Montana Fish, Wildlife & Parks

2300 Lake Elmo Drive
Billings, MT 59105
January 5, 2004

TO:

Environmental Quality Council
Director's Office, Dept. of Environmental Quality
Montana Fish, Wildlife & Parks

Director's Office	Wildlife Division
Resource Assessment	Design & Construction
Fisheries Division	Legal Unit
Parks Division	Lands Section
Regional Supervisors	Piscicide Committee

Montana Historical Society, State Preservation Office
Janet Ellis, Montana Audubon Council
Montana Wildlife Federation
Montana State Library
George Ochenski
Commissioner Dan Walker
Montana Environmental Information Center
U.S. Fish and Wildlife Service
American Fisheries Society, Montana Chapter
Yellowstone River Parks Association
Magic City Fly Fishers
Federation of Fly Fishers
Walleyes Unlimited, Billings Chapter
Montana Pike Masters, Billings Chapter
Adjacent Landowners
Montana State University Foundation
Montana State University – Veterinary Molecular Biology

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LEGISLATIVE ENVIRONMENTAL
POLICY OFFICE

Ladies and Gentlemen:

The enclosed Environmental Assessment (EA) is submitted for your consideration. It was prepared for the proposed chemical treatment of Otie Reservoir in Stillwater County as part of an effort to establish a self-sustaining population of Yellowstone cutthroat trout in the pond. This treatment will target white suckers present in the pond that have repeatedly become over-abundant causing reduced growth of desired trout species. A short section of Unnamed tributary of the North Fork Grove Creek upstream of the reservoir will be restored to facilitate Yellowstone cutthroat spawning.

Any questions or comments on this project should be addressed to the undersigned by February 20, 2004.

Sincerely,

Jim Darling

Jim Darling
Regional Fisheries Manager
(406) 247-2961
e-mail jdarling@state.mt.us

MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

ENVIRONMENTAL ASSESSMENT OF THE CHEMICAL TREATMENT OF OTIE RESERVOIR AND RESTORATION AND ENHANCEMENT OF AN UNNAMED TRIBUTARY OF THE NORTH FORK GROVE CREEK

PART 1. PROPOSED ACTION DESCRIPTION

A: Type of Proposed Action: Otie Reservoir (T4S R17E S 14&15) is an impoundment on an unnamed tributary of the North Fork Grove Creek that covers approximately 3.0 surface acres at full pool. The reservoir is on private ground and is used for irrigation and stock water. Historically, Montana Fish, Wildlife and Parks (MFWP) Region 5 and the landowner have maintained an agreement to provide access for fisheries management and public fishing at the reservoir. Currently the fish species present include rainbow trout, white suckers and lake chubs. Historically brook trout were present in the reservoir and Yellowstone cutthroat trout were stocked once, but neither has been found in recent samplings. Historically and presently, the white sucker population has reached high numbers causing reduced growth of target species (i.e., trout). Mechanically removing white suckers from the reservoir has proven effective at temporarily enhancing trout growth, but ineffective at reducing long-term sucker numbers. Therefore, MFWP is proposing to renovate the reservoir by chemically removing all fish using rotenone, and subsequently restocking the reservoir with Yellowstone cutthroat trout (YCT).

The unnamed tributary of the North Fork Grove Creek that feeds the reservoir is a spring-fed stream that originates approximately 0.25 miles upstream of the reservoir. Livestock grazing, most recently by sheep, has heavily impacted the stream. Degraded habitat and the lack of gravels in the feeder stream upstream of the reservoir appears to have precluded successful salmonid spawning in the past. The stream banks are heavily grazed and trampled, leaving the channel overwidened and choked with fine sediment. The property upstream of the reservoir is owned by Montana State University, co-managed by the Veterinary Molecular Biology and the Montana State University Foundation, and leased to a sheep producer. MFWP is proposing to restore the degraded habitat upstream of the reservoir to aid in salmonid spawning.

1. **Project Goal:** Successful conversion of Otie Reservoir to Yellowstone cutthroat trout and elimination of the white sucker population. Enhancement of the feeder stream to facilitate salmonid spawning. Successful establishment of a self-sustaining population of Yellowstone cutthroat trout, which could facilitate restoration of YCT to the Grove Creek.

Project Phase	Expected Completion Date
Phase 1. Repair of outlet structure on reservoir so it can be filled and drained as desired	Nov/03
Phase 2. Obtain and summarize data and complete Environmental Assessment for reservoir rehabilitation and creek restoration	Nov/03
Public comment period for EA	Jan/04-Feb/04
Obtain necessary permits for chemical treatment	Feb/04
Phase 3. Draw down reservoir and chemically treat reservoir and upper feeder stream	Feb/04-Mar/04
Phase 4. Fence feeder stream and begin filling reservoir	Spring 2004
Phase 5. Restock Reservoir with YCT	Sep/04-Oct/04
Phase 6. Restore feeder stream by manipulating channel and adding gravels to create spawning areas for YCT. Construct structure in the feeder stream to selectively preclude suckers from reaching spawning areas, should chemical removal not be entirely successful.	2004-2007
Phase 7. Monitor spawning and recruitment of YCY trout. Monitor presence/absence of white suckers	2006-2010

B. Agency Authority for the Proposed Action: The Montana Fish, Wildlife & Parks (FWP) "...is hereby authorized to perform such acts as may be necessary to the establishment and conduct of fish restoration and management projects..." under statute 87-1-702.

C. Estimated Commencement Date: Fall 2003.
Estimated Completion Date: Fall 2007 (excluding monitoring)

D. Name and Location of the Project: Chemical Treatment of Otie Reservoir Restoration and Enhancement of an Unnamed Tributary to North Fork Grove Creek. Location: T4S R17E S 14&15, Stillwater County, Southwest of Absarokee.

E. Project Size (acres affected)

1. Developed/residential – 0 acres

2. Industrial – 0 acres
3. Open Space/Woodlands/Recreation – 3 acre private pond
4. Wetlands/Riparian – 0.25 miles of stream and 3 acre pond
5. Floodplain – 0.25 miles of stream will be restored and enhanced for trout spawning
6. Irrigated Cropland - 0 acres
7. Dry Cropland – 0 acres
8. Forestry – 0 acres
9. Rangeland – By fencing off the stream, approximately 5-8 acres will be excluded from grazing
10. Other – 0 acres

F. Narrative Summary of the Proposed Action and Purpose of the Proposed Action.

1. **Summary of the Proposed Action**:

Otie Reservoir was originally stocked in 1983 with 2,174 catchable (9.0 inch) McBride strain Yellowstone cutthroat trout. Eagle Lake rainbow trout were stocked in 1986, 1989, 1991, and 1999. Boom electrofishing on October 20, 2003 yielded several hundred white suckers, 6 rainbow trout (age 4, 16 to 18 inches long) and lake chub. Brook trout may have been planted in the stream historically, but are no longer present in the reservoir. In the past, efforts have been made to remove white suckers from the lake, but current surveys yielded a minimum of 4 year-classes of white suckers and a ratio of approximately 3 trout to 50 suckers. While limited trout spawning may have occurred in the feeder stream historically, we found no evidence of naturally produced trout in the reservoir or stream. However, white sucker spawning is not limited by the habitat conditions in the feeder stream. Adequate spawning habitat and the lack of an effective predator in the reservoir has caused chronic overpopulation of this species, leading to reduced trout growth.

Because the high numbers of white sucker and the unsuccessful efforts of mechanical removal in the past, MFWP is proposing to chemically treat Otie Reservoir with rotenone to remove white suckers and rainbow trout and convert the reservoir to a Yellowstone cutthroat trout (YCT) fishery. Rotenone is a commonly used piscicide that is very effective at killing fish at low concentrations. Rotenone is a naturally occurring substance that is derived from tropical plants from the bean family. It kills fish by inhibiting respiration at the cellular level. It enters the fish's body through the gills and goes into the blood stream. The concentrations used to kill fish are low, usually 1 ppm (parts per million or one part rotenone solution to 1,000,000 parts water). Because of the low concentration of rotenone in the water there is very little risk to human or animal health. At this concentration, a person would have to drink 26,000 gallons of water at one time to have an effect (American Fisheries Society Publication). Rotenone is not readily absorbed through the stomachs of vertebrates or other animals, so there is little risk to wildlife that consume treated waters or consume fish killed by rotenone. Invertebrates and larval amphibians are affected by rotenone, but populations have been shown to quickly recover following treatment (see pages 12-13 and Appendix 1 for more specific information). It is anticipated that Otie Reservoir will be treated in the early spring before amphibians have emerged from winter hibernation, which potentially may reduce the exposure to the chemical. Rotenone does not affect aquatic plants at fish-killing concentrations. Rotenone also degrades

readily in the environment, the rate of which depends on temperature, alkalinity, sunlight and other factors, but rarely does it persist more than a few weeks (see pages 9-10). Rotenone also readily binds to soil particles where it is naturally broken down, so the risk of contaminating ground water supplies is minimal (see Appendix 1 for more information). Studies conducted adjacent to rotenone-treated waters failed to show the presence of the chemical in the ground water. If needed, rotenone can also be quickly neutralized using potassium permanganate ($KMnO_4$).

To reduce the amount of rotenone to be applied, and reduce the probability that any chemical will escape downstream of Otie Reservoir, the reservoir will be lowered to near or at its lowest possible level. The reservoir drainpipe will then be completely closed and no water will be allowed to escape the pond. At this low level and with the drain completely closed, the rotenone will be applied to the pond. All label requirements for rotenone application to ponds and streams will be followed along with the regulations set forth by the Montana Department of Agriculture. Only certified applicators and trained operators will be allowed to assist in the chemical treatment of the reservoir. At low pool, the quantity of water (acre-feet) in the reservoir will be calculated to determine the correct amount of rotenone to apply to reach a concentration of 1 ppm (part per million). According to the product label, this concentration of rotenone should produce a successful fish kill; however, the fish kill will be monitored during the treatment uisgn gill nets and if 1 ppm is not sufficient to produce a 100% fish kill, the concentration of rotenone will be incrementally increased. Prentox Prenfish brand rotenone (5% active ingredient) will be used for the project. Two potential treatment dates are planned for Otie Reservoir: the first is early spring while ice covered and the second is after irrigation season in the fall. Rotenone will be applied to the reservoir from a motorized boat, or through holes drilled in the ice if still ice covered. Pumps will be used to distribute the rotenone throughout the water column if the chemical is applied through the ice. It is anticipated that the pond will fill to the top of the spillway in no less than 2 months after rotenone is applied. The concentration of rotenone in the reservoir will be monitored during this time using sentinel fish placed in nets in the reservoir. No water will be allowed to leave the reservoir until sentinel fish can survive in the reservoir for at least 48 hours, indicating that the rotenone has naturally broken down. Gill nets will be set post treatment to monitor for the presence of live fish. As a precaution, a $KMnO_4$ detoxification station will be available onsite to detoxify any treated water that may escape over or through the dam. To monitor for the presence of rotenone below the dam, sentinel fish will be placed downstream of the dam in a large complex of beaver dams and at the confluence of the outlet of Otie Reservoir and the North Fork Grove Creek.

To kill fish that may attempt to avoid the poison by entering the feeder stream to the reservoir and to kill any resident fish in the creek, a rotenone drip station will be placed at the head of the creek approximately 0.25 miles upstream of the reservoir. Rotenone will be dripped into the stream at a constant rate to produce a concentration of 1.0 ppm in the stream water according to the rotenone label. The drip station will run for a minimum of two days or until the rotenone applied to the reservoir is thoroughly mixed to ensure that no untreated water enters the reservoir to provide a refuge for target fish. A sentinel cage of fish will be placed in the stream at the inlet of the reservoir to insure the rotenone in the stream is still at fish-killing concentrations. If the rotenone applied to the stream is naturally broken down before it reaches the reservoir, a second drip station will be established on the stream.

We anticipate that a single treatment will eradicate rainbow trout and white suckers from Otie Reservoir. In other systems, however, a second treatment has been used when the first failed to produce a 100% fish kill. After the treatment is complete, nets will be set to check for the presence of white suckers and rainbow trout. If present, a second treatment may be warranted. If a second treatment is performed, the same procedures will be followed.

Following the chemical removal of rainbow trout and white suckers, the reservoir will be restocked with Yellowstone cutthroat trout (YCT). The goal of the project is to establish a self-sustaining population of cutthroat trout in the reservoir. The LeHardy Rapids strain or McBride Lake strain of cutthroat trout will be used to restock the reservoir. A minimum of 3 age classes of fish will be stocked into the reservoir to ensure adequate age class structure for future natural spawning and recruitment.

To improve the habitat in the feeder stream to Otie Reservoir to provide for YCT spawning and rearing, FWP in cooperation with Montana State University proposes to construct a fenced exclosure around the feeder stream to the reservoir to aid in the recovery of riparian vegetation. Past livestock grazing has substantially impacted the riparian area and aquatic habitat. A small livestock watering pond will be constructed near the head of the spring to provide for a watering area. By excluding livestock, vegetation will recover, narrowing the channel, providing additional shade and cover, and minimizing sedimentation of spawning gravels. In addition, minor channel reconstruction may be required to encourage a single thread channel to develop in heavily impacted areas. In key locations such as pool tailouts, gravel will be imported to provide suitable substrate for spawning. Habitat features will be enhanced to provide for spawning and rearing areas for YCT. Finally, a culvert just upstream of the reservoir will be replaced with a culvert modified to provide a selective fish migration barrier and/or fish trap.

Summary of Project Objectives:

1. Renovate reservoir to remove white suckers and remnant rainbow trout;
2. Restock appropriate strain of YCT;
3. Create fenced livestock exclosure with watering pond to allow stream banks to revegetate and restore proper stream dimensions while minimizing sedimentation of spawning gravels;
4. Replace culvert in inlet stream to provide selective passage barrier and trap to limit sucker spawning, if treatment does not produce a 100% fish kill;
5. Restore and enhance the feeder stream by performing minor channel alterations and importing gravels to facilitate spawning and rearing.

2. Purpose and Need for the Proposed Action:

The purpose of the project is to establish a self-sustaining population of YCT in Otie Reservoir and eliminate white suckers from the pond. Otie Reservoir has provided an important recreational fishery in the past. Because of the chronic overpopulation of the reservoir with white suckers, however, trout growth has been reduced. The reservoir is also located near the

upper end of North Fork Grove Creek. Grove Creek has historically supported a YCT population, but the current status of that population is unknown. Renovating Otie Reservoir and converting it to YCT will lessen the probability of rainbow trout escaping from the reservoir and populating Grove Creek downstream, and potentially hybridizing with cutthroats.

3. Benefits of the Project:

By eliminating white suckers and establishing a self-sustaining population of YCT, the reservoir will once again provide a valuable recreational fishery. Small, mid-elevation reservoir fisheries that are accessible to the public are rare in Stillwater County and surrounding areas. The reservoir is approximately 15 miles from the town of Absarokee. Through the agreement with the landowner, the public has had continued access to the pond and will continue to have access to the pond and to a greatly improved fishery as a result of this project. By using the native cutthroat trout in the reservoir, this drainage may serve as a source population for colonizing fish in Grove Creek. In turn, this project will help achieve the goals and objectives listed in the Cooperative Conservation Agreement for YCT within Montana for the restoration of YCT both statewide and locally. The potential for YCT to be listed under the Endangered Species Act will be reduced or eliminated through implementation of this and other similar projects. The social benefit of this effort will be the ability of future generations of Montanans to use and enjoy this unique native fish species. This project may also aid in future recovery and restoration efforts in North Fork Grove Creek and main Grove Creek downstream.

G. Other Local, State or Federal agencies with overlapping jurisdiction.

Montana Department of Agriculture
Montana Department of Environmental Quality
Montana State University
U.S. Army Corps of Engineers
Stillwater Conservation District
Stillwater County Floodplain Administrator

H. Agencies Consulted During the Preparation of the EA

Montana Department of Environmental Quality. John Wadhams, Helena, MT.
Montana Department of Agriculture

PART II. ENVIRONMENTAL REVIEW

A. PHYSICAL ENVIRONMENT

1. LAND RESOURCES Will 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		Yes	1a
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		Yes	1a
e. Exposure of people or property to earthquakes, landslides, ground failure, or other natural hazard?		X				

Comment 1a. Fencing and stream restoration activities on the feeder stream upstream of Otie Reservoir will result in increased soil stability and improved fish habitat. By excluding livestock grazing from much of the riparian area, the streambank vegetation will improve, causing increased bank stability and natural narrowing of the stream channel. In areas severely impacted by grazing, some minor channel changes will likely be made to decrease the width to depth ratio and accelerate the natural recovery of the stream. Gravels will be imported and added to the stream to facilitate YCT spawning. Log or rock drop structures may be used to create rearing habitat and to aid in maintaining clean gravels for YCT spawning.

2. WATER Will the proposed action result in:	IMPACT 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	2a
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		YES	2f
g. Changes in the quantity of groundwater?		X				

2. WATER (continued) Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
h. Increase in risk of contamination of surface or groundwater?			X		YES	see 2f
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		YES	2j
k. Effects on other users as a result of any alteration in surface or groundwater quantity?		X				
l. Will the project affect a designated floodplain?			X		YES	2l
m. Will the project result in any discharge that will affect federal or state water quality regulations? (Also see 2a)			X		YES	see 2a

Comment 2a. Rotenone is commonly used in agriculture and home gardening as well as being an effective fish toxicant. It is relatively inexpensive, compared to other piscicides, and has been routinely used in lake and pond rehabilitation. Rotenone acts by blocking the ability of tissues to use oxygen. Fish quickly asphyxiate in the presence of fish-killing concentrations of the poison. Rotenone is not a carcinogen, although the carcinogen TCE (trichloroethylene) is a component of some brands of rotenone. Rotenone has a half-life of 14 hours at 24°C and 84 hours at 0°C; meaning that half of the rotenone is degraded and is no longer toxic in that time. As the temperature and sunlight increase, they both speed the rate that rotenone is degraded. Higher alkalinity (>170 ppm) and pH (>9.0) also increase the rate of degradation. Rotenone tends to bind and react with organic molecules rendering it ineffective, so higher concentrations are required in streams and lakes with increased amounts of organic debris. Without detoxifying, rotenone will be reduced to non-toxic levels in one to several days in streams due to its degradation and dilution in the aquatic environment and 2-4 weeks in lakes.

Rotenone will have only a minor potential impact on water quality below the reservoir because the outlet structure will be completely closed. Thus, no treated water will escape the reservoir during treatment. Rotenone readily degrades in the environment and it is anticipated that no water will be released from the dam for at least a period of 1 to 3 months following treatment. It is anticipated that the rotenone will naturally break down in the reservoir within 2 to 4 weeks following treatment, but this rate can vary depending on the variables mentioned above. Therefore, the rate of breakdown of the chemical will be monitored using sentinel fish that will be placed in the reservoir following treatment. No treated water will be released from the dam until the sentinel fish indicate that the rotenone has been broken down to non-fish killing concentrations (i.e., fish survive for 24 hours in the reservoir). Rotenone binds to organic molecules and becomes inert, and it naturally breaks down quickly in the environment without detoxification. In addition, KMnO4, which quickly detoxifies rotenone, will be present on site if for some unforeseen reason treated water begins to come through the outlet or over the spillway of the dam. KMnO4, when administered at similar concentrations as rotenone, quickly breaks rotenone down into non-toxic byproducts. Rotenone is safe to use for chemical removal

of unwanted species of fish, when handled appropriately. Rotenone has been approved for use in fish removal, and represents no threat to humans at concentrations that are used to kill fish.

Dead fish will be allowed to naturally decompose in the reservoir. As fish decompose, there may be a temporary increase in the availability of nutrients in the water. This increase should not present a problem for water quality downstream of the reservoir because no water will be released from the reservoir and nutrients will be diluted as the reservoir fills. Further, aquatic macrophytes are abundant in the reservoir and will likely benefit from the increased nutrient levels and act to temporarily store nutrients. If the treatment occurs under the ice, fish will likely have decomposed thoroughly prior to ice out and there will be little evidence of the fish kill. If treatment occurs post ice out, dead fish will be sunk or allowed to decompose naturally.

During stream restoration activities and construction of the selective fish barrier it is likely that turbidity levels will slightly increase in the feeder stream. These impacts will be minimized by the presence of Otie Reservoir downstream. The reservoir will allow the sediment to settle, thus reducing the potential impacts to Grove Creek downstream. Further, the potential impacts of increased turbidity will be minimized by performing minimal work during the first and second years after riparian fencing to allow natural vegetation to become established along the banks. Work done in the actual channel will be only what is necessary to create proper channel dimensions and fish habitat in heavily impacted areas. The addition of larger sediment such as small gravel, gravel and cobble will enhance the habitat conditions found currently in the stream by providing spawning and rearing locations for YCT.

Comment 2f: Changes in groundwater quality: The risk that rotenone will enter and be mobile in groundwater is minimal because it has a strong tendency to adsorb to sediment. Once bound to organic molecules, it becomes inert and breaks down quickly in the environment without detoxification. Groundwater tests in areas adjacent to rotenone-treated waters did not show evidence of the chemical moving into groundwater supplies. Even if groundwater contamination did occur, there would be no consequences for human health, 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 2j). Furthermore, the chance for groundwater contamination would be minimal, because the reservoir will be at a low level when the treatment is performed, and there will be substantially less hydrostatic pressure at the ground-water interface at low reservoir levels than when the reservoir is full. The mud and organically enriched bottom of Otie Reservoir will also bind and inactivate the rotenone before it can enter the groundwater. The nearest residence to Otie Reservoir is Lee Dunn's home that is approximately 1/3 mile from the reservoir on a separate stream. Therefore, any wells supplying Lee's residence with water are not likely influenced by groundwater from Otie Reservoir. To monitor the potential for groundwater conveyance of treated waters from Otie Reservoir, sentinel fish will be placed in the beaver dam complex located downstream of the reservoir and at the confluence of the North Fork Grove Creek.

Restoration of the feeder stream upstream of Otie Reservoir will result in an improvement in water quality in the feeder stream by enhancing the riparian area and reducing the impacts of grazing. This improvement will reduce the amount of fine sediment entering the stream during

rain or snowmelt events and reduce long-term turbidity levels. Increased canopy cover will also likely reduce the effects of thermal pollution on the stream.

Comment 2j: Effects on other water users: Bioassays on mammals indicate that the proposed concentration of rotenone will have no effect on mammals, including humans and cattle, that drink the treated water (Schnick 1974). As a precaution, however, cattle and other livestock will be removed from the pastures surrounding the reservoir and the feeder stream upstream of the reservoir during treatment, according to the product label specifications. The public will not be allowed into the pond or to the stream above the reservoir during treatment. Denying permission for anglers to use the private pond until the treatment is completed will restrict public access.

Comment 2l. It is unknown whether the floodplain has been delineated for the feeder stream to the reservoir, but a county floodplain application will be filed with the floodplain coordinator before any stream enhancement work is done.

3. AIR Will 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? (also see 13 (c))		X				
b. Creation of objectionable odors?			X		Yes	3a
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. Will the project result in any discharge which will conflict with federal or state air quality regs?		X				

Comment 3a. Rotenone produces objectionable odors because of petroleum-based carriers (naphthalene) in the product and not the active ingredient (rotenone). These odors should be strongest around the pond. The nearest residence to the pond is approximately 0.3 miles away and the second nearest is 1 mi away. Objectionable odors will not likely be detectable to residents because of the distance from the pond to homes. Odors will not likely persist more than a 2 weeks following treatment (Finlayson et al. 2000). Further, if carried out under the ice, there should be very little odor present during treatment because of the limited contact with treated waters and the air.

4. VEGETATION Will the proposed action result in:	IMPACT 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		YES	4a

b. Alteration of a plant community?			X		YES	4a
c. Adverse effects on any unique, rare, threatened, or endangered species?		X				
d. Reduction in acreage or productivity of any agricultural land?			X		NO	
e. Establishment or spread of noxious weeds?						
f. Will the project affect wetlands, or prime and unique farmland?		X				

Comment 4a: Rotenone does not affect plants at fish-killing concentrations, so there will be no effect of rotenone application on the aquatic and riparian plant communities. By fencing the riparian area from livestock grazing, it is likely that the plant community composition will change. Native willows, aspen and cottonwoods will likely increase in abundance along the creek providing habitat and cover for terrestrial and aquatic species. Native willows and other native riparian vegetation may be planted in the most heavily impacted areas to expedite recovery of the riparian areas. These changes will result in a riparian community similar to less impacted streams in the area. These changes are considered to be positive for native plant and animal species. Periodic grazing within the livestock exclosure may be necessary to aid in controlling noxious weeds present at the site.

Comment 4d: By fencing the riparian area, pasture ground will be taken out of the total acreage of the pasture available for grazing on ground owned by Montana State University. However, the riparian area on the feeder stream is relatively narrow and the amount of acreage that will be excluded from grazing will be small in comparison to the total acreage of the pasture. Further, Montana State University is participating in the project development and is in favor of enhancing the riparian area for native species. A stock pond will be provided in to allow livestock watering, so the remaining pasture will continue to be grazed and few changes will be necessary in grazing practices to accommodate the stream restoration. Periodic grazing within the exclosure will likely occur to facilitate weed control.

5. FISH/WILDLIFE Will the proposed action result in:	IMPACT Unknown	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		NO	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		YES	5e
f. Adverse effects on any unique, rare, threatened, or endangered species?		X				
g. Increase in conditions that stress wildlife populations or limit abundance (including harassment, legal or illegal harvest or other human activity)?		X				

h. Will the project be performed in any area in which T&E species are present, and will the project affect any T&E species or their habitat? (Also see 5f)		X				
i. Will the project introduce or export any species not presently or historically occurring in the receiving location? (Also see 5d)		X				

Comment 5b: The objective of this project is to eradicate white suckers (non game fish) and rainbow trout from Otie Reservoir and to establish native a self-sustaining YCT population. This is, however, considered a minor impact because white suckers are present in Grove Creek downstream of Otie Reservoir, and these populations will not be impacted by the proposed action. Further, because of their wide distribution and stable populations in Montana, white suckers are not a species of special concern, unlike YCT. White suckers are not an undesirable species in Otie Reservoir, but because of their high reproductive rate and lack of an effective predator, they have consistently become overpopulated leading to negative impacts on other species. Rainbow trout are a non-native fish to south-central Montana and pose a threat to cutthroat trout through competition and hybridization.

Because our goal is to eliminate or substantially reduce the number of white sucker in the reservoir, if chemical treatment does not eliminate white suckers, actions will be taken to limit their long-term recruitment to prevent future over population of the reservoir. This will be done through the construction of a selective fish barrier near the inlet to the lake. The project will increase YCT, a unique and potentially endangered environmental resource with limited distribution in the Yellowstone River basin. The increase in abundance associated with this project will help insure the long-term viability of YCT in the reservoir system and may serve as a source of fish in Grove Creek and eventually the Stillwater River.

Waterfowl are known to frequent Otie Reservoir regularly during migration seasons and some Canada geese are known to nest near the reservoir. These birds feed on aquatic plants and animals in the reservoir. Birds are not affected by drinking water or eating insects killed by rotenone at fish-killing concentrations. If the reservoir is treated while frozen, there will be little potential for waterfowl to come in contact with treated waters. The temporary reduction in invertebrates as a result of a rotenone treatment may affect invertebrate-eating waterfowl. These impacts should be minimal because the low level of the reservoir will reduce the amount of vegetation and invertebrates that are generally available and invertebrate populations have been shown to rebound quickly following treatment.

Comment 5c: The target fish species in this project is the white sucker, a native, non-game fish. Also present in the reservoir are native lake chub. Both species are very abundant in streams and reservoirs in Stillwater and surrounding counties. Lake chub are not an undesirable species in Otie Reservoir, because of their small size and potential as a prey fish for salmonids in the lake. If the treatment produces a 100% fish kill, the impacts to lake chub cannot be mitigated except through the reintroduction of lake chub following treatment. The other non-game species that will be affected by this project are the aquatic invertebrates in the reservoir and the feeder stream. Because rotenone is an insecticide, it will have impacts on invertebrates. The predicted effect is a temporary decrease in some invertebrate populations (Bramblett 1998). There is no

effect on birds or mammals that are directly exposed to rotenone or by drinking treated water, or by eating fish killed by fish toxicants (Schnick 1974). Amphibian adults are not affected by rotenone at the proposed concentrations (Bramblett 1998), but sub-adults are affected. Because we anticipate treating the pond in the early spring, juvenile amphibians will not likely be present; therefore, impacts to amphibians should be minimal.

Comment 5e: Should the white sucker population persist following chemical treatment, a barrier will be installed near the inlet of Otie Reservoir that will selectively pass YCT and inhibit passage of white suckers. This will consist of a culvert modified to include a screen or drop structure that will reduce the probability of suckers passing upstream to spawning areas.

B.HUMAN ENVIRONMENT

6. NOISE/ELECTRICAL EFFECTS Will the proposed action result in:	IMPACT 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				

7. LAND USE Will 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		No	7a
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				

Comment 7a. A small amount of acreage will be taken out of use for pasture through the action of riparian fencing. This action will benefit the riparian area of the stream and lead to habitat improvement for native aquatic and terrestrial species.

8. RISK/HEALTH HAZARDS Will 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 8a
d. Will any chemical toxicants be used?			X		YES	see 8a

Comment 8a: Prenfish Toxicant, and most other brands of rotenone solution come in concentrations of 1 to 5% rotenone. Thus, at an application rate of 1-2 ppm rotenone solution, the actual concentration of rotenone in the water is approximately 0.025-0.050 ppm (California Department of Fish and Game 1994). The hazard associated with the short-term exposure to drinking water containing rotenone is very small because of the low concentration of rotenone (0.1 ppm) used in the treatment and the rapid breakdown and dilution of rotenone. Estimates of a single lethal dose to humans are 300-500 mg of rotenone per kilogram (2.2 pounds) of body weight. For example, a 160-pound (72.6 kilogram) person would have to drink over 23,000 gallons (87,000 liters) of water treated at 0.25 mg of rotenone per liter of water at one sitting; 0.25 mg of rotenone per liter of water is the highest allowable treatment rate for fish management. A 22-pound (10 kilogram) child would have to drink over 1,429 gallons (5,400 liters). An intake of 0.7 mg of rotenone per kilogram of body weight per day is considered safe (Haley 1978), which is equivalent to about 25 mg per liter when consumed as drinking water; this concentration is far greater than the expected exposure resulting from the maximum fish management treatment rate of 0.25 mg of rotenone per liter of water or our proposed concentration of 0.1 mg per liter.

With respect to long-term exposure to rotenone, there is probably no significant risk to humans because of the low concentrations at which it is applied (100 ug/L) and the fact that it degrades so quickly. The EPA (1997) has determined that the safe level for chronic (lifetime) exposure to rotenone is 4 ug/L. If we assume that rotenone in our treatment has a half-life of 10 days, then it will take 50 days for the concentration to drop below 4 ug/L. Exposure to hazardous concentrations of rotenone for 50 days is a far shorter period of time than the EPA says is necessary to elicit chronic effects.

Because the reservoir and stream will be closed to the public during chemical treatment, the risk of human exposure will be most apparent for the applicators of the rotenone. Rotenone is a restricted-use pesticide, which the Montana Department of Agriculture regulates through its licensing process. A certified applicator that has successfully met the state requirements for their license will supervise the application of rotenone to the lake and stream. All who assist in the project will also be trained on the safe handling and application of the piscicide. Chemicals will be transported, handled, applied and stored according to the label specifications to reduce the probability of human exposure or spill.

If needed, the expected concentration of potassium permanganate ($KMnO_4$) that will be required to neutralize rotenone will be 2 to 4 mg/L. The EPA believes the chronic toxicity of $KMnO_4$ breakdown products to be of no health concern based on the fact that they are naturally occurring and common in surface waters. The safety of $KMnO_4$ is further demonstrated by the fact that it is routinely used in drinking water treatment to achieve oxidation of iron and manganese, oxidation of taste and odor compounds and control of nuisance organisms such as bacteria and viruses (USEPA 1999).

9. COMMUNITY IMPACT Will 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				

10. PUBLIC SERVICES/TAXES/UTILITIES Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Will the proposed action have an effect upon or result in a need for new or altered governmental services in any of the following areas: fire or police protection, schools, parks/recreational facilities, roads or other public maintenance, water supply, sewer or septic systems, solid waste disposal, health, or other governmental services? If any, specify:		X				
b. Will the proposed action have an effect upon the local or state tax base and revenues?		X				
c. Will the proposed action result in a need for new facilities or substantial alterations of any of the following utilities: electric power, natural gas, other fuel supply or distribution systems, or communications?		X				
d. Will the proposed action result in increased used of any energy source?		X				
e. Define projected revenue sources			X		YES	10e
f. Define projected maintenance costs		X				

Comment 10e: Implementation of this project will be accomplished through a commitment of 40-60 person-days from FWP, contracted workers, and volunteers from 2003–2007. The project

would be accomplished using funds contributed by FWP through the state Future Fisheries Improvement grant program and other potential state sources. Other funding sources including Montana State University, and volunteers may also be used to complete the stream restoration and enhancement phase of the project. FWP possesses the rotenone and equipment necessary for applying the chemical, so other than personnel time, there will be no additional cost associated with chemical removal of fish.

Breakdown of person-days			
Activity	**# people**	**# days**	**Person/days**
Treatment #1	3	3	9
Assessment	1	3	3
Fencing	6	2	12
Replace YCT	3	1	3
Stream Restoration	3	10	30
Total		29 days	57

Otie Reservoir and Tributary Yellowstone Cutthroat Trout Restoration

Proposed Budget and amount applied for through Future Fisheries Grant

Item	*Unit Cost*			*Subtotal*
Fencing	2624 feet @ $0.91/ ft			**$2411.96**
Wire	$350.00 (5 strand barbed wire)			
Posts	$106.60 (steel T posts)			
	$255.36 (wood brace posts)			
Hardware	$100.00			
Labor	$1600.00 (5 days @ 8hrs/days $40.00/hr)			
Culvert/Trap				
Prefabricated Structure		$556.35		
Delivery		$150.00		
Materials - splashboards, gravel, etc			$250.00	
Installation				
Backhoe (4 hrs @ $70)		$280.00		
mobilization			$200.00	
Subtotal		$1436.35		**$1436.35**
Stream Enhancement				
Spawning Gravel (8 yds @ $18)		$144.00		
Wetland Seed Mix (30 lbs.acre)		$250.00		
			$394.00	**$394.00**
Stockwater				
Pond Storage and Spring Development				
Backhoe (4hrs @ $70)		$280.00		
Terracell (2 panels @ $125)		$250.00		
Gravel (pitrun18 yds @ $10)			$180.00	
			$710.00	**$710.00**
		Grand Total		**$4952.31**

11. AESTHETICS/RECREATION Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Alteration of any scenic vista or creation of an aesthetically offensive site or effect that is open to public view?		X				
b. Alteration of the aesthetic character of a community or neighborhood?		X				
c. Alteration of the quality or quantity of recreational/tourism opportunities and settings? (Attach Tourism Report)			X		YES	
d. Will any designated or proposed wild or scenic rivers, trails or wilderness areas be impacted? (Also see 11a, 11c)		X				

Comment 11c: This project will provide the opportunity for individuals to fish for genetically pure, native YCT. Lee Dunn has historically allowed public access at Otie Reservoir and is currently signed up in the Private Lands Fishing Access Program. The reservoir has historically provided good fishing for good-sized trout.

12. CULTURAL/HISTORICAL RESOURCES Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Destruction or alteration of any site, structure or object of prehistoric historic, or paleontological importance?		X				
b. Physical change that would affect unique cultural values?		X				
c. Effects on existing religious or sacred uses of a site or area?		X				
d. Will the project affect historic or cultural resources?		X				

13. SUMMARY EVALUATION OF SIGNIFICANCE Will the proposed action, considered as a whole:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Have impacts that are individually limited, but cumulatively considerable? (A project or program may result in impacts on two or more separate resources which create a significant effect when considered together or in total.)		X				
b. Involve potential risks or adverse effects which are uncertain but extremely hazardous if they were to occur?		X				

c. Potentially conflict with the substantive requirements of any local, state, or federal law, regulation, standard or formal plan?		X				
d. Establish a precedent or likelihood that future actions with significant environmental impacts will be proposed?		X				
e. Generate substantial debate or controversy about the nature of the impacts that would be created?		X				13e
f. Is the project expected to have organized opposition or generate substantial public controversy? (Also see 13e)			X		YES	see 13e
g. List any federal or state permits required.						13g

Comment 13e: Very little, if any opposition is expected, because the outlet to the reservoir will be closed and no treated waters will be allowed to go downstream until the chemical has naturally broken down. All landowners downstream of the reservoir on North Fork Grove Creek will be made aware of the project and will receive a copy of this EA.

Comment 13g: The following permit will be required:

Fish toxicant permit:
DEQ 308 - Department of Environmental Quality (authorization for use of a fish toxicant)

Tributary work:
DEQ 318
SPA 124 (FWP)
Floodplain Permit (Stillwater County)
Section 404, US Army Corps of Engineers

PART III. ALTERNATIVES

Three alternatives were considered during preparation of the Environmental Assessment.

Alternative 1 - No Action.

The predicted consequence of the "No Action" alternative is a high probability that the sucker population would remain at its current size or continue to increase and trout growth would continue to decline. Angler opportunity would also continue to decline. Rainbow trout in Otie Reservoir could escape into the Grove Creek watershed and hybridize with Yellowstone cutthroat trout. No Yellowstone cutthroat would be present in this part of the North Fork Grove Creek drainage.

Alternative 2 – Mechanical Removal

This alternative has the same goal as the Proposed Action except that no fish toxicants would be used. Rather, removal of fish would be by mechanical means only, including both electrofishing

and netting. Electrofishing is inefficient at removing all fish, particularly small fish and electrofishing generally is not effective in water deeper than 6 ft, thus complete removal of fish would be impossible using electrofishing. Gill and trap netting in the past has been effective at reducing the numbers of adult and sub-adult white suckers, resulting in increased trout growth. However, netting is ineffective at capturing juvenile fish. Thus, within a few years of netting, the sucker population has rebounded to previous levels. Using a combination of electrofishing and netting would likely produce the most effective results, but it is clear from work done in other reservoirs that 100% removal of the sucker population would be impossible. Therefore, to manage the reservoir for good trout growth would require repeated removal efforts every 2 to 4 years to maintain the sucker population at low levels. This would require a considerable investment of time and resources by MFWP over the years and it is more costly in the long run than chemical treatment. Further, rainbow trout would also likely persist in the pond, which would impede efforts to restore the drainage to the native Yellowstone cutthroat trout.

Alternative 3 - Proposed Action

The proposed action includes chemically treating Otie Reservoir and restoring the upper reaches of its feeder stream to enhance YCT spawning and rearing. YCT will be restocked into the reservoir following treatment. Because toxicants have been demonstrated to be 100% effective when proper techniques are used, it is anticipated that treatment of the reservoir will result in the complete removal of white suckers and rainbow trout from the project area. When restocked and when combined with stream restoration and enhancement, we anticipate that a self-sustaining population of cutthroat trout will inhabit the reservoir and upper stream.

PART IV. ENVIRONMENTAL ASSESSMENT CONCLUSION SECTION

A) Is an EIS required? No

This environmental review demonstrates that the impacts of this proposed project are not significant. The proposed action would benefit YCT in the North Fork Grove Creek and potentially in entire Grove Creek Drainage and provide a valuable recreational fishery for native YCT with minimal impact on the physical, biological, or the human environment.

B) Public Involvement.

The EA will be posted on the FWP website during the comment period. Neighboring landowners will be contacted. A public meeting will be held if necessary.

C) Duration of the comment period?
Public comment will be accepted January 20, 2004 to February 19, 2003.

D) Name, title, address and telephone number of the Person Responsible for Preparing the EA Document.

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References

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Schnick, R. A. 1974. A review on the literature on the use of antimycin A in fisheries. USDI, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife. Fish Control Laboratory, La Crosse, Wisconsin. NTIS PB-235 454/AS.

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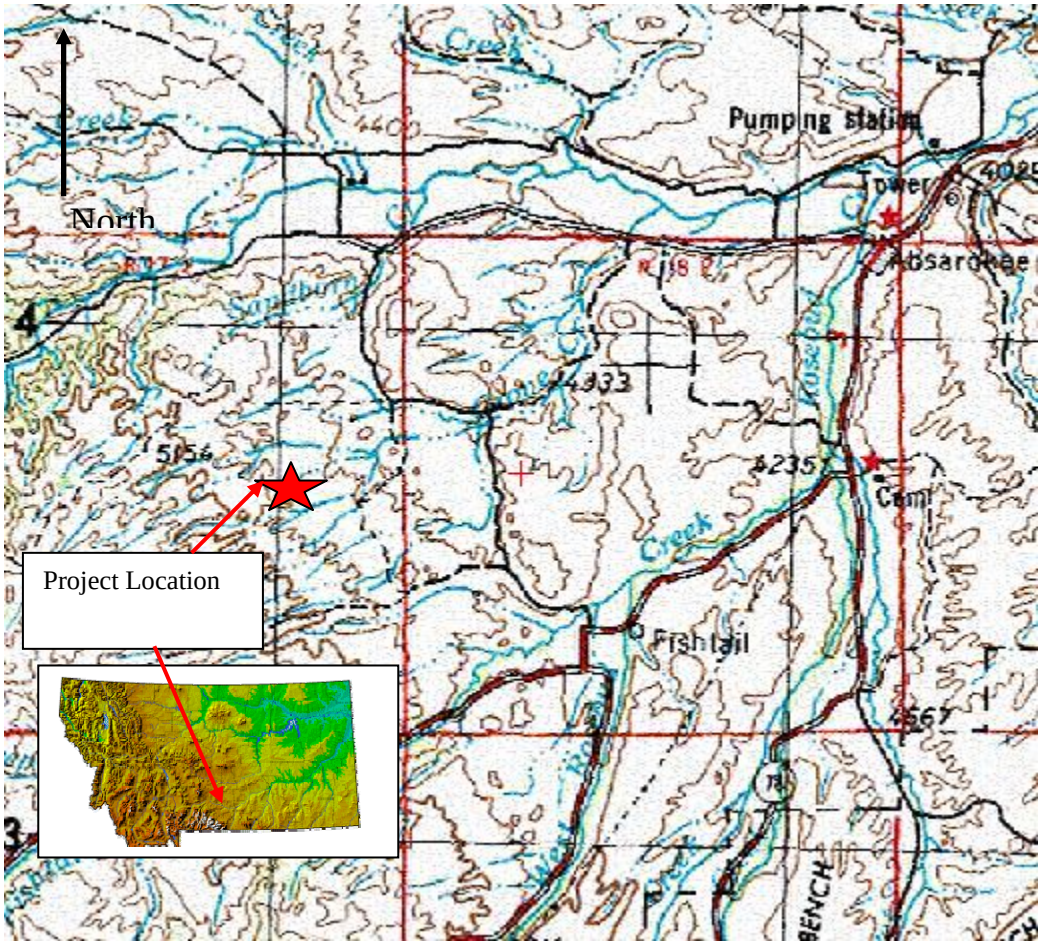
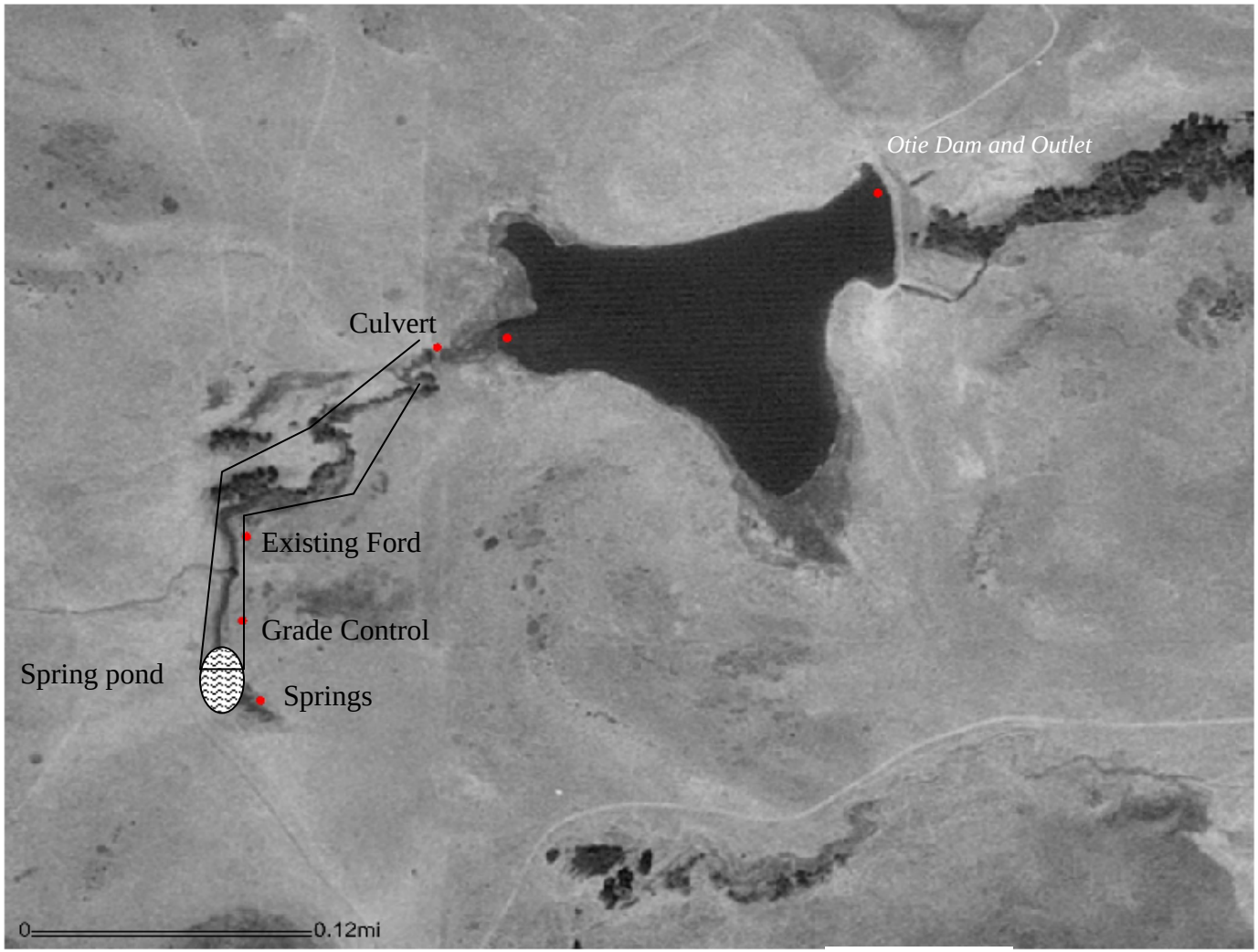
Otie Reservoir and Tributary Stream Project Vicinity Map





LEGEND

GPS Themes
- Otie Reservoir

Key Points:
Springs: Origin of spring creek, site of pond
Grade Control: Cobble seam preventing further entrenchment, enhanced for stockwater pond
Existing Ford: stock crossing
Culvert: To be modified as barrier/trap
Proposed Fence Alignment

Montana Fish, Wildlife & Parks

Otie Reservoir and Spring Creek

Stockwater Development

Plan View

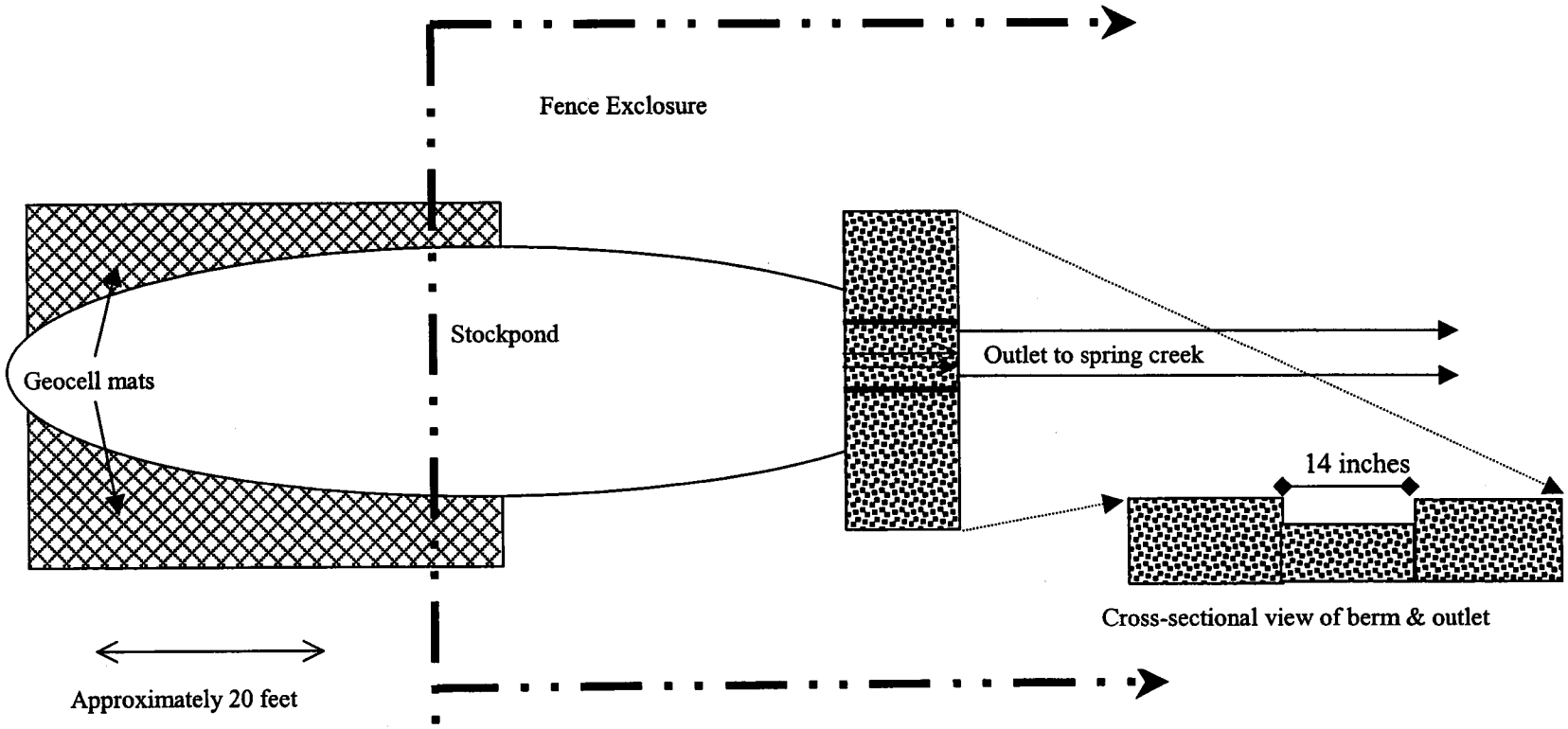
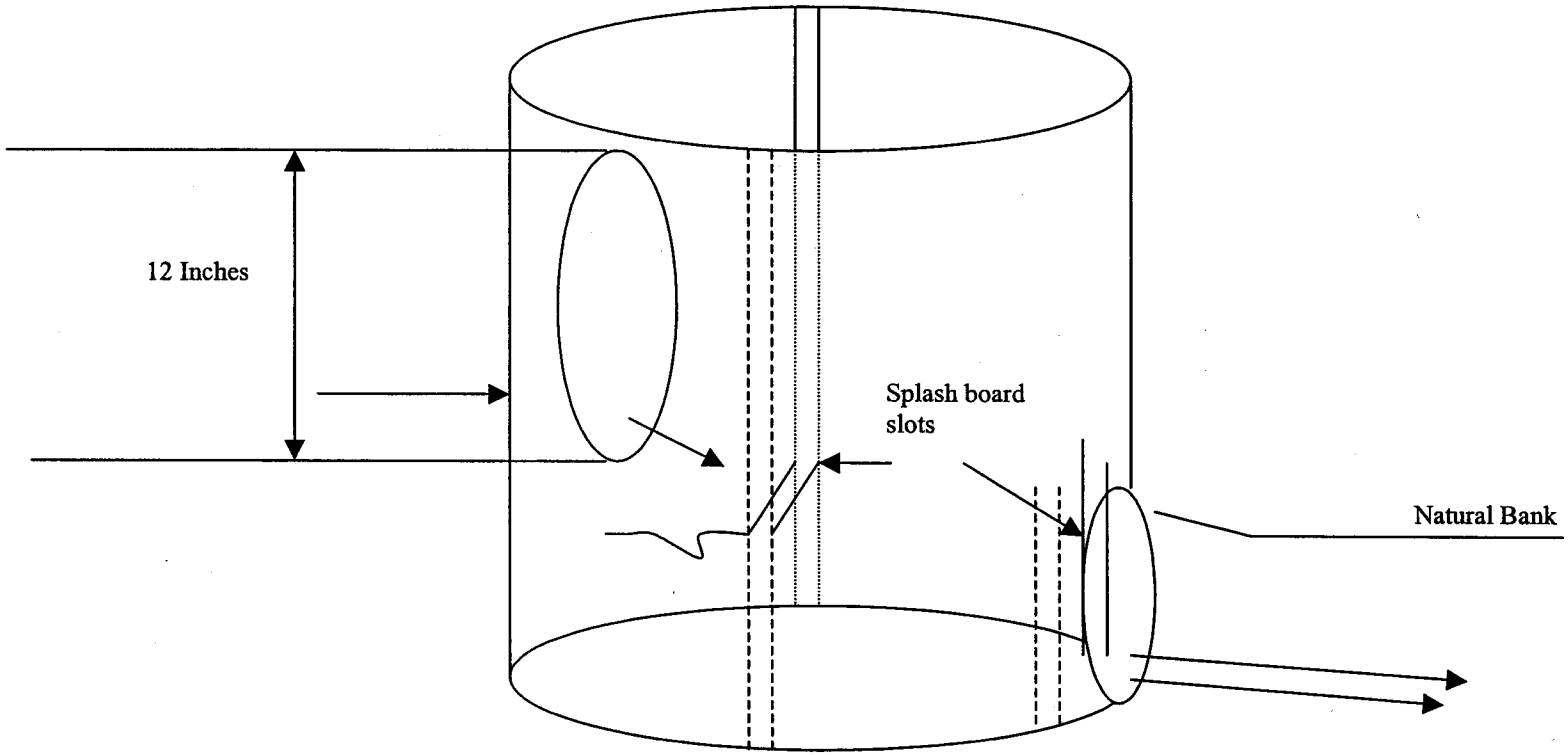


Diagram of culvert and fish passage barrier/ladder



Appendix 1

Chapter 5 from

Rotenone Use in Fisheries Management
Administrative and Technical Guidelines Manual

Finlayson et al. 2000

5

ISSUES AND RESPONSES

This section was written with the lay (nontechnical) public in mind with minimal use of technical terminology. It includes its own references for reproduction and distribution to the public independent of the remainder of the manual. The Fish Management Chemicals Subcommittee intends to update this information annually for access on the American Fisheries Society Web site.

5.1 GENERAL INFORMATION

Q. What is rotenone?
A. Rotenone is a naturally occurring substance derived from the roots of tropical plants in the bean family Leguminosae including jewel vine *Derris* spp. and lacepod *Lonchocarpus* spp. Rotenone is very insoluble in water, and other materials can be added to disperse it throughout the water column in deep lakes and flowing waters. Rotenone is used either as a powder from ground-up plant roots (e.g., Pro-Noxfish®) or extracted from the roots and formulated as a liquid (e.g., Nusyn-Noxfish® and Noxfish®). The liquid formulations contain dispersants and emulsifiers (primarily naphthalene, methylnaphthalenes, and xylenes) that add little, if any, toxicity but disperse the rotenone throughout the water.
Q. How does rotenone work?
A. Rotenone does not suffocate fish or interfere with the uptake of oxygen

in the blood as was long believed. Instead, it inhibits a biochemical process at the cellular level making it impossible for fish to use the oxygen absorbed in the blood and needed in the release of energy during respiration (Oberg 1967a, 1967b).

Q. Why is rotenone used in fish management?

A. Use of rotenone enables fisheries managers to eradicate entire populations and communities of fishes with minimum impact to nontarget wildlife. Following treatment, the desired population of fish is then reestablished in the water body. Although other approaches are useful as control measures, these are only partially effective in eradicating fish. Use of rotenone is the only sampling method that allows for an accurate estimation of standing crop (biomass of a population) of diverse fishes in large water bodies.

Q. Is rotenone a selective pesticide?

A. Although rotenone has some toxicity to all oxygen-breathing animals, it is selective to fish and other gill-breathing organisms at the concentrations used by fish biologists. In general, most common aquatic invertebrates are less sensitive than fish to rotenone. Some of the zooplankton (cladocerans and copepods) are equally sensitive; however, these do have life history stages that can survive the treatment. Snails and clams are quite tolerant. Shad, pike, trout, and salmon are among the most sensitive fish. Sunfish are less sensitive, and catfish are among the most tolerant (Marking and Bills 1976; Chandler and Marking 1982).

5.2 Public Health

Q. Are there any public health effects from the use of rotenone?

A. Millions of dollars have been spent on research to determine the safety of rotenone before approval of use from the U.S. Environmental Protection Agency (USEPA). Much of this research has been directed toward potential effects on public health. This research has established that rotenone does not cause birth defects (Hazleton Raltech Laboratories 1982), reproductive dysfunction (Spencer and Sing 1982), gene mutations (Biotech Research 1981; Goethem et al. 1981; NAS 1983), or cancer (USEPA 1981b; Tisdel 1985). When used according to label instructions for the control of fish, rotenone poses little, if any, hazard to public health. The USEPA (1981b, 1989b) has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment.

Q. What is a lifetime safe exposure level for rotenone?

A. The National Academy of Science (NAS 1983) has suggested a Suggested No-Adverse Response Level (SNARL) for rotenone in drinking water of 0.014 milligrams (mg) rotenone per liter of water (14 parts per billion [ppb]). The California Department of Health Services (memorandum from P. Berteau, California Department of Health Services, to B. Finlayson, California Department of Fish and Game, 26 June 1984) has suggested an Action Level (level of concern) for rotenone in drinking water of 0.004 mg rotenone per liter of water (4 ppb). These proposed life-time, allowable levels for drinking water are based on applying a 1,000-fold safety factor to the chronic feeding study of Ellis et al. (1980). These levels assume a lifetime of exposure to rotenone. For comparison, most rotenone treatments are done within the range of 0.025–0.25 mg rotenone per liter of water (25–250 ppb), and rotenone generally persists

for no longer than a few weeks. In addition, rotenone treatments are only infrequently applied to any body of water.

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

A. The hazard associated with drinking water containing rotenone is very small because of the low concentration of rotenone used in the treatment (0.025–0.25 mg of rotenone per liter of water [25–250 ppb]) and the rapid breakdown of rotenone. Estimates on a single lethal dose to humans are 300–500 mg of rotenone per kilogram of body weight (Gleason et al. 1969). Hence, a 160-pound person would have to drink over 87,000 liters (23,000 gallons) of water treated at 0.25 mg of rotenone per liter of water (highest allowable treatment rate for fish management) at one sitting to receive a lethal dose; similarly, it is extremely unlikely that a 10-kilogram child would drink over 5,400 liters of water. An intake of 0.7 mg of rotenone per kilogram of body weight per day is considered safe (Haley 1978), far greater than the expected exposure resulting from the maximum fish management treatment rate of 0.25 mg of rotenone per liter of water.

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

A. Tolerances for rotenone in potable and irrigation water have not been established by USEPA, even though the studies required for setting tolerances have been completed. This does not mean that rotenone concentrations in drinking or irrigation waters will create problems, it just means that the USEPA has not established rotenone tolerances at the time of writing these guidelines. As a result, water containing residues of rotenone cannot be legally allowed for use as a domestic water source or on crops. During the treatment and for the period of time that rotenone residues are present, alternative water sources must be used for domestic and irrigation uses. Depending on initial rotenone concentration and environmental factors (e.g., temperature), this period can vary from 1 to 8 weeks (CDFG 1994; Finlayson and J. Harrington, unpublished data, presented at Chemical Rehabilitation Projects Symposium, Bozeman, Montana, 1991).

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

A. The USEPA (1981b, 1989b) has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment. The California Environmental Protection Agency found that adverse impacts from properly conducted, legal uses of liquid rotenone formulations in prescribed fish management projects were nonexistent or within acceptable levels (memorandum from J. Wells, California Department of Pesticide Regulation, to Finlayson, 3 August 1993). Liquid rotenone contains the carcinogen trichloroethylene (TCE). However, the TCE concentration in water immediately following treatment (less than 0.005 mg TCE per liter of water [5 ppb]) is within the level permissible in drinking water (0.005 mg TCE per liter of water; USEPA 1980b). None of the other materials including xylenes, naphthalene, piperonyl butoxide, and methylnaphthalenes exceed any water quality criteria or guidelines (based on lifetime exposure) set by the USEPA (1980a, 1981a, 1993). Many of these materials in the liquid rotenone

formulations (trichloroethylene, naphthalene, and xylene) are the same as those found in fuel oil and are present in waters everywhere because of the frequent use of outboard motors.

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

A. No public health effects from rotenone use as a piscicide have been reported. The use of the powder Pro-Noxfish® and the liquid formulation Nusyn-Noxfish® have been monitored for airborne drift into adjacent areas. Airborne rotenone concentrations immediately adjacent to the treatment site, monitored in California during a treatment in 1997, varied from a high of 0.02 ppb rotenone (0.00053 mg of rotenone per cubic meter) immediately after application to nondetectable levels two weeks later (CARB 1997). The highest levels were approximately 1,000-fold lower than the estimated no observed effect level (NOEL) of 0.43 mg of rotenone per cubic meter of air for a 24-hour period estimated by the California Office of Environmental Health and Hazard Assessment and the California Department of Pesticide Regulation (CARB 1997). In the same monitoring program, TCE was detected only once at a trace amount in air at one spillway. The heavier hydrocarbons (naphthalene and methylnaphthalene) were found at 281 ppb (1.74 mg per cubic meter) in air immediately after treatment and diminished to 1.61 ppb (0.010 mg per cubic meter) in air within two weeks. Individuals can normally detect naphthalene and methylnaphthalene at levels between 40 and 84 ppb in the air. The highest levels of all materials in the 1997 monitoring program were found at a dam spillway because of water turbulence. The highest levels were determined not to be responsible for any health effects (CDPR 1998).

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

A. The USEPA (1981b) concluded that there was no reason to restrict the use of rotenone in waters intended for irrigation, livestock (with the possible exception of swine) consumption, and recreational swimming use. The USEPA (1990) ruled that a reentry interval was not needed for persons who swim in waters treated with rotenone based on an assessment of the toxicology data (e.g., skin, oral water intake) and exposure level. The reentry statement on the product labels—"do not swim in rotenone treated water until the application has been completed and all the pesticide has been thoroughly mixed into the water according to labeling instructions" —indicates the safety of rotenone use for fish control. The reason for this slight waiting period is esthetic.

Q. Are people at risk from consuming fish stocked into a recently treated water body?

A. Fish are not stocked into a treated area until all of the toxic effects are gone and rotenone has dissipated. Hence, stocked fish cannot accumulate residues of rotenone from the water. Residues of rotenone in tolerant fish that survive a rotenone treatment won't last for more than several days because the bioaccumulation potential for rotenone is low and the half-life of rotenone in fish is about 1 day (Gingerich and Rach 1985; Gingerich 1986).

Q. Is there any risk to people from consuming fish that have been killed from rotenone?

A. The USEPA has not established guidelines for consuming fish killed with rotenone. Therefore, agencies cannot condone this practice. Additionally,

there is a valid concern of risk of salmonella and other bacteriological poisoning from consuming fish that have been dead for a period of time. Fish that end up on land as a result of wave or wind action are no more a threat to public health than fish that die of natural causes.

5.3 Environmental Quality

Q. Do dead and decaying fish pose any problems to the recovery of fishing?

A. Most dead fish will sink to the bottom of the treated body of water in several days, decompose, and release nutrients back into the water. These nutrients will directly stimulate phytoplankton and indirectly stimulate insect and zooplankton production. These organisms are a good food base for fish.

Q. Can the toxic effects of rotenone to fish and other aquatic life be neutralized?

A. In lakes or rivers, if biologists want to neutralize the effects of rotenone, potassium permanganate, an oxidizing agent, can be used. This is added to the water at a minimum 1:1 ratio with the concentration of rotenone applied plus sufficient additional permanganate to satisfy the oxygen demand caused by organic matter that may be present in the treated water. Neutralization of rotenone with permanganate may be impaired at water temperatures of 50°F (10°C) or less (CDFG 1994; AgrEvo, no date).

Q. What is the "pesticide" smell sometimes associated with the use of rotenone?

A. The aromatic smell (like the smell of mothballs) associated with the use of liquid rotenone formulations is likely airborne concentrations (greater than 40 ppb) of naphthalene and methylnaphthalene (CDPR 1998). This smell may last for several days, depending on air and water temperatures and wind direction. These relatively "heavy" organic compounds tend to sink (remain close to the ground) and move downwind.
The California Department of Pesticide Regulation (CDPR 1998) found no health effects from this smell despite complaints.

Q. How long does rotenone persist?

A. The time for natural degradation (neutralization) of rotenone by hydrolysis is governed primarily by temperature. Studies in standing, icefree waters in California show that rotenone completely degrades within 1 to 8 weeks within the temperature range of 10–20°C (CDFG 1994; Siepmann and Finlayson 1999; Finlayson and Harrington, unpublished); the estimated half-life values for California waters vary from 7.8 to 1.5 days, respectively. Other studies indicate half-life values of 13.9 hours to 10.3 days for water temperatures of 24°C and 5°C, respectively (Gilderhus et al. 1986, 1988). Rotenone dissipates in flowing waters relatively quickly (less than 24 hours) due to dilution and increased rates of hydrolysis (Borriston Laboratories 1983) and photolysis (Cheng et al. 1972; Biospherics 1982). Although rotenone can be found in lake sediments, the levels approximate those found in water, and breakdown of rotenone lags one to two weeks behind water levels. It is uncommon to find rotenone in stream sediments (CDFG 1994).

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

A. Researchers in California have found other organic compounds associated with the use of the liquid formulation Nusyn-Noxfish® (CDFG

1994; Siepmann and Finlayson 1999; Finlayson and Harrington, unpublished). These include the volatile organic compounds (VOC) [xylene, trichlorethylene (TCE), toluene, and trimethylbenzene] and the semivolatile organic compounds (semiVOC) [piperonyl butoxide (PBO), naphthalene, 1-methyl naphthalene, and 2-methyl naphthalene] (Table 5.1). With the exception of PBO, the other organic compounds disappear before rotenone dissipates, typically within 1 to 3 weeks. Piperonyl butoxide, which is the other active ingredient (synergist) in Nusyn-Noxfish®, is relatively stable; photolysis does not contribute significantly to its degradation (Friedman and Epstein 1970). Piperonyl butoxide has persisted in deep lake waters at low temperatures (below 10°C) for approximately nine months. The VOC's do not accumulate in the sediment, and only naphthalene and the methyl naphthalenes temporarily (less than 8 weeks) accumulate in the sediments (CDFG 1994; Siepmann and Finlayson 1999; Finlayson and Harrington, unpublished).

Table 5.1. Persistence of rotenone and other organic compounds in water and sediment impoundments treated with 2 ppm rotenone formulation.

Compound	Initial water concentration (parts per billion)	Water persistence	Initial sediment concentration (parts per billion)	Sediment persistence
Rotenone	50	<8 weeks	522	<8 weeks
Trichloroethylene	1.4	<2 weeks	ND*	
Xylene	3.4	<2 weeks	ND	
Trimethylbenzene	0.68	<2 weeks	ND	
Naphthalene	140	<3 weeks	146	<8 weeks
1-m-naphthalene	150	<3 weeks	150	<4 weeks
2-m-naphthalene	340	<3 weeks	310	<4 weeks
Toluene	1.2	<2 weeks	ND	
Piperonyl Butoxide	30	<9 months	ND	

*ND=below detection limits

Q. Does the synergist piperonyl butoxide used in some formulations pose an environmental risk?

A. No, piperonyl butoxide has little toxicity to fish and wildlife and is not a risk to humans at the concentrations used in fish management (Roussel Bio Corporation, no date).

Q. Is rotenone likely to enter groundwater and pollute water supplies?

A. The ability of rotenone to move through soil is low to slight. Rotenone moves only 2 cm (<1 inch) in most types of soils. An exception would be in sandy soils where the movement is about 8 cm (slightly more than 3 inches). Rotenone is strongly bound to organic matter in soil so it is unlikely that rotenone would enter groundwater (Dawson et al. 1991). The other compounds in the liquid formulation Nusyn-Noxfish® have not been detected in groundwaters (CDFG 1994; Siepmann and Finlayson 1999; Finlayson and Harrington, unpublished).

Q. Are there any degradation products from rotenone that can cause environmental problems?

A. The metabolite of rotenone, rotenolone, persists longer than rotenone, especially in cold, alpine lakes (Finlayson and Harrington, unpublished). Rotenolone has been detected for as long as 6 weeks in cool water temperatures (<10°C) at high elevations (>8,000 feet). In part, this situation occurs because rotenone may be more susceptible to photolysis than rotenolone. However, studies have indicated that rotenolone is approximately one-tenth as lethal as rotenone (CDFG 1991a). In those rare

cases of rotenolone persistence, fish stocking would be delayed until both rotenone and rotenolone residues have declined to nondetectable (<2 ppb) levels to err on the side of safety.

5.4 Fish and Wildlife

Q. Does rotenone affect all aquatic animals the same?

A. No. Fish are more susceptible. All animals including fish, insects, birds, and mammals have natural enzymes in the digestive tract that neutralize rotenone, and the gastrointestinal absorption of rotenone is inefficient. However, fish (and some forms of amphibians and aquatic invertebrates) are more susceptible because rotenone is readily absorbed directly into their blood through their gills (non-oral route) and thus, digestive enzymes cannot neutralize it. Contrary to common belief, the other ingredients in Noxfish® and Nusyn-Noxfish® impart no toxicity to fish, insects, birds, or mammals (CDFG 1994). Rotenone residues in dead fish are generally very low (<0.1 ppm), unstable like those in water, and not readily absorbed through the gut of the animal eating fish.

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

A. For the reasons listed above, birds and mammals that eat dead fish and drink treated water will not be affected. A bird weighing ¼ pound would have to consume 100 quarts of treated water or more than 40 pounds of fish and invertebrates within 24 hours to receive a lethal dose. This same bird would normally consume 0.2 ounces of water and 0.32 ounces of food daily; thus, a safety factor of 1,000- to 10,000-fold exists for birds and mammals. No latent or continuing toxicity is expected since under normal conditions rotenone will not persist for more than a few weeks (CDFG 1994).

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

A. During recent treatments in California, fish-eating birds (i.e., herons and sea gulls) and mammals (i.e., raccoons) were found foraging on dying and recently dead fish for several days following treatment (CDFG 1994). Following this abundance of dead fish, a temporary reduction in food supplies for fish- or invertebrate-eating birds and mammals will result until the fish and invertebrates are restored. There is no indication that this temporary reduction results in any significant impacts to most bird or mammal populations because most animals can utilize other water bodies and sources for food. However, the temporary loss in food resources for sensitive animals during mating may cause unavoidable impacts. California has mitigated an impact to nesting bald eagles during mating by removing their eggs from the nest to an approved eagle recovery program out of the area (CDFG 1991b). Likewise, Michigan has mitigated the impacts to loons by delaying treatments until chicks have fledged.

Q. Is it safe for livestock to drink from rotenone-treated waters?

A. Rotenone was used for many years to control grubs on the backs of dairy and beef cattle. The USEPA (1981b) has stated that there is no need to restrict livestock consumption of treated waters. However, swine are more sensitive to rotenone than cattle (Thomson 1985).

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