BROWN TROUT REMOVAL FROM ABOVE A PERMANENT FISH BARRIER IN CROOKED CREEK

Environmental Assessment Addendum

September 9, 2008

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Montana Fish, Wildlife & Parks

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List of Abbreviations

BLM	Bureau of Land Management
CNF	Custer National Forest
DEGEE	Diethyl glycol monoethyl ether
DEQ	Montana Department of Environmental Quality
EA	Environmental assessment
EPA	Environmental Protection Agency
FWP	Montana Fish, Wildlife & Parks
$KMnO_4$	Potassium permanganate
MCA	Montana Code Annotated
MOU	Memorandum of understanding
MSDS	Material data safety sheet
NHP	Montana Natural Heritage Program
PEG	Polyethylene glycol
ppm	Parts per million
USFS	US Forest Service
USFWS	US Fish and Wildlife Service

Executive Summary

This document is an addendum to an environmental assessment (EA) entitled *Brown Trout Removal from above a Permanent Fish Barrier in Crooked Creek* issued in fall of 2007 (http://fwp.mt.gov/publicnotices/notice_1559.aspx). The purpose of the proposed action was to remove nonnative brown trout from a portion of Crooked Creek located above a barrier constructed to protect a genetically pure population of Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*). Montana Fish, Wildlife & Parks (FWP) received one comment on the action, which was in opposition to the use of piscicide to remove brown trout (*Salmo trutta*).

The objective of this addendum is to reevaluate the impacts of piscicide application on the environment and human health using a thorough survey of the scientific literature, including recently published investigations. In addition, this document includes an analysis of the effectiveness of mechanical removals implemented in 2008. The third objective is to present modifications to the proposed approach, aimed at increasing break down of the piscicide to decrease the spatial and temporal extent of toxic concentrations.

Reevaluation of the potential impacts of the proposed action to the environmental and human health found this action would result in minor and temporary effects on water quality. The effects of this project on fisheries would be elimination of brown trout, a nonnative fish, from Crooked Creek within the treated area, which lies above a barrier constructed to prevent encroachment of brown trout. These actions would have a positive effect on native Yellowstone cutthroat trout, as this species could recolonize the treated area, and be free of predation and competition pressures from nonnative brown trout.

FWP has established a second public comment period to allow evaluation of this new information by interested parties. The 30-day public comment period will extend from September 9 to October 9. A public meeting may occur if public interest in the project warrants this additional forum. Interested parties should send comments to:

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1.0 Introduction

Crooked Creek has been the focus of considerable effort to secure and protect an isolated population of pure Yellowstone cutthroat trout. Threats to this population include its small size and presence of brown trout, which compete with and prey on Yellowstone cutthroat trout. In October 2007, project partners, FWP, Bureau of Land Management (BLM), and the Custer National Forest (CNF), completed construction of a fish barrier to prevent upstream movement of nonnative fishes. Unfortunately, brown trout managed to move above a temporary gabion barrier installed in 2006, and reproduced. Repeated efforts to remove brown trout through electrofishing have not diminished numbers of this nonnative fish.

In fall of 2007, FWP released an EA that evaluated several alternatives to securing Crooked Creek's Yellowstone cutthroat trout (FWP 2007[1]). The preferred alternative involved the use of rotenone, a piscicide, to chemically remove brown trout. Yellowstone cutthroat trout residing above the reach slated for treatment would then recolonize the reclaimed waters. This reach currently supports low density of fish of any species, as wildfire in 2002 resulted in debris flows that wiped out fish in much of Crooked Creek.

Public comment on the proposed action consisted of one response, which was in opposition to use of piscicide. The project was postponed, and FWP did not release a record of decision on the proposed action. FWP chose to continue with mechanical removal, while reevaluating the scientific literature on rotenone, which includes recent publications. In addition, FWP decided to modify the preferred alternative by strengthening the approach to detoxification, thereby limiting the spatial and temporal extent of toxic concentrations of rotenone. Subsequent mechanical removals allowed further evaluation of a non-preferred alternative, mechanical removal of brown trout. The objectives of this supplement to the original EA are as follows:

- Strengthen the evaluation of the potential impacts of the proposed action through additional review of the scientific literature;
- Describe modifications to the preferred alternative, which would reduce the spatial and temporal extent of rotenone treatment; and
- Present information allowing evaluation of mechanical removal as a potential option.

[1] http://fwp.mt.gov/publicnotices/notice_1559.aspx

Figure 1: Constructed fish barrier on Crooked Creek.

2.0 Project Area

Crooked Creek is a tributary in the Big Horn Lake hydrologic unit (HUC 1008001). Crooked Creek is largely spring fed, and flows through a deep canyon for most of its length in Montana. The proposed action would occur on public lands managed by the Custer National Forest and Bureau of Land Management (Figure 2).

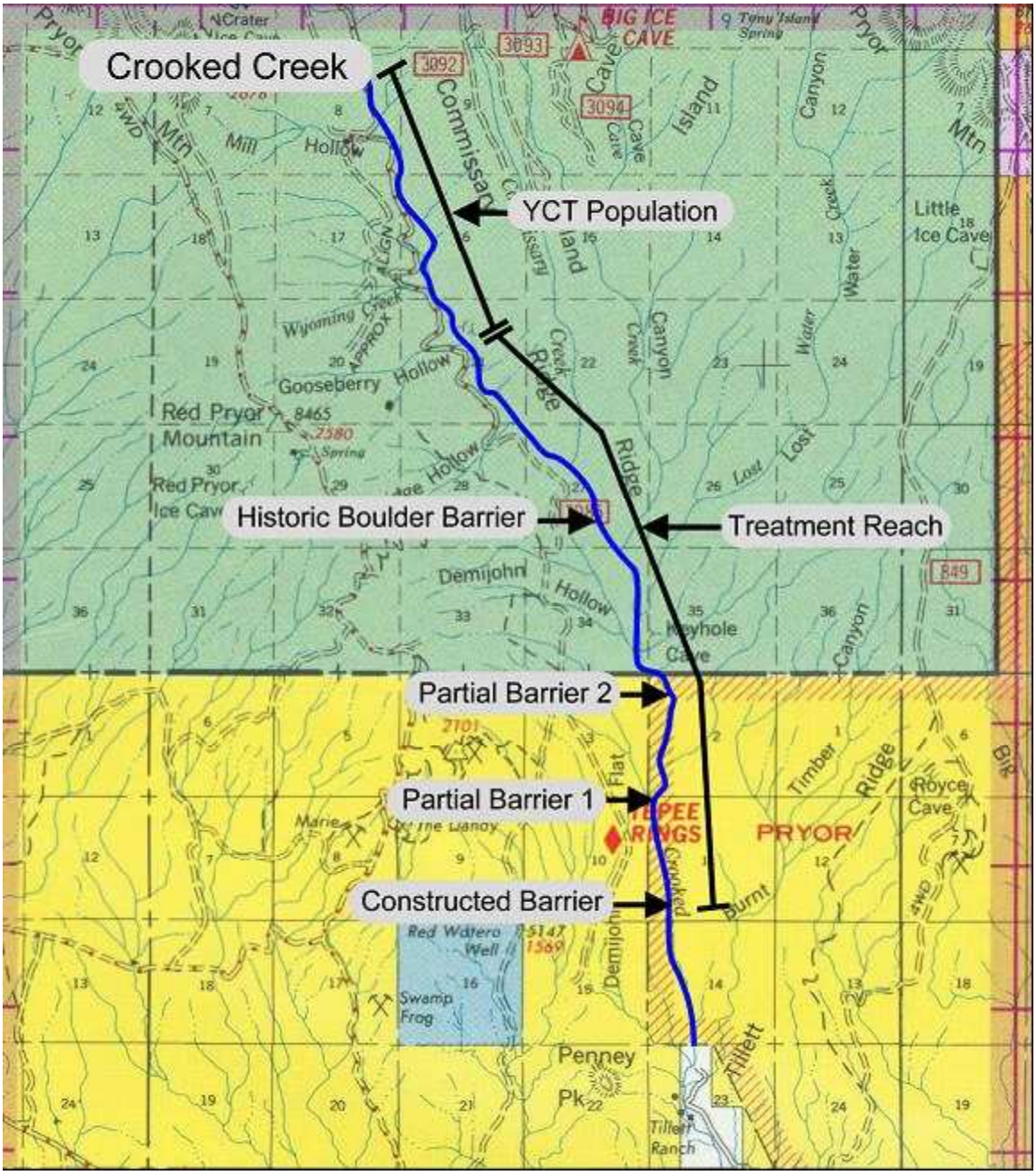

Figure 2: Map of Crooked Creek.

3.0 Alternatives Evaluated

The EA developed for this proposed action examined three alternatives. This chapter reiterates these alternatives, and describes modifications to address concerns presented in the public comment process. In addition, this section includes review of recent electrofishing data in order to evaluate the feasibility of the mechanical removal alternative in eliminating brown trout from above the constructed barrier.

3.1. Alternative 1: Chemical Removal of Brown Trout above the Permanent Barrier with Increased Mitigative Actions (Preferred Alternative)

This alternative involves the use of the piscicide rotenone to remove brown trout from above the constructed barrier. It differs from the preferred alternative presented in the EA in that additional mitigative actions would be implemented to decrease the spatial and temporal extent of toxic concentrations of rotenone in Crooked Creek. The primary detoxification station would be established immediately downstream of the constructed barrier, and a backup detoxification station would be established approximately 40 minutes of stream travel upstream of the boundary separating BLM from private land. Water flowing past the barrier would be automatically detoxified with potassium permanganate ($KMnO_4$). Additional $KMnO_4$ would be added at the backup detoxification station if sentinel fish show indications of toxicity. The EA called only for the lower, backup detoxification station. This modification would limit the fish kill to the reach of Crooked Creek upstream of the constructed barrier, and provide an additional safeguard to ensure toxic concentrations of rotenone do not reach private lands.

Another modification to the preferred alternative is an electrofishing effort implemented before treatment to reduce mortality of Yellowstone cutthroat trout from piscicide treatment. An electrofishing crew would shock about a mile of stream below Gooseberry Hollow. Yellowstone cutthroat trout caught in this effort would be moved above the treated reach. Electrofishing efforts in 2008 found Yellowstone cutthroat trout to be rare, but present in this reach. This mitigative action would minimize the number of incidental Yellowstone cutthroat trout deaths to piscicide treatment.

The original EA (FWP 2007) proposed to complete the initial treatment of Crooked Creek in the fall of 2007 with a follow-up treatment in 2008 if posttreatment monitoring indicated it was necessary. The timing of this entire process has now been set back by one year.

3.2. Alternative 2: No Action

Under the “no action” alternative, no further efforts would be made to remove brown trout from above the permanent barrier on Crooked Creek. Without mechanical or chemical removal, brown trout would thrive in the productive waters between the constructed barrier and the next barrier upstream. High flows would eventually cause the failure of this natural barrier, which would allow brown trout to invade the stronghold for the remaining Yellowstone cutthroat trout in Crooked Creek. Ultimately, brown trout would likely eliminate this remnant population through competition and predation. No benefits would be realized from the sizeable investment in barrier construction and associated fisheries management efforts.

3.3. Alternative 3: Mechanical Removal of Brown Trout above the Permanent Barrier

Mechanical removal of brown trout using electrofishing was an alternative rejected as infeasible in the original analysis. Subsequent removal efforts in 2008 have further confirmed the ineffectiveness of electrofishing in removing brown trout from Crooked Creek, as these efforts fail to result in a decrease of brown trout captured. In April of 2008, electrofishing crews captured and dispatched 33 brown trout in the reach slated for piscicide treatment. In August, 35 brown trout were removed from the project reach. Combined with previous fish removal efforts,

these results indicate electrofishing would not meet the project objectives, namely eradication of brown trout from above the constructed barrier.

4.0 Revised Environmental Review

This section is a revision of the environmental review presented in the EA prepared for brown trout removal. It presents much of the same information; however, it expands on review of the scientific literature, and includes safety information provided by manufacturers of chemicals that would be used.

4.1. Physical Environment

4.1.1. Land Resources

Land Resources Would the proposed action result in:	Impact Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Soil instability or changes in geologic substructure?		X				
b. Disruption, displacement, erosion, compaction, moisture loss, or over-covering of soil which would reduce productivity or fertility?		X				
c. Destruction, covering or modification of any unique geologic or physical features?		X				
d. Changes in siltation, deposition or erosion patterns that may modify the channel of a river or stream or the bed or shore of a lake?		X				
e. Exposure of people or property to earthquakes, landslides, ground failure, or other natural hazard?		X				

4.1.2. Air

Air Would the proposed action result in:	Impact Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Emission of air pollutants or deterioration of ambient air quality?		X				
b. Creation of objectionable odors?			X			2b
c. Alteration of air movement, moisture, or temperature patterns or any change in climate, either locally, or regionally?		X				
d. Adverse effects on vegetation, including crops, due to increased emissions of pollutants?		X				
e. Exposure of people or property to earthquakes, landslides, ground failure, or other natural hazard?		X				

Comments on 2b:
Alternative 1: Proposed Action

According to the material safety data sheet (MSDS) for CFT Legumine™, this compound has a slight solvent odor. Respiratory protection is required when working with undiluted product in a confined space. Likewise, the MSDS for n-methylpyrrolidone, an emulsifying agent in CFT Legumine™, does not require respiratory protection when handling in a well-ventilated area. As CFT Legumine™ will be applied outside, the objectionable solvent odor will likely dissipate rapidly, presenting a minor and temporary creation of objectionable odors. FWP personnel with experience applying CFT Legumine™ indicate it has only a very slight odor and is not disagreeable to work with.

Alternative 2: No Action
This alternative would not result in creation of objectionable odors, and would have no impact.

4.1.3. Water

Water	**Impact**					
Would the proposed action result in:	**Unknown**	**None**	**Minor**	**Potentially Significant**	**Can Impact Be Mitigated**	**Comment Index**
a. Discharge into surface water or any alteration of surface water quality including but not limited to temperature, dissolved oxygen or turbidity?			X		YES	3a
b. Changes in drainage patterns or the rate and amount of surface runoff?		X				
c. Alteration of the course or magnitude of flood water or other flows?		X				
d. Changes in the amount of surface water in any water body or creation of a new water body?		X				
e. Exposure of people or property to water related hazards such as flooding?		X				
f. Changes in the quality of groundwater?		X				3f
g. Changes in the quantity of groundwater?		X				
h. Increase in risk of contamination of surface or groundwater?			X		YES	see 3f
i. Effects on any existing water right or reservation?		X				
j. Effects on other water users as a result of any alteration in surface or groundwater quality?		X				3j
k. Effects on other users as a result of any alteration in surface or groundwater quantity?		X				
l. Would the project affect a designated floodplain?			X		YES	3l
m. Would the project result in any discharge that would affect federal or state water quality regulations? (Also see 2a)			X		NO	See 3a

Comments 3a: Discharge into surface waters
Alternative 1: Proposed Action
As this project proposes discharge of a piscicide into Crooked Creek, this impact would be unavoidable. Nonetheless, discussion of the nature of the piscicide, physical setting, and mitigative actions provide a framework to predict the severity and spatial extent of the impacts.

Rotenone is an insecticide commonly used in organic agriculture and home gardening, as well as being an effective piscicide. Rotenone is obtained by extraction from the roots and stems from a

variety of tropical and subtropical plants in the pea family (Fabaceae). The empirical formula of this isoflavonoid compound is $C_{23}H_{22}O_6$. Carbon comprises 70% of its molecular weight, and hydrogen and oxygen constitute 6% and 24% respectively. Compared to other piscicides, rotenone is relatively inexpensive and accessible, and has been routinely used to remove unwanted fish from lakes and streams. Rotenone acts by blocking the ability of tissues to use oxygen, which causes fish to asphyxiate quickly.

Rotenone is a highly reactive molecule, a factor favoring its quick decomposition in the environment. This degradability is in marked contrast to some pesticides used in nonorganic agriculture. Organochlorines are synthetic pesticides comprised of chlorinated hydrocarbons, and include chemicals such as DDT, heptachlor, and chlordane. These compounds persist in the environment long after their release, making the behavior and fate of organochlorine pesticides substantially different from rotenone.

Organophosphates are another class of pesticide that differs markedly from rotenone in terms of threats to human health and the environment. Commonly used organophosphate pesticides include malathion, parathion, and diazinon. Although these chemicals are considerably less persistent than the organochlorines, they are more acutely toxic, and act as potent neurotoxins. Organophosphate poisonings are one of the most common causes of poisoning worldwide. In contrast, rotenone does not share this acute toxicity to humans with the organophosphate pesticides.

CFT Legumine™, is the rotenone formulation proposed for this project. This chemical is registered by the EPA (Reg. No. 75338-2) and approved for use as a piscicide. Information on its chemical composition, persistence in the environment, risks to human health, and ecological risks come from a number of sources including material data safety sheets (MSDS) and manufacturer's instructions. (A MSDS is a form detailing chemical and physical properties of a compound, along with information on safety, exposure limits, protective gear required for safe handling, and procedures to handle spills safely.) In addition, a recent study presented an analysis of major and trace constituents in CFT Legumine™, evaluated the toxicity of each, and examined persistence in the environment (Fisher 2007).

The MSDS for CFT Legumine™ list three categories of ingredients for this formula (Table 1). Rotenone comprises 5% of CFT Legumine™ by weight. Associated resins account for 5%, and the remaining 90% are inert ingredients, of which the solvent n-methylpyrrolidone is a component. Additional information in the MSDS confirms its extreme toxicity to fish. The TVL addresses risks to human health from exposure, which is addressed in 8a.

Table 1: Composition of CFT Legumine™ from material safety data sheets (MSDS)

Chemical Ingredients	Percentage by Weight	CAS No.[1]	TLV[2] (Units)
Rotenone	5.00	83-79-4	5 mg/m^3
Other Associated Resins	5.00		
Inert Ingredients Including n-methylpyrrolidone	90	872-50-4	Not listed

[1]Chemical Abstracts Number
[2]A TLV reflects the level of exposure that the typical worker can experience without an unreasonable risk of disease or injury.

Fisher (2007) analyzed chemical composition of CFT Legumine™, including the inert fraction (Table 2). On average, rotenone comprised 5% of the formula, consistent with MSDS reporting. Other constituents were solvents or emulsifiers added to assist in the dispersion of the relatively insoluble rotenone. DEGEE, or diethyl glycol monoethyl ether, a water soluble solvent, was the largest fraction of the CFT Legumine™ analyzed. Likewise, methylpyrrolidone comprised about 10% of the CFT Legumine™. The emulsifier Fennedofo 99™ is an inert additive consisting of fatty acids and resin acids (by-products of wood pulp and common constituents of soap formulations), and polyethylene glycols (PEGs), which are common additives in consumer products such as soft drinks, toothpaste, eye drops, and suntan lotions. Trace constituents included low concentrations of several forms of benzene, xylene, and naphthalene. These organic compounds were considerably lower than measured in Prenfish, another commercially available formulation of rotenone, which uses hydrocarbons to disperse the piscicide. Their presence in trace amounts is related to their use as a solvent in extracting rotenone from the original plant material.

Table 2: Average percent concentrations and ranges of major constituents in CFT Legumine™ lots to be used in a piscicide project in California (Fisher 2007).

Major CFT Legumine™ Formula Constituent	***Rotenone***	***Rotenolone***	***Methylpyrrolidone***	***DEGEE[1]***	***Fennedefo 99™***
Average %	5.12	0.718	9.8	61.1	17.1
Range	4.64-5.89	0.43-0.98	8.14-10.8	58.2-63.8	15.8-18.1

[1]diethyl glycol monoethyl ether

Toxicity to nontarget organisms and persistence in the environment are key considerations in determining the potential risks to human health and the environment, and several factors influence rotenone's persistence and toxicity. Rotenone has a half-life of 14 hours at 24 °C, and 84 hours at 0 °C (Gilderhus et al. 1986, 1988), meaning that half of the rotenone is degraded and is no longer toxic in that time. As temperature and sunlight increase, so does degradation of rotenone. Higher alkalinity (>170 mg/L) and pH (>9.0) also increase the rate of degradation. Limited alkalinity data exist for Crooked Creek; however, streams draining limestone-dominated catchments, like Crooked Creek, are typically rich in calcium carbonate. High concentrations of calcium carbonate result in waters with high alkalinity and pH, which would favor rapid breakdown of rotenone. Rotenone tends to bind to and react with organic molecules rendering it

ineffective, so higher concentrations are required in streams with increased amounts of organic debris. Without detoxification, rotenone would be reduced to nontoxic levels in one to several days due to its degradation and dilution in the aquatic environment.

Mitigative activities proposed in this supplement will further reduce the spatial and temporal extent of rotenone. A detoxification station will be established immediately below the constructed barrier, which will release about 4 mg/L of $KMnO_4$. This strong oxidizer rapidly breaks down rotenone into nontoxic constituents of carbon, oxygen, and hydrogen. $KMnO_4$ in turn breaks down into potassium, manganese, and water, which are common constituents in surface waters, and have no deleterious effects at the concentrations used (Finlayson et al. 2000). The result of release of $KMnO_4$ on water quality will be elimination of toxic concentrations of rotenone. Instream concentration of KmnO4 will be measured during the detoxification procedure to assure that none of this chemical persists beyond the BLM property boundary with private land.

Concentration of rotenone in treated waters is another factor relating to potential effects from incidental ingestion by other organisms, including humans. The effective concentration of rotenone is 1 ppm or 1 mg/L, which is well below concentrations harmful to humans from ingestion. The National Academy of Sciences suggested concentrations at 14 ppm would pose no adverse effects to human health from chronic ingestion of water (NAS 1983). Moreover, concentrations associated with acute toxicity to humans are 300-500 mg per kilogram of body weight (Gleason et al. 1969), which means a 160-pound person would have to drink over 23,000 gallons in one sitting to receive a lethal dose (Finlayson et al. 2000). Similarly, risks to wildlife from ingesting treated water are low. For example, ¼ pound bird would have to consume 100 quarts of treated water, or more than 40 pounds of fish and invertebrates within 24 hours for a lethal dose (Finlayson et al. 2000). The US EPA, in their recent reregistration evaluation of rotenone (EPA 2007), concluded that there are no unacceptable risks to humans and wildlife from exposure to rotenone when applied according to label instructions. In summary, this project would have no adverse effect on humans or wildlife associated with ingesting water, dead fish, or dead invertebrates.

Bioaccumulation of rotenone would not result in threats to human health and the environment under this alternative. Rotenone can bioaccumulate in the fat tissues of fish that are not exposed to toxic levels (Gingerich and Rach 1985). As a complete fish-kill is the goal, bioaccumulation would not be a problem.

Potential toxicity and persistence of the other constituents of the CFT Legumine™ formulation are additional considerations. Proposed concentrations of n-methylpyrrolidone (about 2 ppm) would have no adverse effects to humans ingesting treated waters. According to the MSDS, ingestion of 1000 ppm per day for three months does not result in deleterious effects to humans. In addition, n-methylpyrrolidone will not persist in surface waters given its high biodegradability. In fact, this feature, combined with its low toxicity, makes methylpyrrolidone a commonly used solvent in wastewater treatment plants.

Fisher (2007) examined the toxicity and potential persistence of other major constituents in CFT Legumine™, including DEGEE, fatty acids, PEGs, and trace organic compounds, (benzene,

xylene, naphthalene). With proposed application of CFT Legumine™, none of these compounds would violate water quality standards, nor would they reach concentrations shown to be harmful to wildlife or humans. Furthermore, persistence of these chemicals was not a concern. The trace organics would degrade rapidly through photolytic (sunlight) and biological mechanisms. Likewise, the PEGs would biodegrade in a number of days. The fatty acids are also biodegradable, but would persist longer than the PEGs or benzenes. Nonetheless, these are not toxic compounds, so the relatively longer persistence would not adversely affect water quality. Overall, the low toxicity, low persistence, and lack of bioaccumulation indicate the inert constituents in CFT Legumine™ would have a minor and temporary effect on water quality.

To reduce the potential risks associated with the use of CFT Legumine™, the following management practices, mitigation measures, and monitoring efforts would be employed:

1. A pretreatment bioassay would be conducted to determine the lowest effective concentration and travel time.
2. Signs will be posted at trailheads and along the stream to warn people not to drink the water or consume dead fish.
3. Piscicides would be diluted in water and dripped into the stream at a constant rate using a device that maintains a constant head pressure.
4. A detoxification station would be set up downstream of the target reach. Potassium permanganate ($KMnO_4$) would be used to neutralize the piscicide at this point.
5. An additional detoxification will be established above the boundary between BLM and private land to as a safeguard.
6. Project personnel would be trained in the use of these chemicals including the actions necessary to deal with spills as prescribed in the MSDS for CFT Legumine™
7. Persons handling the piscicide would wear protective gear consistent exposure control/personal protection gear as prescribed in the MSDS for CFT Legumine™.
8. Only the amount of piscicide and potassium permanganate that is needed for immediate use would be held near the stream.
9. Sentinel or caged fish would be located below the detoxification station and within the target reach to determine and monitor the effectiveness of both the rotenone and potassium permanganate. Yellowstone cutthroat trout obtained from a state hatchery would be the species used in monitoring toxicity.

Alternative 2: No Action
This alternative would have not result in discharge into surface water and would have no impact.

Comment 3f: Changes in groundwater quality
Alternative 1: Proposed Action
The risk that rotenone would enter and be mobile in groundwater is minimal because it has a strong tendency to bind to organic soil particles (Dawson et al. 1991), and has a low solubility in water. Once bound to organic molecules, rotenone becomes inert and breaks down quickly in the environment without detoxification. Moreover, rotenone would be detoxified with $KMnO_4$ at the downstream boundary of the project. Even if groundwater contamination did occur, no consequences for human health would occur because the surface water concentrations to be used in this project have already been shown to have no toxic effect on humans or other mammals

(see 2a). Furthermore, the chance for exposure to rotenone is minimal given the location of domestic water sources. The following factors suggest very little, if any, rotenone would reach any wells:

1. Virtually all piscicide that reaches these points would have already been broken down by natural conditions or been oxidized by KMnO4;
2. Any remaining piscicide would likely be bound up by sediments before entering groundwater; and
3. Any piscicide that enters groundwater would be diluted by water already present in the aquifer.
4. Monitoring of domestic wells adjacent to previous rotenone treatments in Montana and California has failed to detect rotenone or any inert ingredients.

Alternative 2: No Action
This alternative would have no impact of groundwater.

Comment 3j: Effects on other water users
Timing piscicide application for fall would result in no effects on other water users. Swimming and irrigation are the only uses with potential to be affected by rotenone. Swimming in rotenone treated water is prohibited until the chemical has been thoroughly mixed. Crops should not be irrigated with rotenone treated water because of potential effects on beneficial invertebrates. As swimming and irrigation are unlikely in October, this action would have no effect on these uses.

4.1.4. Vegetation

Vegetation	Impact					
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Changes in the diversity, productivity or abundance of plant species (including trees, shrubs, grass, crops, and aquatic plants)?		X				
b. Alteration of a plant community?		X				
c. Adverse effects on any unique, rare, threatened, or endangered species?		X				4c
d. Reduction in acreage or productivity of any agricultural land?		X				
e. Establishment or spread of noxious weeds?			X		YES	4e
f. Would the project affect wetlands, or prime and unique farmland?		X				

Comments 4c: Adverse effects on any unique, rare, threatened, or endangered species?
The Pryor Mountains are home to numerous rare and endemic species of plant. The Montana Natural Heritage Program maintains a database of plant species of special concern, and several have been observed within the townships and ranges encompassed within the project area. Project timing, slated for fall, would be outside the sensitive reproductive stages of these special plants; therefore, the proposed action would have no impact on plant species of special concern.

COMMENT 4e: Establishment or spread of noxious weeds

Alternative 1: Proposed Action
Trucks and four wheelers transporting gear and personnel have potential to spread noxious weeds from seeds transported in the undercarriage. To mitigate and reduce the risk of invasion or spread of noxious weeds, all vehicles would be cleaned before arrival on site, including an undercarriage wash.

Alternative 2: No action.
This alternative would have no effect on spread on establishment or spread of noxious weeds.

4.1.5. Fish and Wildlife

Fish and Wildlife Would the proposed action result in:	Unknown	Impact None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Deterioration of critical fish or wildlife habitat?		X				
b. Changes in the diversity or abundance of game animals or bird species?			X		YES	5b
c. Changes in the diversity or abundance of nongame species?			X		NO	5c
d. Introduction of new species into an area?		X				
e. Creation of a barrier to the migration or movement of animals?		X				
f. Adverse effects on any unique, rare, threatened, or endangered species?			X		YES	5f
g. Increase in conditions that stress wildlife populations or limit abundance (including harassment, legal or illegal harvest or other human activity)?		X				
h. Would the project be performed in any area in which T&E species are present, and would the project affect any T&E species or their habitat? (Also see 5f)		X				
i. Would the project introduce or export any species not presently or historically occurring in the receiving location? (Also see 5d)		X				

Comment 5b: Changes in the diversity or abundance of game animals or bird species?
Alternative 1: Preferred Action
This proposed action would alter fish community composition in Crooked Creek. Currently, this portion of Crooked Creek supports low numbers of Yellowstone cutthroat trout and nonnative brown trout. This project would remove these species; however, recolonization of native Yellowstone cutthroat trout from upstream would mitigate loss of nonnative brown trout.

As discussed in 4.1.3 Water, exposure to rotenone through ingestion of treated water or dead fish presents no threat to wildlife because of its low toxicity when ingested. Nonetheless, reductions in aquatic prey species, both fish and sensitive macroinvertebrates, may have a negative effect on species relying on prey of aquatic origin. In the case of animals relying on fish for a significant portion of their diets, fish densities are currently low in the treatment reach because of catastrophic debris flows that eliminated most of the fish present. Therefore, this reach is unlikely to support fish-consuming predators to an appreciable degree. Of course, ultimate recolonization of Yellowstone cutthroat trout from the upper watershed will support reestablishment of populations of mammals and birds that consume fish.

Invertivorous birds would also have potential to be affected by reductions in macroinvertebrate populations. The American dipper (*Cinclus mexicanus*) is the species typically considered in effects analysis relating to rotenone treatment, as this species consumes benthic macroinvertebrates as its primary food source. The NHP does not extend the breeding range of the American dipper into the Pryor Mountains, although another source provides incidental evidence of dippers breeding in the general area (Bergeron et al. 1992). If present in the Crooked Creek watershed, impacts on dippers would be minor and temporary. First, not all invertebrates would succumb to piscicide treatment, resulting in a remaining forage base in treated waters. In addition, macroinvertebrate populations recover biomass rapidly following this type of disturbance, making the decrease in forage availability a short-term alteration. Project timing would also limit the effect on other invertivorous birds, as many of these migratory species would not be present in October.

Implementing the project in fall would also avoid potential effects on bats and birds that consume aerial invertebrates with an aquatic life history stage. These species would be hibernating or have migrated to their overwintering grounds. Therefore, impacts on these animals would be negligible.

Alternative 2: No Action
This alternative would have no impact on game or bird species.

Comment 5c: Changes in the diversity or abundance of nongame species?
Alternative 1: Proposed Action
In addition to the nonnative game species targeted for removal, Crooked Creek likely supports numerous vertebrates, primarily reptiles and amphibians, and associated aquatic life such as benthic macroinvertebrates. Rotenone is toxic to organisms that respire through gills, which include fish, larval amphibians, and some macroinvertebrates such as mayflies, caddis flies, and stoneflies.

One predicted effect would be a temporary decrease in some invertebrate taxa. These populations rebound quickly from many types of disturbance through two primary mechanisms. Invertebrates drift as a normal component of their life history strategies, so untreated, fishless headwaters would provide a source of invertebrates. Likewise, aerial adults would supplement drift by laying eggs in Crooked Creek allowing for recovery of sensitive invertebrates within one year. Additionally, applying piscicide in October would coincide with relatively low numbers of gilled invertebrates, as most would have emerged to complete their life cycle. A large proportion of taxa will be present in the stream as eggs, which are tolerant of rotenone.

Timing piscicide treatment in October would result in insignificant impacts on amphibians and reptiles that use Crooked Creek for foraging or reproduction. These would not be exposed to rotenone, as they would be hibernating. In addition, as discussed in 5b, timing would limit impacts on their invertebrate prey base.

Comment 5c: Adverse Effects on Any Rare, Threatened or Endangered Species?

The Montana Natural Heritage Program lists a number of mammals, birds, and reptiles with special status as being present in the townships and ranges through which Crooked Creek flows (Table 3). None of these species consume fish or invertebrates with an aquatic life history stage. Most are migratory, or would be hibernating during treatment, so they would not be affected by the proposed action. The Merriam's shrew and greater sage grouse are nonmigratory, and active in the fall; however, their preferred habitat is sagebrush steppe, so the proposed action would not have an influence on these species.

Yellowstone cutthroat trout is another species of special concern in the project area. This project has potential to result in mortality of small numbers of Yellowstone cutthroat trout; however, the overall impact would be beneficial with removal of nonnative brown trout. Electrofishing the treated reach before applying piscicide and moving any Yellowstone cutthroat trout captured above Gooseberry Hollow would reduce incidental mortality on this native fish.

Table 3: Species of special concern documented within the townships and ranges

Group	Scientific Name	Common Name	Global Rank	State Rank	USFS	BLM
Mammals	*Antrozous pallidus*	Pallid Bat	G5	S2	Sensitive	Sensitive
Mammals	*Corynorhinus townsendii*	Townsend's Big-eared Bat	G4	S2	Sensitive	Sensitive
Mammals	*Euderma maculatum*	Spotted Bat	G4	S2	Sensitive	Sensitive
Mammals	*Myotis thysanodes*	Fringed Myotis	G4G5	S3		Sensitive
Mammals	*Sorex merriami*	Merriam's Shrew	G5	S3		
Birds	*Calcarius ornatus*	Chestnut-collared Longspur	G5	S3B		Sensitive
Birds	*Centrocercus urophasianus*	Greater Sage-Grouse	G4	S3	Sensitive	Sensitive
Birds	*Charadrius montanus*	Mountain Plover	G2	S2B		Sensitive
Birds	*Oreoscoptes montanus*	Sage Thrasher	G5	S3B		Sensitive
Birds	*Polioptila caerulea*	Blue-gray Gnatcatcher	G5	S1B	Sensitive	Sensitive
Birds	*Spizella breweri*	Brewer's Sparrow	G5	S2B		Sensitive
Reptiles	*Phrynosoma hernandesi*	Greater Short-horned Lizard	G5	S3	Sensitive	Sensitive
Reptiles	*Sceloporus graciosus*	Common Sagebrush Lizard	G5	S3		
Fish	*Oncorhynchus clarki bouvieri*	Yellowstone cutthroat trout	G4T2	S2	Sensitive	Sensitive

4.2. Human Environment

4.2.1. Noise and Electric Effects

	Impact					
Would the proposed action result in:	**Unknown**	**None**	**Minor**	**Potentially Significant**	**Can Impact Be Mitigated**	**Comment Index**
a. Increases in existing noise levels?		X				
b. Exposure of people to serve or nuisance noise levels?		X				
c. Creation of electrostatic or electromagnetic effects that could be detrimental to human health or property?		X				
d. Interference with radio or television reception and operation?		X				

4.2.2. Land Use

Would the proposed action result in:	Impact: Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Alteration of or interference with the productivity or profitability of the existing land use of an area?		X				
b. Conflicted with a designated natural area or area of unusual scientific or educational importance?		X				
c. Conflict with any existing land use whose presence would constrain or potentially prohibit the proposed action?		X				
d. Adverse effects on or relocation of residences?		X				

4.2.3. Risks/Health Hazards

Would the proposed action result in:	Impact: Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Risk of an explosion or release of hazardous substances (including, but not limited to oil, pesticides, chemicals, or radiation) in the event of an accident or other forms of disruption?			X		YES	8a
b. Affect an existing emergency response or emergency evacuation plan or create a need for a new plan?		X				
c. Creation of any human health hazard or potential hazard?			X		YES	see 8c
d. Would any chemical piscicides be used?			X		YES	see 8a and 3a

Comment 8a: Risk of explosion or release of hazardous substances
Alternative 1: Proposed Action
Use of rotenone constitutes a release of a substance hazardous to fish and other gill-respiring organisms. See comments 3a on risks to the environment and human health, and mitigative actions to minimize adverse effects.

MSDSs for CFT Legumine™ and $KMnO_4$, describe risks of explosion for these compounds. With a flashpoint of 192 °F (89 °C), CFT Legumine™ has a low risk of combustion or explosion. Special caution is required for transporting and using materials with a flashpoint of less than 140 °F (60 °C). Nevertheless, foam or CO_2 fire extinguishers would be available during transport and handling or undiluted product. $KMnO_4$ is nonflammable, but has an explosion hazard when in contact with organic or readily oxidizable compounds. Such materials would not be at the project site, which eliminates the risk of explosion from $KMnO_4$ reacting with other chemicals.

Alternative 2: No Action
This alternative presents no risk of explosion or release of hazardous substances.

Comment 8b: Creation of a human health hazard or potential hazard.

Alternative 1: Proposed Action

Hazards to human health relate to handling non-dilute CFT Legumine™ and $KMnO_4$. (As described in 4.1.3 Water, application of CFT Legumine™ or $KMnO_4$ to surface waters according manufacturer's instructions does not present a risk to human health from exposure to treated water.) To prevent health risks associated with skin contact and inhalation, workers handling full strength CFT Legumine™ would follow exposure controls/personal protection requirements detailed in the MSDS and the label. Workers with potential to be exposed to non-dilute CFT Legumine™ would wear chemical resistant gloves, boots, protective eyewear and respirators.

$KMnO_4$ presents a potential human health hazard with skin contact, inhalation, or ingestion. Personnel working with the non-dilute product would follow safety practices detailed in the MSDS for KMnO4. This includes gloves and eye protection.

Accidental spills present another potential avenue for threats to human health from either CFT Legumine™ or KMnO4. In the event of a spill, workers would follow accidental release measures detailed in the MSDSs for each compound, which involve containment and disposal Protective eyewear and gloves are required to handle spills.

Alternative 2: No Action

This alternative would not create a human health hazard or potential hazard.

4.2.4. Community Impact

Would the proposed action result in:	Impact					
	Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Alteration of the location, distribution, density, or growth rate of the human population of an area?		X				
b. Alteration of the social structure of a community?		X				
c. Alteration of the level or distribution of employment or community or personal income?		X				
d. Changes in industrial or commercial activity?		X				
e. Increased traffic hazards or effects on existing transportation facilities or patterns of movement of people and goods?		X				

5.0 Conclusions

Reclaiming streams for native fish using piscicide is an important conservation tool for fisheries managers, and several of these projects occur in Montana each year. Nevertheless, release of toxic chemicals into the environment should be undertaken cautiously, and with full examination of the potential risks to human health and the environment. Furthermore, applicators should be stringent in following manufacturer's instructions and implementing safety measures designed to minimize environmental risks.

Revising the preferred alternative to require detoxification immediately below the constructed barrier is a significant improvement over the original approach. This mitigative measure would decrease the spatial and temporal extent of the fish kill in Crooked Creek, limiting it to the reach above the barrier. Moreover, employing sentinel fish and a second, back-up detoxification station downstream, would provide an additional safeguard against presence of rotenone in reaches flowing through private lands.

Reevaluation of the scientific literature reaffirmed the conclusion from the EA that the proposed action would have minor and temporary impacts on the environment, and that use of rotenone would not put human health at risk. Rotenone breaks down rapidly into its nontoxic constituents of carbon, hydrogen and oxygen. In addition, its toxicity is specific to fish and other gill respiring organisms, meaning humans and other organisms will not be affected. The inert ingredients in the formulation to be used are nontoxic and degrade rapidly.

Finally, reexamination of the use of mechanical removal as an alternative to piscicide indicated this approach would not meet project objectives. Repeated mechanical removals have not resulted in a decrease in brown trout above the barrier. Fish eluding capture would continue to thrive and reproduce in Crooked Creek, which would eventually threaten the pure Yellowstone cutthroat trout population upstream.

6.0 Literature Cited

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