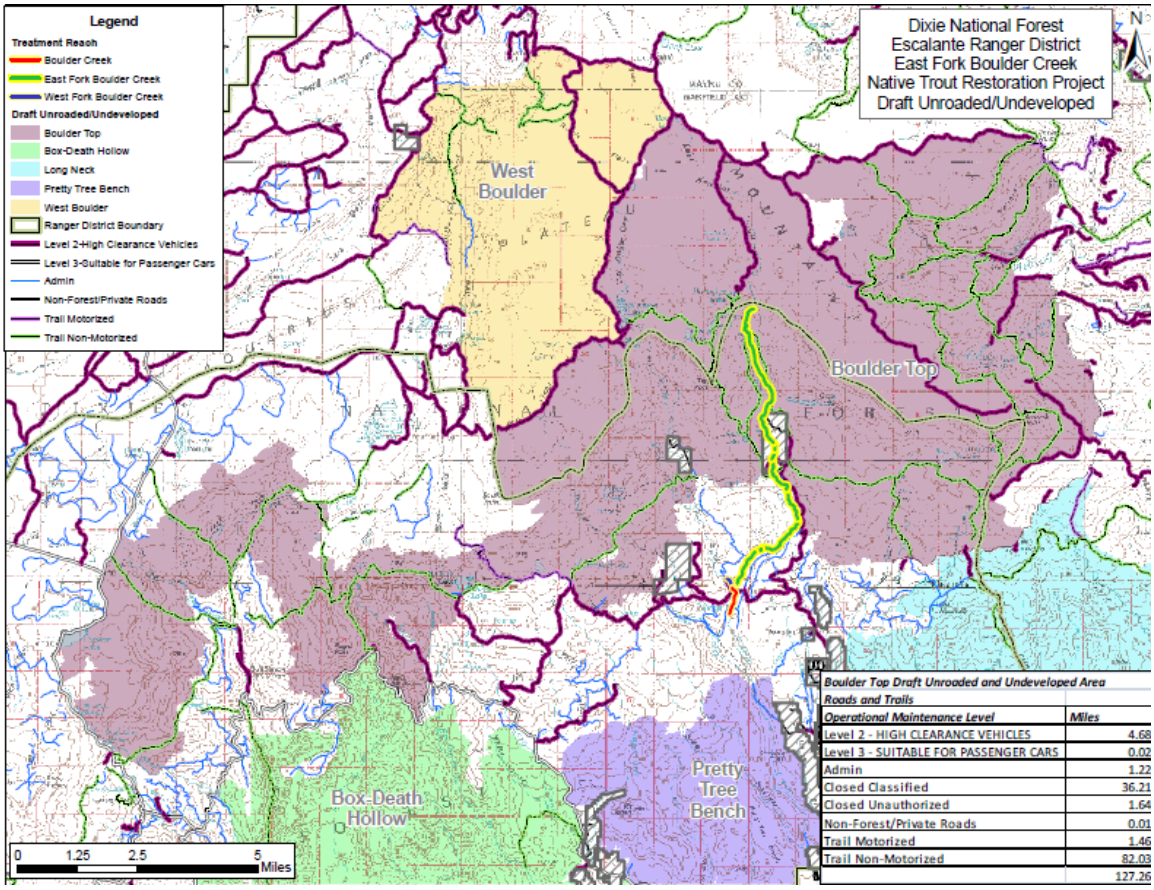


Figure 9. Boulder Mountain/Boulder Top/Deer Lake Inventoried Roadless Area and New Home Bench Inventoried Roadless Area

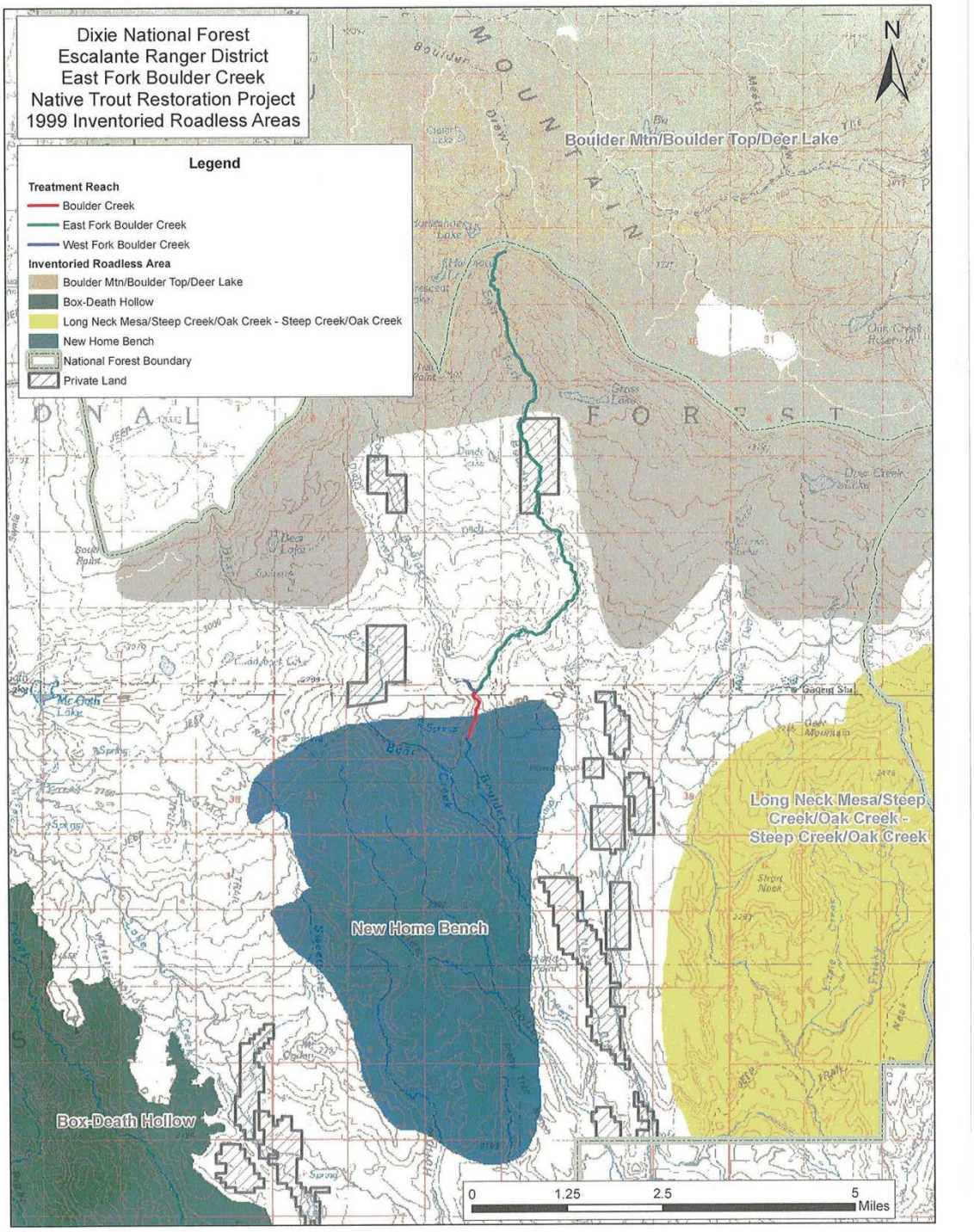
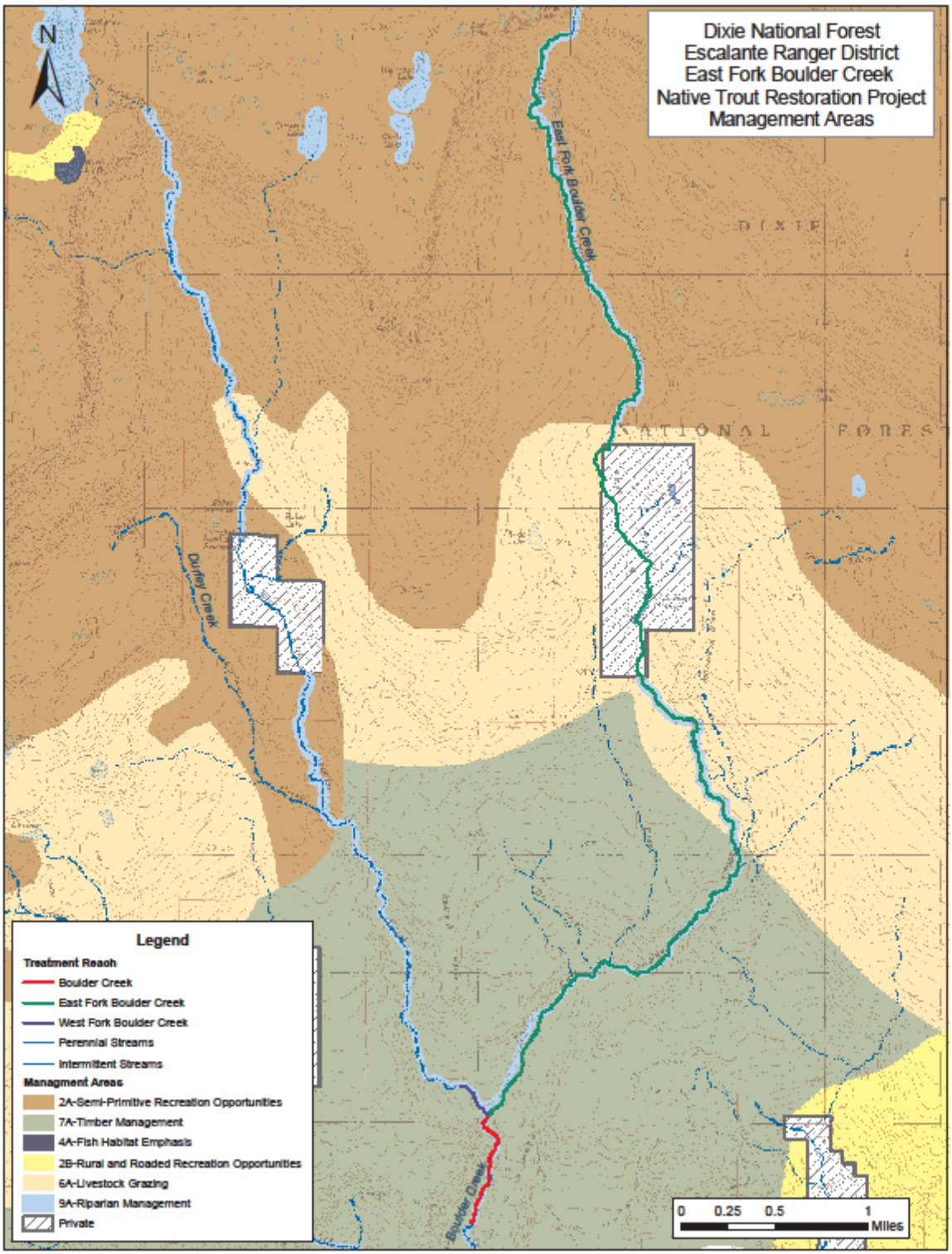


Figure 10. Management areas in vicinity of UDWR's East Fork Boulder Creek Native Trout Restoration Project



Appendices

Appendix A. Chemicals and Application of the Proposed Action

The following describes the chemicals and their application for the Proposed Action of UDWR's proposed East Fork Boulder Creek Native Trout Restoration Project. Chemicals are not used for activities described in the other alternatives.

Rotenone

Rotenone ({2R,6aS,12aS}-1,2,6,6a,12,12a-hexahydro-2-isopropenyl-8,9-dimethoxychromeno[3,4-b]furo[2,3-h]chromen-6-one) is a naturally occurring flavonoid derived from the roots of tropical plants in the pea and bean family (Leguminosae), including jewel vine (*Derris* spp.) and lacepod (*Lonchocarpus* spp.) found in Australia, Oceania, southern Asia, and South America (Finlayson et al., 2000). Rotenone is a non-specific botanical insecticide, acaricide, and piscicide and was historically used as a fishing method by indigenous tribes of South America and Malaysia. Roots containing the compound were ground up and the pulp applied to water bodies.

Rotenone interrupts aerobic cellular respiration by blocking electron transport in mitochondria through the inhibition of the enzyme NADH ubiquitone reductase, which prevents the availability of oxygen for cellular respiration. In other words, rotenone inhibits a biochemical process at the cellular level, making it impossible for fish to use the oxygen absorbed in the blood and needed for releasing of energy during respiration (Singer and Ramsay 1994, Finlayson et al. 2000). In effect, rotenone causes death through tissue anoxia by blocking oxygen uptake at the cellular level and not at the water/blood interface at the gills (Ling 2003). The lack of cellular oxygen availability initiates anaerobic respiration in turn leading to increased lactic acid concentrations and dropping blood pH levels (Fajt and Grizzle 1998).

Rotenone, its toxicity, its effects on the environment, and/or its potential effects on human health have been the subject of several reviews, analyses, and risk assessments over the past decade (Finlayson et al. 2000, Ling 2003, USEPA 2006, Entrix 2007, Turner et al. 2007, USEPA 2007, Durkin 2008). Many of these documents provide detailed discussions of various aspects of rotenone and its use. The following is a brief summary of available information on the composition of rotenone formulations, their toxicity, and how their use as proposed by UDWR for the Proposed Action may affect fish in the UDWR project area and downstream.

Rotenone is highly toxic to fish and is ideal for the control of invasive or unwanted fish species. In the aquatic environment, rotenone is readily transmitted across the permeable membranes of the gills. Gills are highly evolved respiratory structures that maximize the uptake of oxygen (O_2) and excretion of carbon dioxide (CO_2) because of their large surface area, thin lamellar membrane, and efficient countercurrent exchange mechanism. Fish supplement this efficiency by actively ventilating water across the gills by controlled branchial pumping. These features make fish highly susceptible to low concentrations of rotenone. Variation in rotenone sensitivity exists between fish species; however, rotenone tolerance generally varies inversely with oxygen requirements, as would be expected for a respiratory poison (Engstrom-Heg et al. 1978).

The U.S. Environmental Protection Agency (EPA) listed rotenone as "Very highly toxic" to aquatic organisms with a 96 hour LC50 concentration of less than 2 µg/l for rainbow trout (USEPA 2006, USEPA 2007). Ling (2003) reviewed rotenone toxicity information for a variety of fish species and showed that salmonids are generally very sensitive to rotenone with 24-hour LC50 concentrations of less than 6 µg/l. Similarly, Cheng and Farrell (2007) found that the 96-hour LC50 concentration for rotenone was 5.8 µg/l, but that the LC50 concentration increased slightly with increasing levels of dissolved organic carbon in the water. Finlayson et al. (2010) reported older studies that found 3, 6, and 24 hour LC50 concentrations of active ingredient rotenone of 8.8 µg/l, 4.4 µg/l, and 3.4 µg/l for rainbow trout using Noxfish 5% rotenone formulation. Finalyson et al (2010) also derived 4 hour and 8 hour LC50 concentrations of active ingredient rotenone for rainbow trout of 7.4 µg/l and 5.3 µg/l for CFT Legumine rotenone formulation and 7.7 µg/l and 6.2 µg/l for Nusyn Noxfish rotenone formulation. Rotenone toxicity to fish also varies with both water temperature and contact time increasing toxic effects (Ling 2003).

Potassium permanganate

Rotenone can be neutralized by potassium permanganate ($KMnO_4$), and this compound would be used at multiple locations where water leaves the UDWR project area under the activities as described for the Proposed Action and its connected actions. This inorganic chemical would be applied by UDWR at the downstream boundary of the treatment area at the fish barriers, water exiting the upper power plant, and water exiting the main power plant into the power plant pond. Potential effects would extend downstream of the neutralization station up to a 30-minute travel time, approximately 0.25 to 0.5 miles. Potassium permanganate is a strong oxidizing agent used in many industries and laboratories. It is used as a disinfectant in treating potable water. In fisheries and aquaculture, potassium permanganate is used to treat some fish parasites. Under the Proposed Action, potassium permanganate would be used to neutralize rotenone (USEPA 2006, Ling 2003). Following rotenone application, potassium permanganate is applied to the treated water at a ratio between two and four parts potassium permanganate to each part of rotenone (USEPA 2006). Under the UDWR activities as described for the Proposed Action, the potassium permanganate concentration may range from 2 to 4 mg/L depending on the organic load in the receiving water at the time of treatment.

Manganese is the principal element in the permanganate solution with potential toxicity; however, manganese is also an essential nutrient for plants and animals, and specific signs of manganese deficiency include a wide range of symptoms including nervous system disorders, bone fragility, and growth suppression (Browning 1969). Manganese comprises about 0.1% of the earth's crust and is ubiquitous in the environment (rock, soil, water). Potassium permanganate is produced by thermal oxidation of manganese dioxide (MnO_2) followed by electrolytic oxidation. The environmental chemistry and fate of manganese is controlled largely by pH. At pH values above 5.5 (approximately), colloidal manganese hydroxides generally form in water. Such colloidal forms are not generally bioavailable. As a strong oxidizing agent, permanganate is reduced when it oxidizes other substances (such as rotenone). Thus, in the process of oxidizing rotenone, potassium permanganate is in turn reduced, liberating bioavailable oxygen in the process. This mechanism counters rotenone's respiratory toxicity. In the process, potassium ions are liberated (also an essential electrolyte), and manganese dioxide is formed.

Manganese dioxide is insoluble, hence not bioavailable, and chemically similar to the manganese dioxide found in the earth's crust (Vella 2006).

Potassium permanganate is toxic to gill-breathing organisms at the rate (2 to 6 mg/L) required for neutralization. The toxicity of potassium permanganate to fish ranges from 0.75 to 3.6 mg/L (96 hr LC50 values) and is about 1.8 mg/L for rainbow trout; however, recent studies showed rainbow trout treated with a 2mg/l potassium permanganate solution for 2 hours a day did not show increased mortality (Marking and Bills 1975, Oplinger and Wagner 2010). Potassium permanganate will neutralize rotenone in 15 to 30 minutes, depending on water temperature. Manganese oxide, formed during the oxidation of the rotenone, is a biologically inactive compound. In flowing water treatments, this balance usually limits aquatic exposure to permanganate and rotenone to 0.25 to 0.5 mile downstream of the neutralization site (Hobbs et al. 2006).

Because application of excess potassium permanganate could adversely affect downstream fish populations, UDWR would avoid and minimize any effects of potassium permanganate on fish populations.

Other chemicals

In addition to rotenone, liquid formulations of rotenone contain petroleum based products characterized as petroleum distillates, xylene range aromatics, or aromatic petroleum products, as well as "associated resins." The following is a brief discussion on these ingredients in terms of three common rotenone formulations available on the market today Chemfish Regular, manufactured by TIFA International LLC, as well as Prentox Prenfish Toxicant and CFT Legumine, both of which are manufactured by Prentiss Incorporated (Table 1). The MSDS's for the liquid formulations provide varying levels of detail in specifying the nature of the solvents used in the formulations. The MSDS for Prentox Prenfish Toxicant identifies many of the specific compounds in the petroleum products as well as the concentrations of the components in the solvent. Conversely, the MSDS's for CFT Legumine and Chemfish Regular simply refer to other ingredients as inert or an aromatic petroleum solvent.

Table 1. Composition (percent by weight) of liquid rotenone formulations based on Material Safety Data Sheets (MSDS).

Formulation	Rotenone	Other/cube resins	Other ingredients
Prentox Prenfish	5%	10%	85% - Aromatic petroleum solvent[a]
CFT Legumine	5%	5%	90% Inert Ingredients, Including N-90 Methylpyrrolidone
Chemfish	5%	5%	90% Aromatic petroleum solvent

[a] Identifies naphthalene (9.9%), 1,2,4-trimethylbenzene (1.7%), acetone, and two unnamed emulsifiers.

Fisher (2007) analyzed several lots of CFT Legumine to determine their composition and found that the major constituents were rotenone (5.1%), rotenolone (.7%), Methyl Pyrrolidone(9.8%), DEGEE (61.1%; diethylene glycol monoethyl ether), and Fennedefo 99 (17.1%). Sixteen additional constituents were found in the formulations (Fisher 2007; summarized in Table 2 below).

Table 2. Average concentrations of other constituents identified CFT Legumine formulations analyzed by Fisher (2007).

Constituent	**Average concentration in undiluted CFT Legumine formulation (mg/l)**
1,2,4,5-tetramethylbenzene	369
1,4-diethylbenzene	453
total c4 substituted benzenes	2,586
total c5 substituted benzenes	796
1-Hexanol	3,600
tri(ethylene glycol)	266
tetra(ethylene glycol)	1,194
penta(ethylene glycol)	2,471
hexa(ethylene glycol)	4,386
Trichloroethylene	7.3
Toluene	166.7
Tetrachloroethylene	12.8
Xylene-m/p	2.9
Trimethylbenzene, 1,2,4	30.7
Butylbenzene , n-	23.6
Naphthalene	255.1

Chemfish Regular lists an aromatic solvent and other associated resins in its formulation (Chemfish Regular MSDS, Appendix 2). TIFA International LLC released the solvent and two potential emulsifiers used in formulations of Chemfish Regular (Cerciello 2010). The solvent is Aromatic 200 manufactured by Exxon and the emulsifiers a T-Mulz O and T-Mulz-W (see Appendix 2 for MSDS). The MSDS for Aromatic 200 lists the compound as ”Solvent naphtha (petroleum), heavy 64742-94-5 100% aromatic.” Additionally, the MSDS states that the product consists predominantly of C9-C15 aromatic hydrocarbons, primarily C10-C12, and contains

approximately 14% naphthalene by weight. It lists an acute oral LD50 (rat) greater than 3 g/kg of body weight and an acute dermal LD50 (rabbit) greater than 3 g/kg of body weight.

T-Mulz O and T-Mulz-W are listed as "Organic mixtures" on the MSDS (Appendix 2). The MSDS lists n-Butyl Alcohol 1-Butanol (10% maximum) and C (11-13) Branched Alkyl Benzene Sulfonic Acid, Calcium Salts (20% maximum) as potential hazardous components in T-Mulz O. Hazardous components in T-Mulz W include up to 10% Naphtha, Light Aromatic - Aromatic Hydrocarbons C8-10 (up to 3.2 % of this is 1,2,4-Trimethylbenzene Pseudocumene), up to 10% n-Butyl Alcohol 1-Butanol, and up to 25% Branched Alkyl Benzene Sulfonic Acid, Calcium Salts.

Rotenone is obtained by processing the roots of plants such as *Derris* and *Lonchocarpus* species. Consequently, the materials from which rotenone formulations are made consist of complex mixtures of rotenone and other plant materials commonly referred to on the product labels as other associated resins or other associated extracts. Most of the constituents of the associated resins do not appear to be biologically active. A notable exception, however, is deguelin, which appears to be about half as toxic as rotenone (Cabizza et al. 2004) and is present in cube resin at a concentration of about 22%, about half the concentration of rotenone (Fang and Casida 1999). Other agents in cube resin are less toxic than deguelin by at least a factor of 2 (Fang and Casida 1999).

The processing of roots from *Derris* and *Lonchocarpus* species to obtain cube resins, which constitute the non-end use formulations of rotenone, can involve the use of trichloroethylene, which when present in rotenone formulations is considered as a contaminant or impurity. The concentrations of trichloroethylene in rotenone end-use formulations are very low. Fisher (2007) reports that trichloroethylene was found in samples of CFT Legumine at concentrations of 7.3 (0-29.1) mg/L, i.e. about 0.00073% (0% - 0.0029%), and that the estimated concentration in a lake after the application of CFT Legumine is 0.0073 µg/L (about 7.3 parts per trillion). Finlayson et al. (2000) indicates that initial water concentrations of trichloroethylene could reach 1.4 ppb (1.4 µg/L) in water after an application of rotenone at a concentration of 2000 ppb, i.e., a factor of 10 greater than the maximum allowable application rate.

As part of the re-registration process USEPA (2006) conducted a review of the available toxicity data on all formulated products of rotenone and the formulation ingredients typically evaluated; however, only limited toxicity data were available on the inert ingredients. The evaluation of both technical grade rotenone (>95% active ingredient) and formulated end-product determined that the technical grade active ingredient is generally more toxic than formulated end-product [corrected for active ingredient] by at least a factor of 2 (USEPA 2006). These data suggest that for the formulated products tested and the toxicity endpoints measured, the dispersant ingredients do not contribute substantially to the toxicity of the active ingredient and are effectively inert. Similarly, Durkin (2008) presented data indicating that that the toxicity of the formulations is generally less than or equal to the toxicity of rotenone itself. Finlayson et al. (2001) indicated that in flowing water persistence of rotenone, its metabolites, and volatile and semi-volatile other ingredients are limited in duration. Therefore, toxicity to fish from the rotenone formulations is not expected to be different from the toxicity of the active ingredient rotenone in the formulation.

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Appendix B. Effectiveness and Cost Comparison

This analysis will address the effectiveness and provide a cost comparison of the alternatives for UDWR's proposed East Fork Boulder Creek Native Trout Restoration project. The analysis is based on the UDWR activities as described for the No Action - No Further Treatment Scenario, Proposed Action, and Non-chemical Treatment alternative, including the UDWR activities that would be authorized by the Forest and those that are not included in the Forest Service decision but connected to the UDWR project.

Analysis of effectiveness addresses how well the alternative meets the objective of the proposed UDWR project, i.e. eradication of non-native trout from the treatment area. Cost of UDWR's treatment in terms of dollars and effort is provided for comparison across alternatives.

No Action - No Further Treatment Scenario

The No Action - No Further Treatment Scenario would result in no activities to remove nonnative trout from the treatment area. It would not meet the objective of the proposed UDWR project.

Because no actions would be taken, no costs would be incurred.

Proposed Action

Effectiveness

The UDWR activities as described for the Proposed Action include treatment involving rotenone. Rotenone has been shown to be effective at eradicating nonnative trout (Demong 2001, Hamilton et al. 2009, Finlayson et al. 2010). Meronek et al. (1996) found that chemical renovation projects were more successful than mechanical removal projects (58% to 43%) at reducing the abundance of target species; however, the goals of many of these projects were to simply alter population numbers, not completely remove species. The success of stream rotenone renovations to remove nonnative trout for native trout restoration in the Utah Division of Wildlife Resource's (UDWR) Southern Region has been considerably higher (Hepworth et al. 2001a, Hepworth et al. 2001b, Hepworth et al. 2001c, Ottenbacher and Hepworth 2001, Chamberlain and Hepworth 2002a, Chamberlain and Hepworth 2002b, Chamberlain and Hepworth 2002c; Table 1).

Of 26 stream rotenone renovations completed for native trout restoration since 1977, only one, West Fork Deer Creek, was completely unsuccessful. During the first treatment of this stream, UDWR recognized that the complexity of the stream substantially reduced the odds of successful eradication of brook trout and abandoned the project. Three projects required additional treatments over those initially planned to completely eradicate brook trout. One of the three was an early project (1979) that only used a single treatment. Since that time UDWR has recognized that generally two full treatments are needed to ensure complete eradication of the target species. Center Creek and U-M Creek required additional consecutive treatments for complete removal, but this need was recognized immediately and the treatments implemented consecutively. Four

of the 26 projects (15%) have had reinvasions of nonnative fish following barrier failure or unauthorized fish movements. Conversely, five of the treatments remained free of nonnatives for 20 years or more, and six have remained free of nonnatives for 15 years or more.

Where nonnative trout have been completely removed using rotenone in the Escalante River Basin, the standing crop of reintroduced or expanded Colorado River cutthroat trout (CRCT) populations has increased. Where CRCT populations were not present prior to nonnative trout removal, reintroduced populations have reached standing crops similar to CRCT populations in the absence of nonnative trout within 4-6 years after the rotenone treatment (Hadley et al. 2008). Two of the current CRCT populations in the Escalante River drainage were truly sympatric with nonnative trout prior to restoration activities. Both populations saw large increases in standing crop (350% in West Branch Pine Creek and 138% in White Creek) after nonnative trout removal.

Within the Boulder Creek drainage itself, West Fork Boulder Creek was treated in 2000-2001, and no brook trout have been collected within the treated reach since that time (Hepworth et al. 2001b, Hadley et al. 2008, Williams and Hardy 2010). CRCT standing crop in the treated area quickly rose to the levels seen in untreated areas upstream and has remained at those levels (Hadley et al. 2008, Williams and Hardy 2010). Similarly, no brook trout have been found in Short Lake since it was treated in 2007 to remove a stunted nonnative brook trout population and establish a CRCT fishery (Hadley 2010). Sampling of Short Lake in 2010 showed that the catch rate for CRCT was above average when compared to other southern Utah trout lakes and that CRCT were longer, heavier and in better condition than the brook trout that were present when the lake was sampled in 1982 and 1999 (Hepworth and Beckstrom 2004, Hadley 2010).

Cost and effort

East Fork Boulder Creek is complex and will require a large amount of effort for UDWR's treatment. UDWR's September 2009 treatment of East Fork Boulder Creek and inflows from the headwater meadow down to and including King's Pasture Reservoir, along with their treatment of the private pond in King's Pasture used 31 personnel for 1.5 to 3 days for a total of approximately 56.5 man days (Ottenbacher et al. 2009). The manpower plus materials costs totaled approximately $22,300. The reach from King's Pasture Reservoir downstream to the fish barriers is longer but less complex and with less flow volume; therefore, a conservative estimate of cost for treating this lower reach is the same cost as the 2009 treatment of the upper reach. If two UDWR treatments are successful at eradicating nonnative trout in the entire area, then the total estimated cost of the UDWR project would be just under $90,000. There would also be costs associated with transportation vehicles for the crews. The chemical dispensing equipment may also incur a cost, but would likely already be available.

Table 1. Utah Division of Wildlife Resources stream chemical renovation projects for native trout restoration in Utah's Southern Region. Under "Status": S = fully successful (non-native fish eradicated, native fish re-established), S' = fully successful but follow-up management was required, U = unsuccessful

Stream	Treatment dates	Status	Comment
Bonneville cutthroat trout			
Sam Stowe Creek	1977, 1997	S'	Retreated after barrier failure / reinvasion
Pine Creek (Sevier R)	1979, 1986	S'	Required 2nd unplanned treatment
Threemile Creek	1993, 1994	S	Nonnative trout removed below barrier by electrofishing
Delong Creek	1993, 1994	S	
Indian Hollow	1993, 1994	S	
North Fork North Cr	1992, 1999	S'	Partially retreated after barrier failure
Pole Creek	1992	S	
Manning Creek	1995, 1996 2001	S'	Partially retreated following inadvertent or illegal stocking
Barney Creek	1995, 1996	S	
Vale Creek	1995, 1996	S	
E. Manning Cr	1995, 1996	S	
Birch Cr (Sevier R)	2001	S	
Tenmile Creek	2001, 2002	S	
Center Cr / Robs Res	2002-2004	S'	3 treatments required for complete removal
Leap Creek	1985	S	Later extirpated by fire
South Ash Creek	1985	S	Later extirpated by fire
Leeds Creek	1989	S	
Colorado River cutthroat trout			
West Deer Creek	1994	U	Project discontinued after complete removal deemed unrealistic following initial treatment
West Fork Boulder Creek	2000, 2001	S	
Pine Cr (Escalante R)	2001, 2002	S	
Whites Creek	2000, 2001	S	
Twitchell Creek	2001, 2002 2006	S'	Partially retreated after barrier failure
U M Creek	1992-1995	S'	4 treatments required for complete removal; May require stocking to maintain
Pine Cr (Fremont R)	2002, 2003	S	

Non-chemical Treatment Alternative

Effectiveness

Efforts to completely eradicate nonnative fish by non-chemical methods in streams, rivers, lakes, and reservoirs have generally been unsuccessful (Lentsch et al. 1996, Meronek et al. 1996, Thompson and Rahel 1996, Tyus and Saunders 2000, Golden and Holden 2002, Mueller 2005, Koel et al. 2005, Meyer et al. 2006, Caudron and Champigneulle 2010, Koel et al. 2010). Specifically, electrofishing efforts to remove nonnative trout from streams have met with variable success. Several efforts to remove brook trout from small streams (< 3.0 m wide) in the western United States and Canada have been successful at significantly reducing brook trout numbers but have not been successful eliminating them completely (Thompson and Rahel 1996, Buktenica et al. 2000, Peterson et al. 2004, Meyer et al. 2006, Birchell 2007, Earle et al. 2007, Firehammer et al. 2009, Carmona-Catot et al. 2010). Stream size (length, width, and volume) and complexity, ability of brook trout to begin reproducing by age 1, inability to increase removal effort because of funding or timing considerations, and inability to conduct piscicide treatments were offered as reasons for the inability to eradicate brook trout.

A few studies have shown that nonnative trout can be successfully eradicated under certain conditions (Moore et al. 1986, Kulp and Moore 2000, Sheppard et al. 2002, Moore et al. 2005). The majority of these examples are from streams in Great Smoky Mountains National Park, where removal of nonnative rainbow trout to restore native brook trout populations has been ongoing since 1976 (Moore et al. 1986, Kulp and Moore 2000, Moore et al. 2005). Initial efforts focused annual electrofishing removal in four streams (0.1 km – 1.5 km in length) over six years. Rainbow trout abundance was significantly reduced but not eliminated during that time; however, ten years later the streams were reevaluated and two of the four were found to be free of rainbow trout (Moore et al. 1986, Moore et al. 2005). Similarly, rainbow trout were successfully removed from 0.9 km of stream after four removal passes in one year and two removal passes in the second year (Kulp and Moore 2000). In addition to the intensity and duration of removal efforts, the authors concluded that habitat simplicity aided in the complete eradication of rainbow trout. Rainbow trout persisted in at least five streams where long-term removal projects were conducted. Moore et al. (2005) indicated that complete eradication in streams wider than 4.5 m and/or with complex habitats (4 or more pools > 1 m deep per km) was nearly impossible to achieve through electrofishing removal. Multiple electrofishing removal attempts on a stream displaying those characteristics were unsuccessful at eradicating rainbow trout. Moore et al. (2005) determined that the stream was too complex for mechanical removal and eventually used a piscicide to successfully eradicate rainbow trout from a 4.8 km section of that stream.

In the western United States, Shepard et al. (2002) successfully removed brook trout from 4.8 km of a native Westslope cutthroat trout stream using electrofishing removal over an 8 year period. They removed brook trout using a combination of single and multipass removal methods and varied their efforts between single and multiple removals annually. In addition to electrofishing they constructed an immigration barrier, drained stream side ponds that were supplying brook trout to the system, and trimmed back overhanging vegetation to increase their efficiency. They

attributed much of their success to the small size of the stream (2 m wide) and the lack of complex habitat.

Shepard (2010) was also successful in eradicating brook trout from 2.5 to 3.0 km treatment reaches of four streams using multiple pass electrofishing. The streams were 1.4 m to 2.6 m wide with late summer discharges between 2.1 cfs and 6 cfs. Complete eradication took anywhere from 4 to 8 years. The number of treatment efforts each year and the number of passes during each treatment effort varied among streams; however, it took between 13 and 29 total passes (the sum of treatment efforts*passes during each treatment effort) to completely eliminate brook trout. Shepard (2010) was unsuccessful at eradicating brook trout from two other streams because of dense overhanging vegetation and large amounts of instream cover. He concluded that the efficiency of nonnative fish removal is reduced by increasing stream size, increasing amounts of overhanging and instream cover, the presence of deep pools, and the presence of beaver ponds. He recommended planning for at least six treatments of two to three passes per treatment in order to achieve complete eradication.

Conversely, Thompson and Rahel (1996) were not able to completely remove brook trout from three relatively small streams (average width $\leq$ 1.6 m) using a single year of 3 pass electrofishing removal, followed by a second year of single and multiple pass removal efforts. Buktenica et al. (2000) used multiple mechanical removal methods over five years (electrofishing, snorkel-directed electrofishing, trap-netting) in an attempt to remove brook trout from bull trout habitat. They were able to almost completely remove brook trout from a short length (3.4 km) of the headwaters of their study area (average width $\leq$ 1.5 m), which had a low density of brook trout, but they could not mechanically eradicate brook trout from downstream sections that had similar length (5.1 km and 3.1 km), higher brook trout density, and increased stream size (width 3m – 6m). Eventually they used the piscicide Antimycin to eradicate brook trout from the lower sections.

Similar to Thompson and Rahel (1996), Carmona-Catot et al. (2010) found that they were able to reduce significantly but not eliminate brook trout from a small stream (2.1 km, 1.2 m wide, 0.6 cfs). They completed 3 pass removal efforts once a year for three years and found that they were able to suppress, but not eliminate recruitment. They also found that the condition, growth, and fecundity of the remaining brook trout increased, indicating a compensatory response to the reduction in density. Carmona-Catot et al. (2010) concluded that complete elimination of brook trout in their small study stream may have been possible with additional effort; however, they felt that in larger streams, with lower capture efficiencies, complete elimination was much less likely.

Earle et al (2007) found that unlimited angling harvest by trained anglers for eight combined with single pass removal electrofishing efforts for three years suppressed brook trout density and standing crop, but not to a level below those of the bull trout and westslope cutthroat trout populations targeted for benefit. Additionally, no appreciable response in bull trout or westslope cutthroat trout standing crop was in observed in response to the removal efforts. Firehammer et al. (2009) attempted to suppress brook trout numbers using single pass electrofishing in 2.9 to 11.7 km of stream for the benefit of resident westslope cutthroat trout. Over a four year period they were unable to detect a significant decline in brook trout density; however, they did note a

positive response in westslope cutthroat trout populations. Since physical stream restoration was occurring within the same watershed, the positive response could not be directly tied to the brook trout removal efforts.

Birchell (2007) attempted to mechanically remove brook trout from a 12.1 km stretch of stream with an average wetted width of 3.2 m and baseflows of approximately 5 cfs using multiple pass removal electrofishing. He conducted a total of nine removal passes between 2003 and 2005 (four in 2003 and 2004 and one in 2005). They estimated that they had removed more than 80% of the brook trout population after the 2003 and 2004 efforts, but had not eliminated reproduction and recruitment. While Birchell (2007) did not achieve complete eradication of brook trout, the CRCT population in the stream showed improved growth, body condition, and an apparent increase in recruitment and mobility; however, as in the Earle et al. (2007) study population abundance did not increase in response to the removal efforts. He concluded that "the complete eradication of brook trout via depletion removal electrofishing from streams similar in size and habitat complexity…would be nearly impossible to achieve."

East Fork Boulder Creek is a relatively large, complex stream when compared to streams where electrofishing removal has been effective. Approximately 13.7 km of stream are slated for removal efforts under the proposed UDWR project. Average wetted widths at fish survey sites from the headwater meadow downstream to King's Pasture Reservoir ranged from 3.5 m to 6.4 m during fisheries surveys above Kings Pasture Reservoir, while average widths ranged from 2 m to 3.3 m throughout the remainder of the UDWR project area (Hadley et al. 2008, Williams 2010). Baseflows in the UDWR project area vary from 2 cfs to 21 cfs (FERC 2007). The UDWR project area on East Fork Boulder Creek is longer and generally wider than streams where successful electrofishing removal projects have occurred. Additionally, the habitat in a large portion of the UDWR project area is complex with deep riffles and cascades, as well as deep (> 1 m pools), undercut banks, and abundant instream cover. Data from previous mechanical removal projects indicates that achieving complete eradication through electrofishing removal in the proposed UDWR project area will be difficult, if not impossible. Additionally, brook trout in King's Pasture Reservoir would have to be eradicated simultaneously, or prior, to the stream removal efforts. A barrier would have to be maintained between the reservoir and the stream to prevent immigration and emigration between systems.

Removing brook trout from King's Pasture Reservoir and the pond in King's Pasture also presents UDWR with a challenge. Mueller (2005) found that an intensive 5-day trammel net effort in a 3.2 acre backwater along the Colorado River removed about 58% of the warmwater predators. Meronek et al. (1996) found that 37% of netting removal projects they reviewed were not able to produce a measurable reduction in the target species. Koel et al. (2005) and Koel et al 2010 document an intensive netting removal effort for lake trout on Yellowstone Lake. After 12 years, lake trout abundance continued to increase, despite removal hundreds of thousands of lake trout. Conversely, Knapp and Matthews (1998) and Parker et al. (2001) both were able to eliminate brook trout from small (4 to 5 acre, 6 to 9 m maximum depth) mountain lakes. Knapp and Matthews (1998) suggested that mechanical removal was unlikely in lakes large than 4.5 acres, greater than 10 m in depth, with outflows wider than 0.5 m, inflows wider than 1 m, or stream spawning areas larger than 1 sq m. Parker et al. (2001) felt that the use of more, larger nets could successfully eradicate brook trout from lakes as large as 25 acres; however, they

cautioned the lakes with inflows and outflows would need to have barriers erected at the outflow and nonnative fish removed from the inflow before mechanical removal would be effective at eliminating brook trout.

The pond in King's Pasture has a surface area of approximately 1.5 acres and a maximum depth of 1.5 meters. The pond in King's Pasture appears to satisfy all the parameters necessary for a successful mechanical removal. While it has an inflow and outflow, both are small and no evidence of reproduction or recruitment was evident during the September 2009 piscicide treatment of that pond. Based on previous studies it will probably take at least two years to remove brook trout from the pond in King's Pasture using non-chemical methods. Electrofishing removal by UDWR in East Fork Boulder Creek would not be able to be completed until this pond is free of brook trout.

King's Pasture Reservoir has a surface area of approximately 2.5 acres and a maximum depth of approximately 5.5 m and may fit within the size criteria thought to be amenable to complete removal through non-chemical methods; however, East Fork Boulder Creek is the inflow for the reservoir. Above the reservoir East Fork Boulder Creek is approximately 3.5 – 4.0 m wide, which is considerably wider than the 1 m specified by Knapp and Matthews (1998) as a criteria for successful brook trout removal. Additionally, a large amount of spawning habitat for nonnative brook trout exists above the reservoir, as evidenced by the large number of young-of-year and juvenile brook trout previously found in fish surveys of this area (Hadley et al. 2008, Hardy et al. 2009a, Hardy et al. 2009b). Brook trout would have to be eradicated from the stream prior beginning removal efforts in the reservoir, in order for those efforts to be successful; therefore, a barrier would have to be maintained between the reservoir and the stream to prevent immigration and emigration between systems.

Cost and effort

In order for UDWR to complete 4 removal passes on the NFS lands included in the proposed UDWR project and the non-NFS lands connected to the project during one accessible season, approximately 20 people (4 crews) would be necessary for one removal effort. Each removal effort would take approximately 20 days totaling approximately 80 days per year for four removal efforts or 1600 people days per year (20 people X 20 days/effort X 4 effort/yr = 1600 people days/yr). Based on a cost estimate provided by Utah State University's Institute for Natural Systems Engineering, the estimated cost for conducting four removal efforts in the mainstem Boulder Creek in would be approximately $443,776 in labor (Williams 2010). Using the person day rate for UDWR during the 2009 rotenone treatment of East Fork Boulder Creek produces a slightly lower but similar estimate of $416,000 in labor (Ottenbacher et al. 2009). An additional, but unknown amount of effort and labor cost will be necessary to eradicate brook trout from the spring inflows and tributaries on both NFS land and non-NFS land.

In addition to the effort for the flowing portions of the stream, UDWR effort will be needed to remove nonnative trout from King's Pasture Reservoir and the pond on private property. Knapp and Matthews (1998) set and pulled nets 18 times the first year of their study. For a two person crew that would be 36 person days, or approximately $9,360 at the UDWR person day cost.

A final cost associated with the alternative is the construction of at least one fish barrier above King's Pasture Reservoir. A loose rock barrier would cost approximately $2,000 to construct (Ottenbacher 2010). Without accounting for the extra cost of removing nonnative trout from springs and tributary inflows, the cost of labor for removing nonnative trout from all water bodies connected to the proposed UDWR project and the construction of the fish barrier would cost approximately $427,000 during the first implementation year. Previous studies suggest at least one more year of similar effort would be necessary to completely eradicate nonnative trout, bringing the total cost just for removal labor and the construction of the fish barrier to approximately $852,000. The additional labor to remove nonnative trout from springs and tributaries affiliated and connected to the proposed UDWR project would probably bring the costs to well over $1,000,000. There would also be higher vehicle costs than under the UDWR activities described for the Proposed Action because of the higher number of people that would be needed, along with costs for equipment, although most of the equipment is expected to be available.

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