

COLUMBIA NATIONAL WILDLIFE REFUGE FISHERY MANAGEMENT PLAN




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SIGNATURE PAGE

Fisheries Management Plan
Columbia National Wildlife Refuge
Grant and Adams Counties, Washington

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1.0 INTRODUCTION

Recreational fishing is a popular activity in Washington State, infusing millions of dollars into local economies and positively contributing to the quality of life of resident and non-resident anglers. In 2006, an estimated 824,000 resident and non-resident recreational anglers fished a total of 9.1 million days in Washington's fresh and marine waters (TCW 2008). The net economic value of recreational fishing in Washington State in 2006 was estimated at \$462 million. Net economic value measures an angler's willingness to pay over and above actual out-of-pocket costs to go fishing. Freshwater fishing accounts for the majority of recreational angler effort and net economic value in Washington State. A total of 538,000 freshwater anglers (65.3%) fished 7.5 million days (83.0%) accounting for \$380.2 million (82.3%) in net economic value in 2006. Trout fishing is the most popular recreational fishing activity accounting for 337,000 (62.6%) of all freshwater anglers and \$145.9 million (38.4%) of the total net economic value. Furthermore, based on a Washington Department of Fish and Wildlife (Department or WDFW) survey, approximately 78.0% of resident recreational anglers prefer to fish for rainbow trout in Washington's lowland lakes (Responsive Management 2008). To accommodate freshwater angling demand, the Department annually stocks 18-22 million trout into 500 lakes statewide. Most lakes in Washington State are open year-round to recreational fishing. However, seasonal lakes (e.g., last Saturday in April) "signal" the traditional start of lake fishing for most trout anglers. The Department estimates as many as 500,000 anglers participate in the late April lowland lake opening day weekend alone (TCW 2008).

The Department divides the management responsibility of the State's fish and wildlife resources into six administrative Regions. Region 2 is responsible for managing fish and wildlife resources within north central Washington which includes Okanogan, Chelan, Douglas, Grant, and Adams Counties. Within Grant and Adams Counties there are approximately 350 named and unnamed ponds, lakes, and reservoirs ranging in size from ≤ 1 to 28,000 surface acres (Wolcott 1973). Most of these waters are actively managed for recreational fishing and are visited by tens of thousands of anglers annually. The Department stocks approximately 80 of these waters with around two million trout each year. The lakes located on the Columbia National Wildlife Refuge (CNWR or Refuge) near the City of Othello are popular amongst recreational anglers. The Department has provided recreational fishing opportunity for trout in these lakes since the middle 1950s. CNWR lakes represent 28.8% of all Grant and Adams County lakes stocked annually with trout.

One of the Department's major goals is to provide sustainable fishing, hunting, and wildlife-related recreational opportunities throughout Washington State. The Region 2 Fish Program (FP) and United States Fish and Wildlife Service (Service) have a long history co-managing

recreational fishing on the CNWR lakes. WDFW recreational fishing regulations and license requirements have always applied to Refuge lakes since establishment of the CNWR in 1944. Historical fish management and stocking practices on Refuge lakes has been coordinated through informal agreements and coordination between WDFW fisheries and CNWR staff. Fish management and stocking practices for the past three decades has occurred under the guidance of two fishery management plans (FMP) written by WDFW in 1981 and 1996. The objective of both FMPs was to detail specific fish management and stocking practices on Refuge lakes and ensure those practices didn't negatively impact wildlife resources (primarily waterfowl) on the CNWR. The 1996 plan has expired and a new FMP needs to be completed in order to continue recreational fishing on Refuge lakes. Additionally, the Service recently finished a Comprehensive Conservation Plan (CCP) for the CNWR that will only permit recreational fishing on Refuge lakes under the guidance of a current and mutually agreed to FMP. This document is intended to serve as the FMP for Refuge lakes as required within the CNWR CCP.

2.0 PURPOSE

The National Wildlife Refuge System Improvement Act of 1997 mandates that CCPs be developed by the Service for adoption on all federal wildlife refuges by 2012. All CCPs developed must follow and fulfill all requirements of the National Environmental Policy Act prior to adoption. The primary objective of a CCP is to provide guidance for the long-term conservation and management of a refuge's native habitats, fish and wildlife, and other natural resources. Additionally, a CCP identifies, evaluates, and permits public uses (e.g., hiking, camping, recreational angling, hunting, wildlife viewing, etc.) that currently and/or are projected to occur at a particular refuge and deemed compatible with its long-term conservation and management objectives.

In September of 2011, the Service adopted a CCP for the CNWR to guide conservation and management efforts through 2026. Within this CCP, recreational fishing was identified as a compatible public use on the CNWR's many lakes and the section of lower Crab Creek that flows through the Refuge. Fish stocking and lake rehabilitations were also identified in the plan as the two principle methods to sustain recreational fisheries in Refuge lakes. However, there are a number of stipulations related to recreational fishing listed in the Compatibility Determination section of the CCP that Service staff believe are necessary to ensure the long-term compatibility with Refuge conservation and management objectives. Certain stipulations indentified in the CCP are the primary responsibility of CNWR staff, whereas others are specific to WDFW fish management and stocking practices. Recreational fishing stipulations listed in the CNWR CCP include:

- Fish stocking operations will be conducted in accordance with an approved FMP, developed in conjunction with WDFW. If a new plan is not developed within one year of the CCP being adopted, the stocking program will likely be discontinued until a plan is written. The new plan will require to be in conformance with Service policy to the extent possible.
- Stocking will be of rainbow trout (*Oncorhynchus mykiss*) only. While these are not truly native, they are close to the native species found in the area. Stocking of other species and of genetically modified trout will not be allowed.
- The State of Washington will apply rotenone and other chemicals only in consultation with the Service. The Service may require that rotenone, etc., be applied prior to stocking to meet the refuge purposes and to meet justification needs as described below.
- Monitoring will be conducted to ensure that high-quality habitat for feeding, resting, breeding, and thermal protection for waterfowl, waterbirds, and other wildlife species is maintained. Changes to regulations, additional closures, etc., may be implemented if undue impacts are being seen, as determined by refuge biologists and the Refuge Manager.
- CNWR will monitor and evaluate anglers and the fish stocking program to determine if objectives are being met.
- Inventory and monitoring will be conducted to identify and evaluate potential northern leopard frog (*Rana pipiens*) habitat and associated management needs. Selected lakes may be removed from the stocking program, and possibly fishing access closed, to facilitate frog recovery.
- CNWR will provide information on bank fishing and access at appropriate sites and through printed brochures. Information will also include current migratory bird and refuge regulations, as well as maps of closed areas.
- Closed areas and use restrictions will be aggressively enforced.
- All fishing on CNWR will require the appropriate State licenses and tags, and all fishing will be consistent with applicable State regulations, although there may be future instances where more stringent regulations are required to meet resource or management needs.
- Continue to maintain areas closed year-round to boating, areas seasonally closed, and waters open year-round.
- Continue the prohibition of gasoline motors on Upper Hampton, Lower Hampton, Hutchinson, Royal, and Shiner Lakes.
- Permit no boating of air-thrust and inboard water-thrust watercraft.
- Continue periodic law enforcement to help ensure compliance with regulations and area closures.
- Regulations will be described in brochures and posted at refuge boat ramps. Outreach and education to fishing and boating groups will occur periodically.

- Monitor boating activities by periodically assessing and estimating the level of boating activity in various locations. Maintain survey efforts to assess population numbers for the refuge populations of waterfowl and waterbirds. Monitoring data will be used by the Refuge Manager in the periodic re-evaluation of this Compatibility Determination.

The purpose of this FMP is to clearly articulate and document the Department's fish management and stocking practices on Refuge waters and demonstrate how these practices meet CCP recreational fishing stipulations. Refuge waters for the purpose of this FMP refer to all named and unnamed lakes and ponds and their inlets and outlets that are either entirely or mostly ($\geq 50\%$ total surface area) contained within CNWR boundaries. Appendix A lists all named Refuge lakes WDFW considers to reside entirely or mostly within CNWR boundaries and may stock with trout. Unnamed lakes and ponds are not specifically identified or addressed here because WDFW currently does not stock any of these waters. Any proposed stocking of unnamed lakes or ponds will occur after consultation with CNWR staff. Lower Crab Creek (including Marsh Units 1 and 2) is also not addressed in this FMP because WDFW does not currently stock this water.

The FMP must be completed and agreed to between the WDFW and Service within one year (October 31st, 2012) of the adoption of the CNWR CCP. If a FMP is not completed by October 31st, 2012, CNWR staff will prohibit fish management and stocking activities on Refuge lakes indefinitely until an agreed to plan is completed.

3.0 TERMS AND CONDITIONS

The primary objective of the CNWR CCP is to provide guidance for the conservation and management of the Refuge's native habitats, fish and wildlife, and other natural resources through 2026. During this time period, annual reviews and/or minor modifications of the CCP are permitted under the plan's adaptive management process. Extensive revisions to the CCP will occur once the document expires in 2026. The Department recommends this FMP adhere to the same terms and conditions as the CCP. More specifically, the Department will manage Refuge lakes for recreational fishing and maintain those fisheries through rehabilitation without extensive or significant revision through 2026. The Department and/or CNWR staff may review this FMP annually and make minor changes and/or improvements (e.g., remove/add a lake from the stocking program, change a regulation, update tables, etc.) as necessary to meet specific management objectives of each agency. The adaptive management process described below will be the mechanism for making proposed changes and/or improvements to this FMP. Major revisions to this FMP will occur, if necessary, during the re-adoption of this plan in 2026. A revised and adopted version of this FMP should be completed by WDFW in order to continue fish management and stocking activities on CNWR lakes.

4.0 REFUGE DESCRIPTION AND MAPS

The CNWR is located just northwest of the City of Othello in Grant and Adams Counties (Figures 1 and 2). The refuge was established in 1944 with an initial 120 acre purchase of land along lower Crab Creek. Multiple land acquisitions later, the CNWR now encompasses 29,656 acres and surrounds much of the lower Crab Creek Watershed. The CNWR was established primarily as a winter refuge and additionally as a breeding ground for migratory birds and other wildlife. All land acquisitions were authorized by the Migratory Bird Conservation Commission.

In its natural state, CNWR lands were shrub-steppe habitat composed mostly of sagebrush, rabbit brush, and bunchgrasses. The basalt landscape was carved and gouged by the Lake Missoula floods creating large coulees and potholes, redistributing substrates, and depositing fertile glacial soils. The only significant source of surface water was ephemeral Crab Creek that went dry during the summer and fall months. Native wildlife inhabiting the CNWR was generally low in abundance and limited to species adapted to shrub-steppe habitat including deer, coyotes, rodents, snakes, and song birds. Native fish present included red band rainbow trout (resident and anadromous life history types) and native minnows (e.g., suckers *Catostomus spp*, chubs *Gila spp*, sculpins *Cottus spp*, etc.) inhabiting lower Crab Creek.

The landscape of the CNWR was forever changed with the completion of the Columbia Basin Irrigation Project (CBIP) in the late 1940s. The CBIP is the largest water reclamation project in the United States with an original vision of supplying irrigation water to 1.1 million acres of farmland within the Columbia Basin. Only about two thirds of the entire CBIP was completed with intentions to finish the rest of the project waning in the 1960s. Irrigation water is diverted from the Columbia River (Lake Roosevelt) into storage reservoirs (Banks and Billy Clapp Lakes) and then supplied through a vast system of canals to farmers from Odessa south to Pasco. Currently, the CBIP provides irrigation water to approximately 670,000 acres of farmland. One of the unintended benefits of the CBIP was the creation of numerous lakes and ponds throughout the Columbia Basin through seepage, irrigation returns, and/or elevated water tables.

Approximately 39 named and several unnamed lakes and ponds from <1 to 100 surface acres now exist within the CNWR. The once ephemeral lower Crab Creek now flows continuously due to seepage from Potholes Reservoir. Seepage and elevated water tables also created several wetlands and riparian areas within the refuge. As a result, wildlife abundance and diversity increased during this time as waterfowl, shorebirds, amphibians, and other water-dependent wildlife used the refuge more. Shrub-steppe habitat converted to farmland provided a constant and abundant food source for resident and migrating wildlife inhabiting the refuge. Many of the newly formed lakes within the refuge were stocked with trout by Department fishery biologists

to provide recreational fishing opportunities. Native and non-native fish species also colonized the now perennial lower Crab Creek.

Columbia National Wildlife Refuge, Washington State

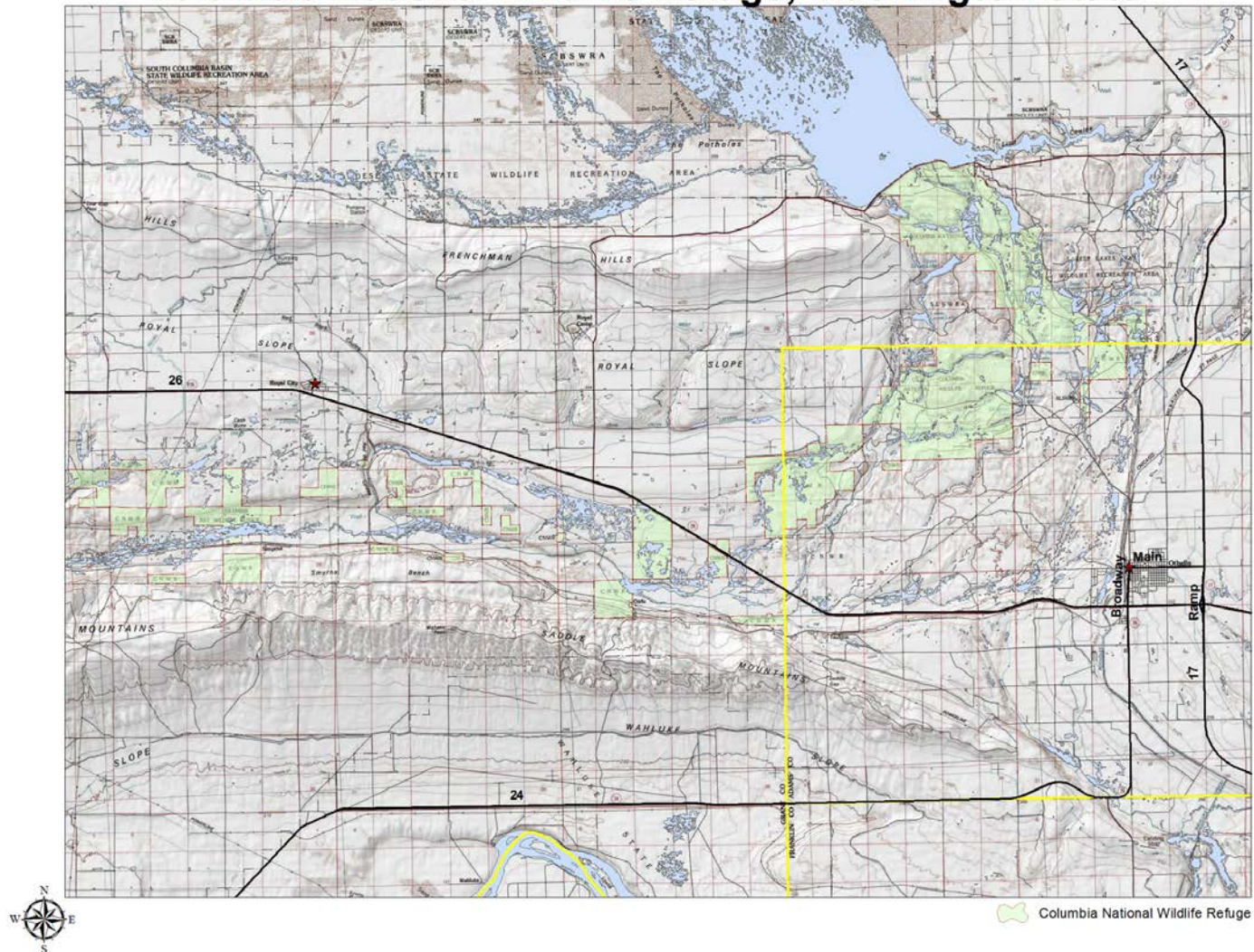


Figure 1. The Columbia National Wildlife Refuge located in Grant and Adams Counties near Othello, WA.

Columbia National Wildlife Refuge: Named Lakes

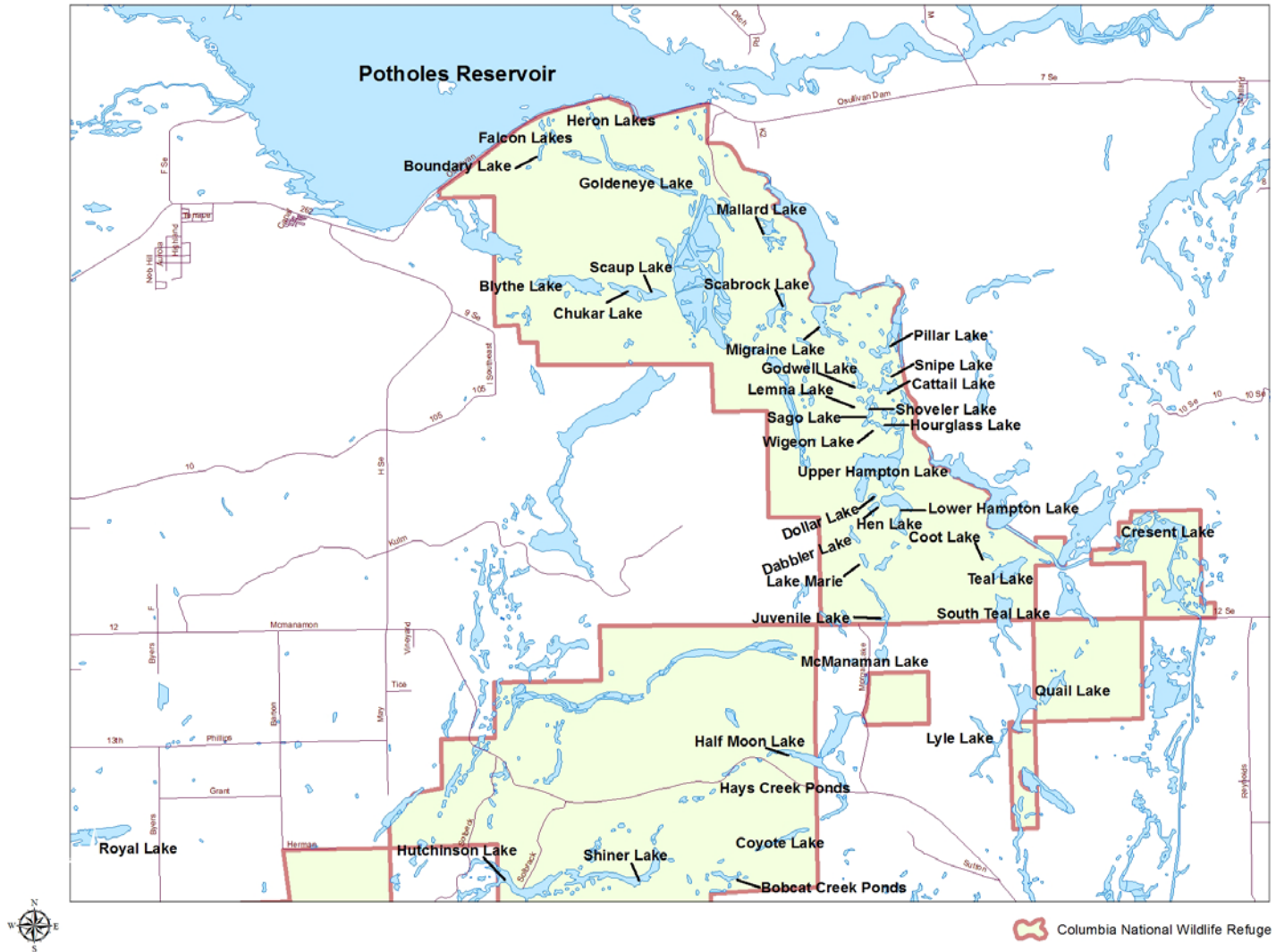


Figure 2. Columbia National Wildlife Refuge managed lakes.

5.0 HISTORICAL FISH MANAGEMENT (1950-1979)

5.1 Fishery Management

The WDFW (formerly the Departments of Game and Wildlife) have managed CNWR lakes for recreational fishing since the middle 1950s. Past fishery managers stocked trout into several of the newly formed and productive Refuge lakes to provide recreational fishing opportunities. From the middle 1950s through 1970s, Refuge lakes were managed primarily as production trout fisheries. The management objective of a production trout fishery is to maximize the abundance of catchable sized yearling trout (≥ 12 inches) to support high angler catch rates (≥ 3 trout/angler) and exploitation ($\geq 75\%$ of stocked trout) from spring through fall. Escapement or carryover of yearling trout to older age classes (e.g., ages 2-3) is typically low in these lakes due to high angler exploitation. Production trout fisheries were maintained through annual plants of trout fingerlings stocked mostly during the spring (late-March through May) at a size of 2-3 inches in length or around 100 fish per pound (fpp). Stocking densities varied depending upon lake size, depth, and productivity, but typically averaged 300 fish per surface acre (fish/SA) and ranged between 200-500 fish/SA. Stocked trout forage on aquatic food items (e.g., zooplankton and insects) in the lake and grow to a catchable size by the following spring. The Department almost exclusively stocked rainbow trout into Refuge lakes. However, historical stocking records indicate brown trout (*Salmo trutta*) and Atlantic salmon (*Salmo salar*) were planted into Quail Lake in 1969 and 1975, respectively. The concept of quality trout fisheries was introduced to Refuge lakes in the early 1960s, with three lakes (Blythe, Chukar, and Scaup Lakes) that received this designation. The management objective of a quality trout fishery is to maximize annual growth and carryover rates of stocked trout. Trout grow closer to 14 inches in length as yearlings and can achieve sizes of 20 inches and greater as they carryover to older age classes. In order to achieve these growth rates, stocking densities of quality trout fisheries is typically half or less of production trout fisheries at ≤ 150 fish/SA. To maximize carryover rates, quality trout fisheries have more restrictive fishing regulations (described below) than production trout fisheries.

5.2 Fishery Maintenance

Both production and quality trout fisheries offer the greatest recreational fishing opportunity when maintained as monocultures in lakes free from competing, predatory, and/or nuisance fish species (e.g., pumpkinseed sunfish *Lepomis gibbosus*, yellow perch *Perca flavescens*, bullheads *Ameiurus spp*, common carp *Cyprinus carpio*, etc). Fishery managers kept Refuge lakes free from these fish species through periodic treatments with the aquatic pesticide rotenone. Rotenone is a naturally occurring substance derived from the roots of certain tropical plants found in areas of South America, Asia, Oceania, and Australia (Finlayson, et al., 2000). Indigenous peoples have used rotenone for centuries to gather fish in areas where these plants naturally occur. Rotenone is toxic to fish at the cellular level, where it binds along the electron

transport chain inhibiting cellular respiration (Bradbury 1986). The Department has treated Washington lakes with rotenone (termed rehabilitations) since the middle 1940s. Lake rehabilitations were common events on the Refuge during the 1950s through 1970s. The first lake rehabilitation on the CNWR was performed in 1958 on Hutchinson and Shiner Lakes. Appendix A summarizes lake rehabilitations performed on CNWR lakes from 1950 to present.

The Department applied both powdered and liquid formulations of rotenone to treat the main body and shoreline areas of Refuge lakes, respectively. Past fishery managers had a great deal of flexibility to perform lake rehabilitations on Refuge lakes and other State waters both in time and frequency. Treatments occurred over a wide work window during the spring (March-May) and fall (September-November) months. Refuge lakes were rehabilitated every 3-10 years because of illegal introductions of unwanted fish species, infestation from connected surface waters, and/or poor applications. Application methods were rather unsophisticated and sometimes resulted in poor treatment success. For example, powdered rotenone came in plastic lined burlap sacks and was applied to the water by towing them behind a boat traveling at relatively high speeds. This application method sometimes made spreading rotenone evenly across a lake difficult (especially for small lakes), resulted in powdered rotenone becoming airborne and settling on land, and negatively impacted desired lake toxicity. Airborne rotenone also increased exposure levels to workers and the general public observing the treatment and/or collecting dying fish (permitted during this time period). Lake rehabilitations were also performed with minimal to no environmental permitting or oversight to assess impacts to water quality and/or non-target organisms (e.g., zooplankton, aquatic insects, amphibians, etc). Public notification and/or scoping for lake rehabilitations was sometimes inadequate depending on the project.

5.3 Fishing Regulations

Fishing regulations on Refuge lakes varied annually and changed considerably during this time period. From 1950 through 1954, Refuge lakes in Grant County were open to fishing from April 17th through October 31st, while Adams County lakes were open year-round. Daily bag limits of trout were liberal at 7.5 pounds plus one trout provided that total catch did not exceed 15 trout. Beginning in the middle 1950s, several Refuge lakes received legal names which allowed fishery managers to easily change fishing regulations and list them in the annual sport fishing rules pamphlet. As a result, the majority of Refuge lakes changed to seasonal fishing from middle to late April (i.e., the second, third, or fourth Sunday) through either August 15th or October 31st. A small number of mostly unnamed Refuge lakes in Adams County remained open year-round to fishing. Daily bag limits of trout remained liberal, but did decrease slightly in 1961 to 6 pounds plus one trout provided that total catch did not exceed 12 trout. Fishery managers also experimented with winter and quality trout fisheries on select Refuge lakes. Winter fisheries were open to fishing from the last Saturday in October through March 15th. The Pillar-Widgeon lake chain in Grant County was managed as winter fisheries from 1957 to 1961. In 1962, the fishing regulation on this lake chain changed back to a middle to late-April through August 15th

season and from that point no other Grant County lakes were managed as a winter fishery. Conversely, Halfmoon Lake in Adams County retained the winter season until 1979. From 1961 through 1967, fishery managers designated Blythe, Chukar, and Scaup Lakes as restricted fishing waters in the sport fishing rules pamphlet and managed them as quality trout fisheries. Fishing regulations on these three lakes were more restrictive with a daily bag limit of three trout, a minimum size limit of 12 inches, no bait allowed, and no fishing from a floating device allowed. Later in 1975, Quail Lake was changed to a quality trout fishery with fly fishing gear only and catch-and-release regulations.

6.0 CURRENT FISH MANAGEMENT (1980-2012)

6.1 Fishery Management

Fishery management on CNWR lakes remained largely unchanged from 1980 to present. The majority of lakes were managed as production trout fisheries stocked annually with rainbow trout fingerlings in the spring and fall and at the same stocking densities. Quail Lake remained as the only Refuge water managed for quality trout production. Trout growth and fishery performance expectations (e.g., yearling growth, carryover rates, harvest rates, etc.) also remained the same during this time period. Fish management and stocking changes of significance that did occur during this time included the introduction of non-rainbow trout species and select Refuge lakes managed for warmwater fish.

From 1980 to present, fishery managers introduced different species of trout (i.e., other than rainbow trout) into Refuge lakes with the objective of enhancing the fishery for recreational anglers. A total of 16 Refuge lakes were stocked with different species of trout that included brook trout (*Salvelinus fontinalis*), brown trout, Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), and/or tiger trout (*Salmo trutta X Salvelinus fontinalis*). Lahontan cutthroat trout was the most frequent non-rainbow trout species planted into Refuge lakes according to historical stocking records. The use of these different trout species became more common due in part to WDFW establishing captive brood or brood stock trapping programs across the State. Fishery managers usually stocked one or two of these different trout species, in addition to rainbow trout, at rate of $\leq \frac{1}{2}$ of a particular lake's total stocking allotment (e.g., Quail Lake: 1,250 total trout allotment including 850 rainbow, 200 brown, and 200 tiger trout). However, fishery managers periodically replaced rainbow trout plants into Refuge lakes entirely with different trout species.

Perhaps the most significant fishery management change during this time was the designation of select Refuge lakes as warmwater fisheries (e.g., bass, panfish, catfish, etc.). During its 1996 regular session, the Washington State Legislature unanimously passed Fourth Senate Substitute Bill 5159 (WDFW 2005). This legislation established a dedicated funding source creating the

Warmwater Fish Program within WDFW. The overarching goal of the Warmwater Fish Program is to increase recreational angling opportunity for warmwater fish across Washington State. One of the specific program goals was to designate between 80-100 lakes statewide where quality warmwater angling existed or could be enhanced through various management actions (e.g., access development, regulation changes, habitat and fish community manipulations, etc.). Shortly after Bill 5159 passed, Region 2 FP staff designated Hutchison and Shiner Lakes as warmwater fisheries. Furthermore, the Warmwater Fish Program directed funds towards two enhancement projects at these two lakes to improve warmwater fishing. The first project used warmwater funds to build a fish barrier at the outlet of Hutchinson Lake, which drains into Crab Creek. The objective of the fish barrier was to prevent upstream immigration of common carp and other nuisance fish species from entering into both lakes. After the installation of the fish barrier, warmwater funds were used to rehabilitate both lakes and all connected surface waters to eradicate the existing fish community dominated by common carp. Following the lake rehabilitations, Region 2 FP restocked Hutchinson and Shiner Lakes with largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), and bluegill sunfish (*Lepomis macrochirus*). Both lakes today remain as popular warmwater fisheries.

6.2 Fishery Maintenance

Lake rehabilitations remained as the primary management tool used to eradicate competing, predatory, and/or nuisance fish species and restore trout fisheries in Refuge lakes. The Department rehabilitated several CNWR lakes from 1980 to present, with the most recent treatments occurring in 2010 on North and South Teal Lakes. Several changes to WDFW's lake rehabilitation program were made to improve environmental responsibility, transparency with the general public and other entities, application methods, and safety to the applicators and public.

The Department now performs lake rehabilitations under much greater environmental oversight and permitting than before. Lake rehabilitations are covered under a National Pollutant Discharge Elimination System (NPDES) permit issued by the Washington State Department of Ecology (Ecology), which replaces the old temporary water quality variance permits governing past treatments. Ecology is the agency charged with controlling water and air pollution in Washington State. The Department's NPDES permit identifies a number of special conditions that WDFW fisheries staff must adhere to when planning and performing lake rehabilitations. Special conditions identified in the NPDES include, but not limited to, pre- and post-treatment water quality monitoring and sampling of macroinvertebrates (e.g., zooplankton), performing bioassays using live fish to document date of lake detoxification, and drafting more detailed post-rehabilitation reports describing treatment methods, quantity of rotenone used, and fish species eradicated. Additionally, the Department completes a Section 7 consultation under the Endangered Species Act through the Service and an environmental review under the State Environmental Policy Act (SEPA) for all proposed lake rehabilitations.

Public notification and scoping for lake rehabilitations improved substantially during this time period. The Department's NPDES permit lists several public notification procedures including, but not limited to, notifying property owners within one quarter mile of waters proposed for treatment, obtaining agreements from water rights holders to prohibit water withdrawal during and post-treatment, publishing legal announcements in local newspapers 10-21 days prior to treatment, signing all areas of access to the project site, and restricting public access at the project site. WDFW policies/procedures require Department staff to obtain Director approval, commit staff to hold public meetings, and issues news releases prior to all treatments. The general public and other entities can also provide comments during SEPA review process.

The Department also changed application methods to improve treatment success and reduce rotenone exposure to workers and the public. The most significant change made was to the application of powdered rotenone. Powdered rotenone is now mixed with lake water and applied as slurry using a flat bottomed boat equipped with a venturi pump system. This new application method practically eliminates powdered rotenone from becoming airborne and significantly reduces exposure to workers.

For more information on WDFW's lake rehabilitation standard operating procedures, consult Appendices B (NPDES Permit) and C (WDFW Actions and Timelines).

6.3 Fishing Regulations

Fishing regulations on Refuge lakes continued to change during this time period. In 1980, several Refuge lakes changed from mostly spring through summer/fall seasons to a more liberal March 1st through July 31st or September 30th season. All remaining Refuge lakes were open to fishing year-round, including Quail Lake which up to this point had been opened seasonally since 1975. Seasonal lakes that remained open to fishing until September 30th were those managed primarily as warmwater fisheries. August and September are prime months for warmwater fishing. Fishing regulations on Refuge lakes remained static for nearly two decades, with the exception of Royal Lake that from 1992 through 2001 was open to fishing from the last Saturday in April through July 31st. Royal Lake had a more restrictive fishing regulation during this time to reduce disturbance of waterfowl and other shore birds and in 2002 was changed to closed waters to further reduce bird disturbance. Also of interest during this time was the regulation change on the Pillar-Wigeon lake chain in 1996 from a March 1st through July 31st season to a two month season in March and September only. An environmental assessment completed for the CNWR recommended changes to fishing regulations on selected lakes to reduce migratory bird impacts during the breeding, nesting, migration, and wintering time periods. Evaluation by CNWR staff of waterfowl use on the Pillar-Wigeon lake chain during the spring and summer fishing closures concluded no significant changes in nesting activity. Conversely, negative impacts to migrating and wintering birds using this lake chain were

observed during March and September. Given these results, WDFW and CNWR staff determined that an April 1st through September 30th fishing season would provide adequate recreational fishing opportunity while reducing disturbance to migratory birds during migration and wintering periods. All remaining Refuge lakes could be open to recreational fishing seasonally or year-round. These changes were made in 2002 and remain as the current fishing regulation construct today.

7.0 PROPOSED FISH MANAGEMENT (2013-2026)

7.1 Fishery Management

The WDFW remains committed to providing and maintaining recreational fishing opportunities on CNWR lakes through 2026. Refuge lakes will be managed as production or quality trout fisheries only. The Department will stock only rainbow trout into Refuge lakes. Stocking will occur primarily during the spring and fall months. A variety of rainbow trout sizes will be stocked into Refuge lakes. Service policy prohibits stocking catchable size fish into federal refuge lakes for the sole purpose of providing and sustaining recreational fishing. However, no definition for catchable size fish is provided in the policy. As such, the Department will use its own definition of catchable size fish to describe rainbow trout stocked into Refuge lakes. The Department defines a catchable size fish as one raised in a hatchery to a size desirable and easily caught by recreational anglers immediately after release. A catchable size rainbow trout is ≤ 2.5 fpp or measuring 12 inches average length at release. CNWR lakes will only be stocked with rainbow trout measuring ≥ 2.5 fpp or < 12 inches. Typically, rainbow trout stocked into Refuge lakes are much smaller in size ranging from 60-100 fpp or 2-4 inches in length.

Consistent with Service policies and the CNWR CCP, the Department will no longer emphasize warmwater fish management on Refuge lakes following the adoption of this FMP. However, the Department recommends that Hutchinson and Shiner Lakes remain as warmwater fisheries for at least the short-term because both waters still have simple and balanced fish communities (Schmuck and Petersen 2005). The Department believes the fish communities in these two lakes do not significantly impact wildlife resources and/or the aquatic environment any differently than Refuge lakes managed as trout monocultures. When the warmwater fish communities in Hutchinson and Shiner Lakes diminish significantly and/or negative impacts to wildlife resources and/or the aquatic environment are realized, the Department will rehabilitate both waters and return them back to rainbow trout management. Additionally, Crescent Lake will not be actively managed as a rainbow trout fishery during this time period. Crescent Lake is a wide spot in the Potholes Canal whose fish community is influenced by fish migrating from Potholes Reservoir and Long and Soda Lakes. Currently, there is a mixture of warmwater fish, nuisance fish, and rainbow trout present in Crescent Lake. Lake rehabilitation is not a feasible option for this site.

7.2 Fishery Maintenance

Lake rehabilitations will remain as the primary management tool used by WDFW to restore and maintain rainbow trout fisheries in CNWR lakes through 2026. The Department will adhere to all special conditions and requirements listed in our NPDES permit (Appendix B) and our internal policies/procedures (Appendix C) when proposing and performing lake rehabilitations on the CNWR. The Department believes these special conditions and requirements provide adequate notification and opportunity for CNWR staff to consult and coordinate with WDFW staff.

WDFW's ability to rehabilitate Refuge lakes on a routine basis, whether for fishery or conservation purposes, is dependent upon a number of factors. The Department typically performs between three to a dozen rehabilitations per year in several eastern Washington counties located in Regions 1 and 2. These treatments are performed on a rotational basis between the two regions. The total number of rehabilitations performed annually is dependent upon total surface acreage proposed for treatment, current rotenone inventory, and available funds for new rotenone purchases. WDFW staff time and total operating budget (e.g., equipment purchases, outside contracting, travel and per diem, etc.) are also important factors affecting our ability to perform lake rehabilitations.

7.3 Fishing Regulations

The Department intends to maintain the current recreational fishing regulation construct on Refuge lakes through 2026. Fishing seasons on Refuge lakes are either seasonal (i.e., April-September), year-round, or closed. Daily bag limits for all game fish will be managed under WDFW's statewide general rule, which for trout is five fish and no minimum size. Quail Lake will continue to be managed as catch-and-release for all species. Appendix A summarizes fishing regulations for all named Refuge lakes. Unnamed Refuge lakes and ponds are open year-round to fishing. Fishing regulations for lower Crab Creek (including Marsh Units 1 and 2) are fully described in the current WDFW Sport Fishing Rules Pamphlet published annually.

If necessary, fishing regulation changes on Refuge lakes can be accomplished through the Department's Major Regulation Cycle (MRC). The MRC is a process where the Department accepts and evaluates fishing regulation change proposals from internal staff and external entities and submits them to the WDFW Commission for adoption as law. The Department will notify CNWR staff of all future MRCs during this time period. Additionally, the Department will take the lead drafting and submitting any regulation change proposals for Refuge lakes.

7.4 CCP Stipulations

Many of the fish management and stocking practices the Department currently employs will be used to provide and maintain recreational fishing on CNWR lakes through 2026. However,

minor changes to some of those practices are necessary in order to become totally compliant with recreational fishing stipulations identified in the CCP. Refuge staff believes these stipulations are necessary to ensure the long-term compatibility between recreational fishing and CNWR conservation and management objectives. Certain stipulations identified in the CCP are the primary responsibility of the Service, whereas others are specific to WDFW fish management and stocking practices. Table 1 below lists all 16 CCP recreational fishing stipulations and summarizes the Department's current practices and/or responsibilities and all necessary actions required to become compliant with those stipulations.

Table 1. List of CNWR CCP recreational fishing stipulations, WDFW current responsibilities and/or practices, and WDFW required actions and explanations.

| CNWR CCP STIPULATION | CURRENT WDFW RESPONSIBILITY AND/OR PRACTICE(S) | WDFW ACTION REQUIRED (Y/N) & EXPLANATION |
|--|---|--|
| <p>a. Fish stocking operations will be conducted in accordance with an approved Fisheries Management Plan, developed in conjunction with WDFW.</p> <p>b. If a new plan is not developed within one year of the CCP being adopted, the stocking program will likely be discontinued until a plan is written.</p> <p>c. The new plan will be required to be in conformance with Service policy to the extent possible.</p> | <p>a. The Department currently stocks trout into CNWR lakes under an expired FMP written in 1996.</p> <p>b. Trout stocking into CNWR lakes did not discontinue when the 1996 FMP expired.</p> <p>c. The Department adheres to all Service policies to the extent possible when stocking trout into CNWR lakes.</p> | <p>a. <u>Action Required:</u> The Department will complete a new FMP that will guide WDFW fish management and stocking activities on CNWR lakes through 2026. This FMP will be mutually agreed to between WDFW and Service staff and updated/renewed when appropriate per the Terms and Conditions section of this FMP.</p> <p>b. <u>Action Required:</u> If the Department does not complete a new FMP within one year (October 31st 2012) of the CCP's adoption, WDFW will voluntarily suspend fish stocking on CNWR lakes until a plan is completed.</p> <p>c. <u>Action Required:</u> This and future FMPs will conform to all current and future CCP stipulations and pertinent Service policies to the extent possible.</p> |
| <p>a. Stocking will be of rainbow trout only. While these are not truly native, they are close to the native species found in the area.</p> <p>b. Stocking of other species and of genetically modified trout will not be allowed.</p> | <p>a. The Department stocks rainbow trout, brook trout, brown trout, Lahontan cutthroat trout, and tiger trout into CNWR lakes. However, this practice has decreased substantially since 2010 with only Quail Lake receiving plants of non-rainbow trout species in 2012.</p> <p>b. The Department does not stock any genetically modified trout (i.e., genetically modified organisms-GMO)</p> | <p>a. <u>Action Required:</u> The Department will stock only rainbow trout into all CNWR lakes beginning in 2013 and through 2026.</p> <p>b. <u>Action Required:</u> The Department will not stock any GMOs into CNWR lakes. The Department may stock triploid rainbow trout to achieve fishery management goals. Triploid rainbow trout are not classified as</p> |

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| | into CNWR lakes. | GMOs because no new genetic material is being introduced into the fish from a different species. |
| <ul style="list-style-type: none"> a. The State of Washington will apply rotenone and other chemicals only in consultation with the Service. b. The Service may require that rotenone, etc., be applied prior to stocking to meet Refuge purposes and to meet justification needs as described below. | <ul style="list-style-type: none"> a. The Department applies rotenone to CNWR lakes only under consultation with Refuge staff per WDFW's NPDES permit and our internal policies/procedures. b. The Department applies rotenone and monitors lake detoxification prior to stocking with trout. | <ul style="list-style-type: none"> a. <u>No Action Required:</u> The Department's NPDES permit and our internal policies/procedures provides adequate pre-notification and opportunities for CNWR staff to review, comment, and coordinate with WDFW on all proposed Refuge lake rehabilitations. b. <u>No Action Required:</u> The Department applies rotenone and monitors lake detoxification prior to stocking with trout. |
| <ul style="list-style-type: none"> a. Monitoring will be conducted to ensure that high-quality habitat for feeding, resting, breeding, and thermal protection for waterfowl, waterbirds, and other wildlife species is maintained. b. Changes to regulations, additional closures, etc., may be implemented if undue impacts are being seen, as determined by Refuge biologist and the Refuge Manager. | <ul style="list-style-type: none"> a. The Department does not conduct any habitat assessments for waterfowl, waterbirds, or other wildlife on the CNWR. b. The Department does not assess whether or not undue impacts to waterfowl, waterbirds, or other wildlife on the CNWR occur as a result of fish management and stocking activities. The Department is responsible for evaluating fishing regulation change proposals through WDFW's MRC. Approved regulation change proposals are submitted to the WDFW Commission for adoption into law. | <ul style="list-style-type: none"> a. <u>No Action Required:</u> Habitat assessments for waterfowl, waterbirds, or other wildlife on the CNWR is the responsibility of Refuge staff. b. <u>No Action Required:</u> Assessing undue impacts to waterfowl, waterbirds, or other wildlife on the CNWR as a result of fish management and stocking activities is the responsibility of Refuge staff. However, the Department will take the lead drafting and submitting fishing regulation changes on CNWR lakes if undue impacts to waterfowl, waterbirds, or other wildlife are realized. |
| <ul style="list-style-type: none"> a. CNWR will monitor and evaluate anglers and the fish stocking program | <ul style="list-style-type: none"> a. The Department annually performs opening day creel surveys on CNWR | <ul style="list-style-type: none"> a. <u>No Action Required:</u> Monitoring and evaluating the fishing stocking |

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| <p>to determine if objective are being met.</p> | <p>lakes to only evaluate whether or not fishery objectives are being met.</p> | <p>program within the CNWR to determine if Refuge objectives are being met is the responsibility of Refuge staff. However, the Department will make opening day creel survey results available to CNWR staff to aid in their evaluation of the fish stocking program.</p> |
| <p>a. Inventory and monitoring will be conducted to identify and evaluate potential northern leopard frog habitat and associated management needs. b. Selected lakes may be removed from the stocking program and possibly fishing access closed to facilitate frog recovery.</p> | <p>a. The Department does not conduct habitat assessments for leopard frog recovery within the CNWR. b. The Department has not removed any CNWR lakes from the stocking program to facilitate leopard frog recovery.</p> | <p>a. <u>No Action Required:</u> Conducting habitat assessments for leopard frog recover within the CNWR is the responsibility of Refuge staff. b. <u>Action Required:</u> The Department will remove select CNWR lakes from the stocking program if they are deemed appropriate for leopard frog recovery. Refuge lakes can be removed from the stocking program immediately through communication between the Region 2 FP and hatchery staff. Closing or changing access to CNWR lakes identified for leopard frog recovery is the responsibility of Refuge staff.</p> |
| <p>a. CNWR will provide information on bank fishing access at appropriate sites and through printed brochures. b. Information will also include current migratory bird and Refuge regulations, as well as maps of closed areas.</p> | <p>a. The Department provides information on bank fishing to recreational anglers who contact WDFW offices or local fishery biologists. b. The Department refers recreational anglers to the CNWR website for information on current migratory bird and Refuge regulations and maps identifying closed areas.</p> | <p>a. <u>No Action Required:</u> Producing printed brochures on bank fishing access sites on the CNWR is the responsibility of Refuge staff. However, the Department will provide pertinent fishing information to Refuge staff to assist in the development of brochures. b. <u>No Action Required:</u> Providing</p> |

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| | | information on current migratory bird and CNWR regulations and maps identifying closed areas in the CWNR is the responsibility of Refuge staff. |
| c. Closed areas and use restrictions will be aggressively enforced. | a. WDFW Enforcement Officers assist Service Officers enforce closed and restricted use areas within the CNWR to extent possible during routine patrols. However, WDFW Enforcement Officers cannot issue citations for lands managed by the federal government. Arrest information is submitted to Service Enforcement Officers for further action. | a. <u>No Action Required</u> : Enforcement of CNWR closed and restricted use areas is the responsibility of Service Enforcement Officers. However, WDFW Enforcement Officers will continue to assist Service Enforcement Officers enforce closed and restricted use areas to extent possible during routine patrols. Arrest information will be submitted to Service Enforcement Officers for further action. |
| a. All fishing on CNWR will require the appropriate State licenses and tags and all fishing will be consistent with applicable State regulations, although there may be future instances where more stringent regulations are required to meet resource and management needs. | a. Recreational anglers must possess a current and valid WDFW fishing license and must adhere to all applicable fishing regulations when fishing CNWR lakes. | a. <u>No Action Required</u> : Recreational anglers will still be required to possess a current and valid WDFW fishing license and must adhere to all applicable fishing regulations when fishing CNWR lakes through 2026. The Department will also take the lead drafting and submitting more stringent fishing regulations on CNWR lakes as necessary through WDFW's MRC. |
| a. Continue to maintain closed year-round to boating, areas seasonally closed, and waters open year-round. | a. The Department does not have the authority to establish boating restrictions on CNWR lakes and other State waters. WDFW can adopt fishing regulations that prohibit anglers from fishing from floating devices. However, these regulations only apply | a. <u>No Action Required</u> : Boating restrictions on CNWR lakes is the responsibility of Refuge staff. |

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| | | to users actively fishing and not to other boaters. | |
| a. Continue the prohibition of gasoline motors on Upper Hampton, Lower Hampton, Hutchinson, Royal, and Shiner Lakes. | a. | The Department does not have the authority to prohibit gasoline motor use on CNWR lakes and other State waters. WDFW can adopt fishing regulations that prohibit anglers from fishing from floating devices equipped with a gasoline motor. However, these regulations only apply to users actively fishing and not other boaters. | a. <u>No Action Required</u> : Restricting gasoline motor use on CNWR lakes is the responsibility of Refuge staff. |
| a. Permit no boating that is not associated with fishing or wildlife observation and photography. | a. | The Department does not have the authority to establish boating restrictions on CNWR lakes and other State waters. | a. <u>No Action Required</u> : Boating restrictions on CNWR lakes is the responsibility of Refuge staff. |
| a. Continue the prohibition of air-thrust and inboard water-thrust watercraft. | a. | The Department does not have the authority to prohibit air-thrust and inboard water thrust watercraft on CNWR lakes and other State waters. WDFW can adopt fishing regulations that prohibit anglers from fishing from floating devices equipped with a gasoline motor. However, these regulations only apply to users actively fishing and not other boaters. | a. <u>No Action Required</u> : Air-thrust and inboard water-thrust watercraft prohibitions on CNWR lakes is the responsibility of Refuge staff. |
| a. Continue periodic law enforcement to help ensure compliance with regulations and area closures. | b. | WDFW Enforcement Officers assist Service Enforcement Officers enforce closed and restricted use areas within the CNWR to extent possible during routine patrols. However, WDFW Enforcement Officers cannot issue citations for lands managed by the | a. <u>No Action Required</u> : Enforcement of CNWR closed and restricted use areas is the responsibility of Service Enforcement Officers. However, WDFW Enforcement Officers will continue to assist Service Enforcement Officers enforce closed and restricted |

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| | federal government. Arrest information is submitted to Service Enforcement Officers for further action. | use areas to extent possible during routine patrols. Arrest information will be submitted to Service Enforcement Officers for further action. |
| <ul style="list-style-type: none"> a. Regulations will be described in brochures and posted at Refuge boat ramps. b. Outreach and education to fishing and boating groups will occur periodically. | <ul style="list-style-type: none"> a. The Department does not produce brochures or post signs at boat ramps describing CNWR regulations. b. The Department does not perform any formal outreach and education activities to fishing and boating groups using CNWR lakes. | <ul style="list-style-type: none"> a. <u>No Action Required</u>: Producing brochures or posting signs at boat ramps on CNWR lakes that describe regulations is the responsibility of Refuge staff. However, the Department will provide pertinent fishing information to Refuge staff to assist in the development of brochures and signs. b. <u>No Action Required</u>: Periodic outreach and education activities for fishing and boating groups on CNWR lakes is the responsibility of Refuge staff. However, the Department will assist Refuge staff perform periodic outreach and education activities to fishing groups to the extent possible. |
| <ul style="list-style-type: none"> a. Monitor boating activities by periodically assessing and estimating the level of boating activity in various locations. b. Maintain survey efforts to assess population numbers for the Refuge populations of waterfowl and waterbirds. c. Monitoring data will be used by the Refuge Manager in the periodic re-evaluation of this Compatibility | <ul style="list-style-type: none"> a. The Department does not monitor boating activities on CNWR lakes. b. The Department does not assess waterfowl and waterbird population numbers on the CNWR. c. The Department does not evaluate the Service's fishing Compatibility Determination for the CNWR. | <ul style="list-style-type: none"> a. <u>No Action Required</u>: Monitoring boating activities on CNWR lakes is the responsibility of Refuge staff. However, the Department will provide Refuge staff with any creel survey results that includes boat angler data. b. <u>No Action Required</u>: Waterfowl and waterbird population assessments on the CNWR is the responsibility of Refuge staff. c. <u>No Action Required</u>: Periodic |

Determination.

evaluation of the fishing Compatibility
Determination on the CNWR is the
responsibility of the Refuge Manager
and/or Refuge staff.

8.0 MONITORING AND EVALUATION

Monitoring and evaluating fishery performance is an important component of WDFW's statewide trout stocking program, which includes CNWR lakes. For production and quality trout fisheries, Department staff evaluates fishery performance by conducting fish community and/or angler creel surveys. Data collected from both survey types is used by WDFW fishery managers to assess trout growth and relative abundance, predict fishery performance, fish species composition, angler effort, and harvest rates. Survey results may be used to modify trout stocking rates, change regulations, and/or recommend lake rehabilitation(s). Fish community and angler creel surveys have been performed on Refuge lakes since the middle 1950s. Provided below is a brief description of each survey type.

Fish community surveys involve collecting biological data from fish either through physical capture or observation. Sampling gear used to conduct fish community surveys includes, but not limited to electrofishing, gill nets, trap nets, seines, live traps, snorkeling, and fishing. WDFW most commonly uses electrofishing, gillnets, and/or trap nets to monitor and evaluate fishery performance and/or fish species composition in lakes. Fish community surveys may be conducted year-round, but most often occur during the spring (April-June) or fall (September-October) when a greater number and/or variety of fish are present in the near-shore areas because of cooler water temperatures. Survey frequency and/or sampling effort varies and is mostly dependent upon available staff time. Currently, the Department performs fish community surveys on Refuge lakes on an as needed basis.

Angler creel surveys typically involve interviewing fishers at a lake and during certain times to collect effort and catch data. WDFW fishery managers use interview data to estimate total angler harvest, numbers released, fish size and condition, and effort. Angler creel surveys may be conducted year-round, seasonally, or opportunistically depending upon survey objectives and/or available staff time. The Department annually performs angler creel surveys during opening day (April 1st) on most of the Refuge's seasonal lakes. Angler interviews are conducted between 8:00AM to 12:00PM on opening day. Annual opening day angler creel surveys also allow WDFW fishery managers to evaluate trends in angler effort and catch over time.

As described in the Communication and Coordination section below, Department staff will notify the Refuge Manager on all planned fish community and angler creel surveys on CNWR lakes. Survey results will be provided to the Refuge Manager at the earliest convenience.

9.0 COMMUNICATION AND COORDINATION

The Department will regularly communicate and coordinate with CNWR staff on all activities related to fish management and stocking on Refuge lakes. Communication and coordination will

occur annually and primarily in two forms including sharing of pertinent fish management and stocking information and attending meetings with CNWR staff. The Department annually produces trout stocking allotments and opening day angler creel survey reports, which includes Refuge lakes. The Department will provide the CNWR Manager with stocking allotments and opening day angler creel results annually. Additionally, the Department will provide the CNWR Manager with all pertinent information related to fish community surveys, proposed lake rehabilitations, and/or regulation change proposals. The Department will attend all scheduled coordination meetings with CNWR staff. Department and CNWR staff will determine whether coordination meetings need to occur on a regularly scheduled (e.g., annual, quarterly, etc.) or as needed basis.

10.0 ADAPTIVE MANAGEMENT

Adaptive management simply stated is learning by doing. More specifically, adaptive management utilizes the best available science and/or technologies to improve decision making and implement actions to better accomplish the goals and/or objectives of a particular plan. This FMP is intended to be a dynamic plan based off the concept of adaptive management. To that end, Department and/or CNWR staff may review this FMP annually and propose changes and/or improvements to fish management and stocking practices that benefit recreational fishing and/or wildlife resources. Changes and/or improvements should be based of the best available science and/or technologies. Both agencies must mutually agree to any changes and/or improvements through scheduled coordination meetings. The adaptive management process will not be used to curtail or significantly alter recreational fishing opportunities on Refuge lakes. As mentioned above in the Terms and Conditions section of this FMP, major plan revisions will occur, if necessary, during the re-adoption of this plan in 2026.

11.0 REFERENCES

- Bradbury, A. 1986. Rotenone and Trout Stocking: A literature review with special reference to Washington Department of Games's Lake Rehabilitation Program #86-2. Washington Department of Fish and Wildlife, Olympia, WA.
- Finlayson, B.J., R.A. Schnick, R.L. Cailteux, L. DeMong, W.D. Horton, W. McClay, C.W. Thompson, and G.J. Tichacek. 2000. Rotenone use in fisheries management: administrative and technical guidelines manual. American Fisheries Society, Bethesda, Maryland.
- Responsive Management. 2008. Washington Angler Survey. Harrisonburg, VA.
- Schmuck, M.R. and M.R. Petersen. 2005. 2004 Warmwater Fisheries Survey on Hutchinson and Shiner Lakes, Adams County, Washington. Washington Department of Fish and Wildlife, Olympia, WA.
- TCW Economics. 2008. Economic analysis of non-treaty commercial and recreational fisheries in Washington State. December 2008. Sacramento, CA. With technical assistance from The Research Group, Corvallis, OR.
- Washington Department of fish and Wildlife. 2005. Warmwater Fishes of Washington Report #FM93-9. Olympia, WA.
- Wolcott, E.E. 1973. Lakes of Washington, Volume II Eastern WA, Third Edition. Washington State Department of Ecology, Olympia, WA.

APPENDICES

APPENDIX A

Table 2. CNWR Named Lakes Currently or Potentially Managed for Recreational Fishing

| NAME | CO | SA ¹ | REG ² | FISH SPP STOCKED ³ | YEAR(S) REHABILITATED |
|--------------------|-------|-----------------|------------------|----------------------------------|--------------------------|
| Bobcat Creek Ponds | Adams | ND | OD | ND | 98 |
| Coyote Creek Ponds | Adams | ND | OD | RB | 98 |
| Hays Creek Ponds | Adams | ND | OD | RB,BT,BK,LCT | 98 |
| Hutchinson | Adams | 43 | OD | RB,LCT,LMB,BG,BC | 58,61,98 |
| Lyle | Adams | 13 | OD | RB | 59,69,75,82,98 |
| McManamon | Adams | 8 | OD | RB,LCT | 71,73,79,86,98 |
| Quail | Adams | 5 | YR | RB,BT,TT,AS | 68,74,82,89,99 |
| Shiner | Adams | 35 | OD | RB,LCT,LMB,BG,BC | 58,61,98 |
| Boundary | Grant | 3 | YR | RB | Never |
| Blythe | Grant | 30 | YR | RB | 65,71,76,83,88,97,07 |
| Cattail | Grant | 10 | OD | RB | 04 |
| Chukar | Grant | 13 | YR | RB | 65,71,76,83,88,97 |
| Coot | Grant | 4 | OD | RB | Never |
| Crescent | Grant | 40 | YR | ND | Never |
| Dabbler | Grant | 3 | YR | RB | 94,04 |
| Dollar | Grant | ND | YR | RB | Never |
| Falcon, East | Grant | 5 | YR | RB,BK | 76,83 |
| Falcon, South | Grant | 5 | YR | RB,BK | 76,83,00 |
| Falcon, West | Grant | 5 | YR | RB,BK | 76,83,00 |
| Gadwall | Grant | 7 | OD | RB,LCT | 86,04 |
| Goldeneye | Grant | 15 | YR | RB,BK | 60,70,76,83,88,00 |
| Hampton, Upper | Grant | 68 | OD | RB | 94,04 |
| Hampton, Lower | Grant | 20 | OD | RB | 73,94,04 |
| Hampton, Slough | Grant | 1 | YR | RB | 94,04 |
| Hen | Grant | 4 | OD | RB | 94,04 |
| Heron, North | Grant | 7 | YR | RB,BK | 76,83,00 |
| Heron, South | Grant | 7 | YR | RB,BK | 76,83,00 |
| Hourglass | Grant | 2 | OD | RB | 94,04 |
| Juvenile | Grant | 12 | OD | RB,LCT | 71,73,79,82,86,98 |
| Lemna | Grant | 2 | OD | RB,LCT | 04 |

| | | | | | |
|-------------|-------|----|----|-----------|--------------------------------|
| Mallard | Grant | 8 | YR | RB | Never |
| Marie | Grant | 8 | YR | RB | 94,04 |
| Migraine | Grant | 10 | YR | LCT | Never |
| Pillar | Grant | 10 | OD | RB,BK,LCT | 69,81,04 |
| Poacher | Grant | 1 | OD | RB,LCT | 04 |
| Sago | Grant | 4 | OD | RB | 94,04 |
| Scabrock | Grant | 10 | YR | ND | Never |
| Scaup | Grant | 9 | YR | RB | 65,71,76,83,88,97,07 |
| Shoveler | Grant | 8 | OD | RB,LCT | 86,04 |
| Snipe | Grant | 4 | OD | RB | 04 |
| Teal, North | Grant | 22 | OD | RB | 59,63,69,71,75,82,90,99, 10 |
| Teal, South | Grant | 28 | OD | RB | 59,63,69,71,75,82,90,99, 10 |
| Widgeon | Grant | 9 | OD | RB | 94,04 |

¹**Surface Acres:** ND=No Data

²**Fishing Regulation:** OD=Open to Fishing April 1st through September 30th, YR=Open to Fishing Year-Round

³**Fish Species Codes:** ND=No Data, RB=Rainbow Trout, BT=Brown Trout, BK=Brook Trout, LCT=Lahontan Cutthroat Trout, TT=Tiger Trout, AS=Atlantic Salmon, LMB=Largemouth Bass, BC=Black Crappie, BG=Bluegill Sunfish

APPENDIX B

WDFW NDPES Permit for Lake Rehabilitations



Issuance Date: June 5, 2002
Effective Date: July 5, 2002
Expiration Date: July 5, 2007

FISHERY RESOURCE MANAGEMENT
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE INDIVIDUAL PERMIT No. WA0041009
WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

State of Washington
DEPARTMENT OF ECOLOGY
Olympia, Washington 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

Washington Department of Fish and Wildlife
600 Capitol Way N.
Olympia, WA 98501-1091

is authorized to discharge in accordance with the special and general conditions which follow.

Megan White, P.E., Manager
Water Quality Program
Department of Ecology

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SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions of this permit for additional submittal requirements.

| Permit Section | Submittal | Frequency | First Submittal Date |
|----------------|---|----------------|--------------------------|
| S3.A | Post-Treatment Report / Discharge Monitoring Report | Annually | June 1, 2003 |
| S3.E | Noncompliance Notification | As necessary | |
| S5. | Antimycin SEPA Review | One time | June 1, 2005 |
| S7. | Spill Prevention and Response Plan | One time | Prior to first treatment |
| G1. | Notice of Change in Authorization | As necessary | |
| G4. | Permit Application for Substantive Changes to the Discharge | As necessary | |
| G7. | Application for Permit Renewal | 1/permit cycle | January 5, 2007 |
| G8 | Notice of Permit Transfer | As necessary | |
| G21 | Notice of Planned Changes | As necessary | |
| G22. | Reporting Anticipated Non-compliance | As necessary | |

SPECIAL CONDITIONS

S1. DISCHARGE LIMITATIONS

A. Water Quality Standards

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit.

Use of any liquid or powder rotenone formulation shall not result in an exceedance of water quality standards as specified in WAC 173-201A.

B. Temporary Water Quality Modification

The application of chemicals listed in this permit to perform fish pest control activities is allowed so long as the conditions of this permit are satisfied and the transitory water quality impact is limited to the minimum time necessary to accomplish the desired pest control objectives.

This temporary water quality modification is allowed throughout the permit term, but its effect shall be temporary in a specific location, though locations where it is in effect may be widespread throughout the state, anywhere lakes or streams are subject to fish control activities by WDFW.

C. Permitted Chemicals

Rotenone is the only chemical permitted for use as a fish toxicant under this individual permit. The rotenone product used must be licensed for use as a fish toxicant in the State of Washington at the time of treatment.

The use of liquid rotenone is only authorized for spot applications in areas that are not practicably accessible by boat. Open water areas that are accessible by boat will be treated with powdered rotenone that is mixed with water and applied as a slurry, as described in S.6. Best Management Practices.

Potassium permanganate is the only chemical permitted to neutralize rotenone treated waters when necessary to prevent damage to non-targeted organisms and maintain water quality outside of the area intended for rotenone treatment.

Other pesticides may be applied on a limited basis in the context of a research and development effort under the jurisdiction of the Washington State Department of Agriculture (WSDA) through the issuance of a Washington State Experimental Use Permit. Limited amounts of an experimental use pesticide may only be distributed or used for testing purposes after a written permit has been obtained from WSDA for purposes which include gathering data in support of registration under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) Section (3) or Section 24(c).

All other conditions of this permit apply as to appropriate monitoring and public notification procedures.

S2. MONITORING REQUIREMENTS

A. Monitoring

The WDFW shall conduct monitoring on each water body treated with aquatic pesticides to determine the extent and duration of the short-term water quality reduction resulting from rotenone applications.

B. Monitoring Schedule

TABLE 1. MONITORING – ROTENONE TREATED WATERS

| Parameters | Units | Minimum Sampling Frequency | Sample Type |
|---|------------------------------------|--|--|
| Rotenone Toxicity - Trout Bioassay: 48-hr live box test (5 trout); 100% survival of rainbow trout | Number of days until 100% survival | Once post-treatment, approximately 3-8 weeks after treatment | Observation (no lab accreditation required) |
| <u>*If liquid rotenone is used</u> : VOC, semi-VOC, plus any other inert ingredients listed on MSDS ¹ | µg/L | 1. 24 hours after treatment, and 2. four weeks after treatment | Grab |
| pH | Standard | Once pretreatment | Grab |
| temperature | °F | Once pretreatment | Grab |
| Alkalinity ² | mg/L CaCO ₃ | Once pretreatment ² | Grab |
| Organic demand ^{2,3} | Standard ³ | Once pretreatment ² | Grab |
| Zooplankton sampling | See below ⁴ | 1. Pre-treatment, 2. Six months after treatment, and 3. One year after treatment | Composite ⁴ |
| ¹ If liquid rotenone formulation is utilized, test for the following parameters: VOC (EPA method 8310) and semi-VOC (EPA method 502.2). Also test for any other inert ingredients listed on MSDS (i.e. the MSDS for Prentox [®] Prenfish [™] Toxicant lists naphthalene; 1,2,4-trimethylbenzene; and acetone). | | | |
| ² Only if neutralization of rotenone with potassium permanganate is required. | | | |
| ³ Use the guidelines provided in Engstrom-Heg (1971) to determine organic demand for KMnO ₄ . | | | |
| ⁴ Lakes only. Zooplankton sampling protocols set forth on Page 4-5 of “Water Quality Assessments of Selected Lakes within Washington State - 1998” Department of Ecology, December 2000, Publication No. 00-03-039 (Appendix B). | | | |

TABLE 2. MONITORING – RECEIVING WATERS DOWNSTREAM OF TREATED WATERS AND NEUTRALIZATION ZONE

| Parameters | Units | Minimum Sampling Frequency | Sample Type |
|---|------------------------|---|---|
| Rotenone Toxicity - Trout Bioassay: 48-hour live box test (5 trout) | % survival | 1. Begin test at time of treatment and 2. Repeat at one week intervals until upstream treated water is detoxified per upstream bioassay. | Observation (no lab accreditation required) |
| Rotenone ¹ | mg/L | Once 24 hours following treatment | Grab |
| <u>*If liquid rotenone is used</u> : VOC, semi-VOC, plus any other inerts ² | µg/L | 1. 24 hours after treatment, and 2. four weeks after treatment | Grab |
| pH | Standard | Once pretreatment | Grab |
| temperature | °F | Once pretreatment | Grab |
| Alkalinity ³ | mg/L CaCO ₃ | Once pretreatment ³ | Grab |
| Organic demand ^{3,4} | Standard ⁴ | Once pretreatment ^{3, 4} | Grab |
| Zooplankton sampling | See below ⁵ | 1. Pre-treatment, 2. Six months after treatment, and 3. One year after treatment | Composite ⁵ |
| Macroinvertebrate monitoring (Only required for <u>wadeable streams</u>) | See below ⁶ | 1. Pre-treatment, between August and September and 2. Post-treatment, approximately 1 year after treatment | See below ⁶ |
| ¹ Analyze using methods set forth in Dawson et al. (1983); Appendix A | | | |
| ² If liquid rotenone formulation is utilized, test for the following parameters: VOC (EPA method 8310) and semi-VOC (EPA method 502.2). Also test for any other inert ingredients listed on MSDS (i.e. the MSDS for Prentox [®] Prenfish [™] Toxicant lists naphthalene; 1,2,4-trimethylbenzene; and acetone). | | | |
| ³ Only if neutralization of rotenone with potassium permanganate is required. | | | |
| ⁴ Use the guidelines in Engstrom-Heg (1971) for measuring organic demand for KMnO ₄ . | | | |
| ⁵ Lakes only. Zooplankton sampling protocols set forth on Page 4-5 of “Water Quality Assessments of Selected Lakes within Washington State - 1998” Department of Ecology, December 2000, Publication No. 00-03-039; Appendix B | | | |
| ⁶ “Macroinvertebrate monitoring” includes gathering benthic invertebrate samples and summarizing the data using the benthic index of biotic integrity (B-IBI) and a ratio measure of the number of observed taxa divided by the number of expected taxa, the River Invertebrate Prediction and Classification System (RIVPACS). | | | |
| All bioassessment sampling and related habitat survey data, laboratory analysis, quality assurance, and data analysis shall follow the protocols in <i>Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams: 2001 Revision</i> , Plotnikoff and Wiseman, August 2001 (http://www.ecy.wa.gov/biblio/0103028.html). | | | |

C. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit shall be representative of the volume and nature of the monitored parameters, including representative sampling of any unusual discharge or discharge condition, including spills, upsets, and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit shall conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136 or to the latest revision of *Standard Methods for the Examination of Water and Wastewater* (APHA), unless otherwise specified in this permit or approved in writing by the Department of Ecology (Department).

D. Laboratory Accreditation

All monitoring data required by the Department shall be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories*, Chapter 173-50 WAC. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. Conductivity and pH shall be accredited if the laboratory must otherwise be registered or accredited. The Department exempts crops, soils, and hazardous waste data from this requirement pending accreditation of laboratories for analysis of these media.

S3. REPORTING AND RECORDKEEPING REQUIREMENTS

The Permittee shall monitor and report in accordance with the following conditions. The falsification of information submitted to the Department shall constitute a violation of the terms and conditions of this permit.

A. Reporting

The first monitoring period begins on the effective date of the permit. Monitoring results shall be submitted annually. Monitoring data obtained during each monitoring period shall be summarized, reported, and submitted in an annual report form approved by the Department.

Post Treatment Discharge Monitoring Report forms shall be received no later than June 1, the year following each treatment. The report(s) shall be sent to Nancy C. Weller, Department of Ecology, Eastern Regional Office, N. 4601 Monroe, Spokane, WA 99205-1295.

Post Treatment Discharge Monitoring Reports shall contain the following information:

1. Name of lake or stream
2. County

3. Section, Township and Range
4. Date(s) of treatment
5. Purpose of treatment
6. Name of licensed applicator
7. Lake description: Surface acreage, number of acre-feet, maximum depth and average depth
8. Stream description: Width, length, flow rate of stream/outlet (cu. ft. per sec.); Volume and weight of water treated (gallons, pounds)
9. Name of fish toxicant product used
10. Description of treatment method(s)
11. Quantity of fish toxicant used (pounds and/or gallons)
12. Concentration of active rotenone in formulated rotenone product (%)
13. Concentration of active rotenone in water (ppm)
14. Water conditions/quality (temperature, pH, hardness, alkalinity – and any other additional data collected)
15. Detoxification of rotenone treated water (if required): Description of detoxification methods/equipment; potassium permanganate application rate (pounds per hour); flow rate of stream/outlet (cu. ft. per sec.); estimate of average concentration (ppm)
16. Description of lake inlet(s)/outlet(s) and any temporary water control measures (if required)
17. Period of toxicity (duration of water quality reduction)
18. Eradicated fish species
19. Results of pre- and post-treatment monitoring
20. Impact on non-targeted organisms
21. Brief description of treatment/detoxification and other comments
22. A copy of the amended FSEIS for the lakes/streams treated during the reporting period including all SEPA comments, results and decisions.
23. A list of the lakes/streams proposed for treatment during the upcoming year

B. Records Retention

The Permittee shall retain records of all monitoring information for a minimum of three (3) years. Such information shall include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by the Director.

C. Recording of Results

For each measurement or sample taken, the Permittee shall record the following information: (1) the date, exact place, method, and time of sampling or measurement; (2) the individual who performed the sampling or measurement; (3) the dates the analyses were performed; (4) the individual who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit using test procedures specified by Condition S2. of this permit, then the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Permittee's Post Treatment Discharge Monitoring Report.

E. Noncompliance Notification

In the event the Permittee is unable to comply with any of the terms and conditions of this permit due to any cause, the Permittee shall:

1. Immediately take action to stop, contain, and clean up unauthorized discharges or otherwise stop the noncompliance, correct the problem and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to the Department within thirty (30) days after becoming aware of the violation.
2. Immediately notify the Department of the failure to comply.
3. Submit a detailed written report to the Department within thirty (30) days, unless requested earlier by the Department. The report shall contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

S4. ANNUAL SEPA PROCESS

All lakes proposed for treatment are included in an addendum to the Final Supplemental Environmental Impact Statement (FSEIS). The FSEIS is subject to a 30 day public comment period. The annual SEPA process must be completed prior to conducting lake or stream rehabilitation activities.

S5. ANTIMYCIN SEPA REVIEW

On or before June 1, 2005, WDFW shall complete the SEPA review process regarding the use of Antimycin as a fish toxicant for certain fish management projects. Based upon the outcome of the SEPA process, Ecology may modify the permit to include the use of Antimycin.

S6. BEST MANAGEMENT PRACTICES

- A. In order to prevent unnecessary damage to the environment, the permittee shall follow the best management practices defined below on the day of application.
- B. The permittee shall comply with all product label instructions. When application requirements specified in this permit differ from those on the label, the more stringent of the two requirements must be complied with. However, no condition in this permit or any amended Order shall reduce or modify the label instruction. All applicable federal, state and local laws and ordinances shall be followed.
- C. Powdered rotenone formulations shall be applied in such a way that minimizes airborne dust, using the best available technology such as the method outlined in "Utah's Procedure for Mixing Powdered Rotenone into a Slurry" (Thompson et al. 2001).
- D. In order to prevent an exceedance of water quality standards outside the area intended for rehabilitation, rotenone treatment should only take place in lakes that are not discharging to downstream waters. This is accomplished by limiting treatments to lakes with closed basins or conducting treatments only during periods of low water, usually September or October.

In instances where treated waters may potentially discharge to downstream waters resulting in an exceedance of water quality standards outside the treatment area, such discharge shall be prevented by installing adequate temporary water control measures.

When it is necessary and unavoidable to discharge rotenone treated waters to downstream waters, the permittee shall conduct pretreatment water quality and biological monitoring, as specified in the monitoring plan.

Treated waters shall be effectively neutralized and detoxified using potassium permanganate so that water quality standards are not exceeded below the neutralization zone. For purposes of this section, neutralization zone is defined as the downstream waters where potassium permanganate has been applied but has not yet fully neutralized the rotenone, due to the lag time normally associated with detoxification. The neutralization zone is typically considered the distance that water can be expected to travel in 20 minutes. Since the neutralization zone may contain toxic levels of rotenone and potassium permanganate, some fish mortalities may occur in this zone.

Below the neutralization zone, rotenone must be totally neutralized and residual potassium permanganate levels maintained at a non-toxic level of 1 mg/L, not to exceed 2 mg/L. Live trout cars will be set up below the neutralization zone to monitor the effectiveness of detoxification measures.

Detoxification procedures must utilize calibrated equipment to achieve the minimum effective concentration of potassium permanganate to oxidize the rotenone within the neutralization zone. Potassium permanganate concentrations must be closely monitored using a field calibrated spectrophotometer to keep residual permanganate levels at a level that effectively neutralizes rotenone while preventing damage to aquatic life downstream of the treatment area and neutralization zone.

- F. In order to minimize the discharge of inert ingredients contained in liquid rotenone formulations, only powdered rotenone formulations shall be utilized, except in very limited cases when the WDFW finds it necessary to treat waters that are inaccessible by boat, such as weedy shorelines or marshy areas.

S7. SPILL PREVENTION AND RESPONSE

- A. Prior to the first rotenone treatment, WDFW shall submit a Spill Prevention and Response Plan to the Department of Ecology, Eastern Regional Office, N. 4601 Monroe, Spokane, WA 99205-1295. The spill plan should cover a plan for the prevention, containment, and control of spills or unplanned discharges from the application, storage and transportation of the pesticides. It should also include spills of oil and gasoline from application equipment including boats. According to the severity of the spill, it should tell when to report certain magnitudes of spills along with a list of names and telephone numbers of spill respondent teams at both WDFW and Ecology.

- B. Spills into state waters, spills onto land with a potential for entry into state waters, or other significant spills that may effect health, the environment, or property must immediately be reported to the following state and federal contacts:

National Response Center (Federal): 1-800-424-8802, and
Emergency Management Division (State): 1-800-258-5990, and
The appropriate Dept. of Ecology regional office:
Northwest Office, Bellevue: 1-425-649-7000
Southwest Office, Olympia: 1-360-407-6300
Central Office, Yakima: 1-509-575-2490
Eastern Office, Spokane: 1-509-456-2926

Within 5 days the event must be also be reported to Nancy C. Weller, Permit Manager, Department of Ecology, Eastern Regional Office, N. 4601 Monroe, Spokane, WA 99205-1295. It should be a written report that includes a description of the event, including exact date and time, and the actions taken to correct the problem

- C. In the event of a spill, containment and clean-up efforts shall begin immediately and be completed as soon as possible, taking precedence over normal work. Clean-up shall include proper disposal of any spilled material and used clean-up material.

PUBLIC NOTICE PROCEDURES

P1. RESIDENTIAL AND BUSINESS NOTICE PROCEDURES

- A. Prior to the initiation of rotenone treatment, the WDFW shall notify all property owners located within one-quarter (1/4) mile of the shoreline or stream bank radius and five-hundred (500) feet upland of the waters affected by rotenone treatment, including waters treated with potassium permanganate to detoxify or neutralize rotenone treated waters.
- B. This notification may be done by mail, e-mail, or by handbills given directly to the residences or businesses. If hand bills are used, the applicator shall secure the notices to the residences or businesses doorknob in a fashion that will hold them in place but will not damage property. If the residence or business is gated or guarded by watch dogs, the applicator may secure the notice in clear view on the outside of the gateway or may attach the notice to the outside of the residence in a fashion that will hold it in place but will not damage property.
- C. A copy of the notice and a list of names and addresses where they were sent shall be kept by the applicator for seven (7) years and be hand delivered or mailed to Ecology immediately upon request. Where notices were delivered by hand (hand bills), names are not required to be recorded; only the address where notification was made.
- D. Notification must take place at least 10 days, but not more than 21 days prior to initial treatment.
- E. Notification information must include:
 - 1. The lake or stream to be treated.
 - 2. The name of the pesticide (and oxidizer, when applicable) to be used.
 - 3. The internet address (URL) of the Material Safety Data Sheet (MSDS) for the chemical products used. For example, the URL for the MSDS for Prenfish™ Fish Toxicant Powder is http://www.prentiss.com/msds/pdf/655_691.pdf.
 - 4. The purpose of the treatment.
 - 5. Any public use or water use restrictions.
 - 6. The date(s) of treatment / restricted use.
 - 7. The names and phone numbers of designated contact people at WDFW and Department of Ecology so people can obtain additional information.

P2. LEGAL NOTIFICATION PROCEDURES

- A. The Department of Fish and Wildlife shall publish announcements in the legal section of the local newspaper of general circulation (or nearest regional paper if local paper does not exist) 10 to 21 days prior to initial treatment. The legal notice shall include:
 - 1. The lake or stream to be treated.
 - 2. The name of the pesticide (and oxidizer, when applicable) to be used.
 - 3. The purpose of the treatment.
 - 4. Any public use or water use restrictions.
 - 5. The posting procedures.

6. The date(s) of treatment / restricted use.
 7. The names and phone numbers of designated contact people at WDFW and Department of Ecology so people can obtain additional information.
- B. An original affidavit from the legal department of the newspaper shall be kept by the Department of Fish and Wildlife for seven years and be mailed to the Department of Ecology upon request.

P3. POSTING PROCEDURES

- A. The WDFW shall post signs prior to the application of any pesticide(s) no more than forty-eight (48) hours prior to application. The Department of Fish and Wildlife shall use good faith and reasonable effort to ensure that posted signs remain in place until the end of the period of water use restrictions, or 30 days, whichever is longer. The Department of Fish and Wildlife shall be responsible for removal of all signs before the following treatment of the waterbody.
- B. When the EPA label restricts human consumption of fish, swimming, irrigation, livestock watering, or any other precaution(s) relevant to public or private water use, all posted signs shall explicitly state the restriction(s) or precaution(s).
- C. The WDFW shall construct and post signs as follows:

1. Public Property

Signs shall be a minimum of eight and one-half (8 ½) by eleven (11) inches in size and be made of durable weather-resistant material. Lettering shall be bold black type with the word "CAUTION" at least one (1) inch high and all other words at least one-quarter (1/4) inch high. The sign board shall be white, yellow, or orange. Signs shall be placed facing all points of normal public access to the shoreline or stream bank; or one every one-hundred (100) feet of public shoreline within ten (10) feet of the mean high water mark. Signs shall be posted so that they are secure from the normal effects of weather and water currents but cause no damage to private or public property. The applicator shall post all signs within 24 hours of initial treatment.

2. Boat Access Areas

Boat launches are defined as publicly designated and privately owned community access boat launches. Signs shall be posted at all boat launches on the waterbody to be treated. Signs shall be a minimum of two (2) feet by three (3) feet in size and be made of durable weather-resistant material. Lettering shall be bold black type with the word "CAUTION" at least two (2) inches high and all other words at least one-half (1/2) inch high. The colors used for the sign board shall be white, yellow, or orange.

Signs must be placed within twenty-five (25) feet of the shoreline, facing the entrance to the boat launch. Where the public access has a shoreline length greater than one hundred-fifty (150) feet, the applicator shall place signs so that they are clearly readable by all people using the access areas. Signs shall be posted so that they are secure from the normal effects of weather and water currents but cause no damage to private or public property.

GENERAL CONDITIONS

G1. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the Department shall be signed and certified.

- A. All permit applications shall be signed by either a responsible corporate officer of at least the level of vice president of a corporation, a general partner of a partnership, or the proprietor of a sole proprietorship.
- B. All reports required by this permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
 - 1. The authorization is made in writing by a person described above and submitted to the Department.
 - 2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)
- C. Changes to authorization. If an authorization under paragraph B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph B.2 above must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.
- C. Certification. Any person signing a document under this section shall make the following certification:

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

G2. RIGHT OF INSPECTION AND ENTRY

The Permittee shall allow an authorized representative of the Department, upon the presentation of credentials and such other documents as may be required by law:

- A. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.
- B. To have access to and copy - at reasonable times and at reasonable cost - any records required to be kept under the terms and conditions of this permit.
- C. To inspect - at reasonable times - any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
- D. To sample or monitor - at reasonable times - any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the permittee) or upon the Department's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

- A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:
 - 1. Violation of any permit term or condition.
 - 2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
 - 3. A material change in quantity or type of waste disposal.
 - 4. A determination that the permitted activity endangers human health or the environment or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination [40 CFR part 122.64(3)].
 - 5. A change in any condition that requires either a temporary or permanent reduction or elimination of any discharge or sludge use or disposal practice controlled by the permit [40 CFR part 122.64(4)].
 - 6. Nonpayment of fees assessed pursuant to RCW 90.48.465.
 - 7. Failure or refusal of the permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the permittee requests or agrees:

1. A material change in the condition of the waters of the state.
2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.
3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.
4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.
5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR part 122.62.
6. The Department has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.
7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:

1. Cause exists for termination for reasons listed in A1 through A7, of this section, and the Department determines that modification or revocation and reissuance is appropriate.
2. The Department has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G8) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new permittee.

G4. REPORTING A CAUSE FOR MODIFICATION

The Permittee shall submit a new application, or a supplement to the previous application, along with required engineering plans and reports whenever a material change to the facility or in the quantity or type of discharge is anticipated which is not specifically authorized by this permit. This application shall be submitted at least sixty (60) days prior to any proposed changes. The filing of a request by the Permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not relieve the Permittee of the duty to comply with the existing permit until it is modified or reissued.

G5. PLAN REVIEW REQUIRED

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications shall be submitted to the Department for approval in accordance with Chapter 173-240 WAC. Engineering reports, plans, and specifications shall be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities shall be constructed and operated in accordance with the approved plans.

G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit shall be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. DUTY TO REAPPLY

The Permittee shall apply for permit renewal at least 180 days prior to the specified expiration date of this permit.

G8. TRANSFER OF THIS PERMIT

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Department.

A. Transfers by Modification

Except as provided in paragraph B below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies the Department at least 30 days in advance of the proposed transfer date.
2. The notice includes a written agreement between the existing and new Permittee's containing a specific date transfer of permit responsibility, coverage, and liability between them.
3. The Department does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under the subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G9. REDUCED PRODUCTION FOR COMPLIANCE

The Permittee, in order to maintain compliance with its permit, shall control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G10. REMOVED SUBSTANCES

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G11. DUTY TO PROVIDE INFORMATION

The Permittee shall submit to the Department, within a reasonable time, all information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also submit to the Department upon request, copies of records required to be kept by this permit [40 CFR 122.41(h)].

G12. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G13. ADDITIONAL MONITORING

The Department may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G14. PAYMENT OF FEES

The Permittee shall submit payment of fees associated with this permit as assessed by the Department.

G15. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars (\$10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten

thousand dollars (\$10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G16. UPSET

Definition – “Upset” means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in condition S3.E; and 4) the Permittee complied with any remedial measures required under S5 of this permit.

In any enforcement proceeding the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G17. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G18. DUTY TO COMPLY

The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G19. TOXIC POLLUTANTS

The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G20. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this Condition, punishment shall be a fine of not more than \$20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G21. REPORTING PLANNED CHANGES

The Permittee shall, as soon as possible, give notice to the Department of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in: 1) the permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b); 2) a significant change in the nature or an increase in quantity of pollutants discharged; or 3) a significant change in the Permittee's sludge use or disposal practices. Following such notice, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G22. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee shall give advance notice to the Department by submission of a new application or supplement thereto at least one hundred and eighty (180) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during non-critical water quality periods and carried out in a manner approved by the Department.

G23. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

**G24. REPORTING REQUIREMENTS APPLICABLE TO EXISTING
MANUFACTURING, COMMERCIAL, MINING, AND SILVICULTURAL
DISCHARGERS**

The Permittee belonging to the categories of existing manufacturing, commercial, mining, or silviculture must notify the Department as soon as they know or have reason to believe:

- A. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in this permit, if that discharge will exceed the highest of the following “notification levels:”
1. One hundred micrograms per liter (100 µg/l).
 2. Two hundred micrograms per liter (200 µg/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony.
 3. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7).
 4. The level established by the Director in accordance with 40 CFR 122.44(f).
- B. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in this permit, if that discharge will exceed the highest of the following “notification levels:”
1. Five hundred micrograms per liter (500µg/L).
 2. One milligram per liter (1 mg/L) for antimony.
 3. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7).
 4. The level established by the Director in accordance with 40 CFR 122.44(f).

G25. COMPLIANCE SCHEDULES

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than fourteen (14) days following each schedule date.

APPENDIX A

**Rapid Method for Measuring
Rotenone in Water at Piscicidal Concentrations**

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Abstract

A high-performance liquid chromatography (HPLC) procedure that is rapid, specific, and sensitive (limit of detection <0.005 mg/liter) was developed for monitoring application and degradation rates of rotenone. For analysis, a water sample is buffered to pH 5 and injected through a Sep Pak ® C₁₈ disposable cartridge. The cartridge adsorbs and retains the rotenone which then can be eluted quantitatively from the cartridge with a small volume of methanol. This step effectively concentrates the sample and provides sample cleanup. The methanol extract is analyzed directly by HPLC on an MCH 10 reverse-phase column; methanol: water (75:25, volume: volume) is the mobile phase and flow rate is 1.5 ml/minute. The rotenone is detected by ultraviolet spectrophotometry at a wavelength of 295 nm.

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Rotenone, the active constituent of derris root, has been used widely as an insecticide and piscicide. Its use for removing undesired fish populations in the United States began in the 1930s (Schnick 1974). Several analytical procedures have been reported for the analysis of rotenone, including colorimetry (Gross and Smith 1934; Goodhue 1936), infrared spectrometry (Delfel 1976), thin-layer chromatography (Delfel and Tallent 1969), gas chromatography (Delfel 1973), and high-performance liquid chromatography (HPLC) (Bushway et al. 1975; Freudenthal and Emmerling 1977; Bowman et al. 1978; Kobayashi et al. 1980). These procedures are either costly, time-consuming, insensitive, or lack specificity for monitoring concentrations of rotenone in water during fish-eradication projects.

We describe a simple, rapid HPLC procedure with a sample-concentrating step that can be used to determine residues of rotenone in water at piscicidal concentrations.

Methods

Apparatus

1. HPLC—Varian 5000 equipped with varichrom ultraviolet-light detector and optional Model CDS-111L data system.¹ Operating conditions:

stationary phase—30 cm X 4 mm Varian micropak MCH- 10 reverse phase;

mobile phase—methanol: water (75:25, volume: volume);

flow rate—1.5 ml/minute; chart

speed—1 cm/minute;

wavelength—295 nm;

attenuation—0.04 absorbance full scale.

¹ Mention of commercial products does not imply endorsement by the United States Government.

2. Sep Pak® C₁₈ disposable cartridges from Waters Associates, Incorporated.
3. Vortex stirrer.
4. Disposable syringes (50 ml).
5. Test tubes (15 ml) with Teflon-lined screw caps.

Reagents

1. Methanol—HPLC grade.
2. Water—HPLC grade.
3. Rotenone—purified grade from Aldrich Chemical Company; 0.01 g/ 100 ml methanol (made fresh daily).
4. Acetic acid (glacial)—American Chemical Society (ACS) reagent grade, 0.2 M; 11.6 ml diluted to 1 liter with water.
5. Sodium acetate—ACS reagent grade, 0.2 M; 2.72 g of C₂H₃O₂Na · 3H₂O diluted to 100 ml with water.
6. Buffer reagent—0.1 M; 14.8 ml of 0.2 M acetic acid + 35.2 ml of 0.2 M sodium acetate diluted to 100 ml with water.

Procedure

1. Precondition Sep Paks with 2 ml methanol and 5 ml water according to instruction sheet supplied by manufacturer.
2. Add 1 ml buffer reagent for each 50 ml of water sample (if expected concentration is less than 0.02 mg/liter, more than 50 ml of sample may have to be extracted).
3. Attach preconditioned Sep Pak to 50-ml syringe with plunger removed.
4. Transfer sample to syringe, insert plunger, and force sample through Sep Pak at a rate of not more than 40 ml/minute. Discard water.
5. Remove Sep Pak, remove plunger, and replace Sep Pak on syringe.
6. Add 2 ml methanol, insert plunger, and slowly force methanol through Sep Pak into test tube.
7. Cap tube and mix on vortex stirrer.
8. Analyze by HPLC against 50 ml of a standard containing a known concentration of rotenone in water solution processed as above.

Results and Discussion

The ultraviolet spectrum of rotenone has an absorption maximum at 295 nm (Fig. 1). A monochromatic detector (254 nm) can be used, but a considerable loss of sensitivity and potential loss of specificity will occur. Performance of monochromatic detectors can be enhanced by the use of 313-nm filters, but a grating monochromator set at 295 nm provides optimal results.

As indicated in step 1 of the procedure, the Sep Paks must be prerinsed with methanol followed by water before they are used in the analyses. Previous tests (Dawson 1982) indicated that, for best results, this step should not be completed more than 2 hours before an analysis.

Rotenone recovery is influenced by the rate water samples flow through the Sep Paks during extraction and by the elution rate of methanol. The recovery was less than 70% at a flow of 100 ml/minute but exceeded 90% at flows of 40 ml/minute or less. Several volumes of methanol were evaluated for most efficient elution of adsorbed rotenone from Sep Paks. Small volumes of methanol provided more

concentrated samples, but recoveries were consistently better when 2 ml or more of methanol were used for elution.

Recoveries of rotenone were evaluated at various pH values to determine whether or not acidity of water samples affected the utility of the method. Water samples were fortified with 0.08 mg/liter of rotenone and buffered to pH 5, 7, and 9 before the Sep Pak extraction. Recoveries of rotenone from the buffered samples were 98, 94, and 73%, respectively, indicating that acidification is essential for optimal performance of the Sep Paks.

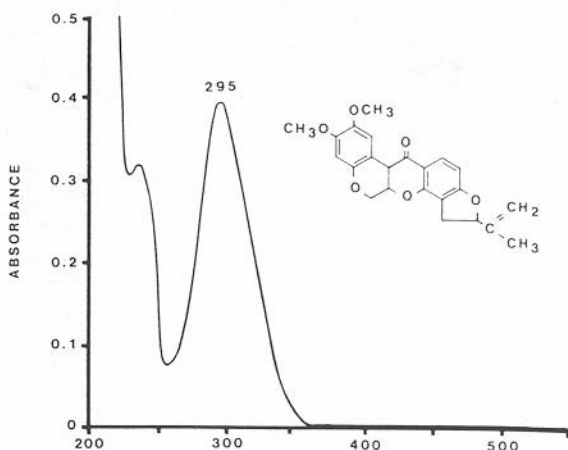


FIGURE 1.—Chemical structure and ultraviolet spectrum of rotenone (10 mg/liter) in methanol : water (75:25, volume : volume).

A water sample volume of 50 ml is sufficient for the analysis of rotenone concentrations of 0.02 mg/liter or greater. However, as much as 200 ml of sample may have to be extracted to achieve a sensitivity of 0.005 mg/liter. The limiting factors for greater sample concentration are the tedium of extracting large volumes of sample and possible interferences that may develop in samples as a result of the extraction and concentration of contaminants. Recently, J. T. Baker Chemical Company developed the Baker-10® extraction system, in which similar adsorption chromatography is used and the tedium of analysis is reduced by a vacuum manifold that extracts up to 10 samples simultaneously.

Samples extracted on Sep Paks are stable for only a few hours. However, if the sample is eluted from the Sep Pak and stored in the methanol eluate, the samples are stable for up to 2 days. For best results, samples should be kept cool and in the dark.

Retention time for rotenone from a sample of spiked pond water injected on the reverse-phase column was 5.7 minutes (Fig. 2). Unfortified pond water had no interfering peaks. The pen deflection at 2 minutes in Fig. 2 is the solvent injection peak.

Water samples from ponds treated with rotenone in summer and late fall were analyzed for residues of rotenone by this HPLC method (unpublished data). No interference problems were encountered and the measured concentration agreed closely with that calculated on the basis of the application rate.

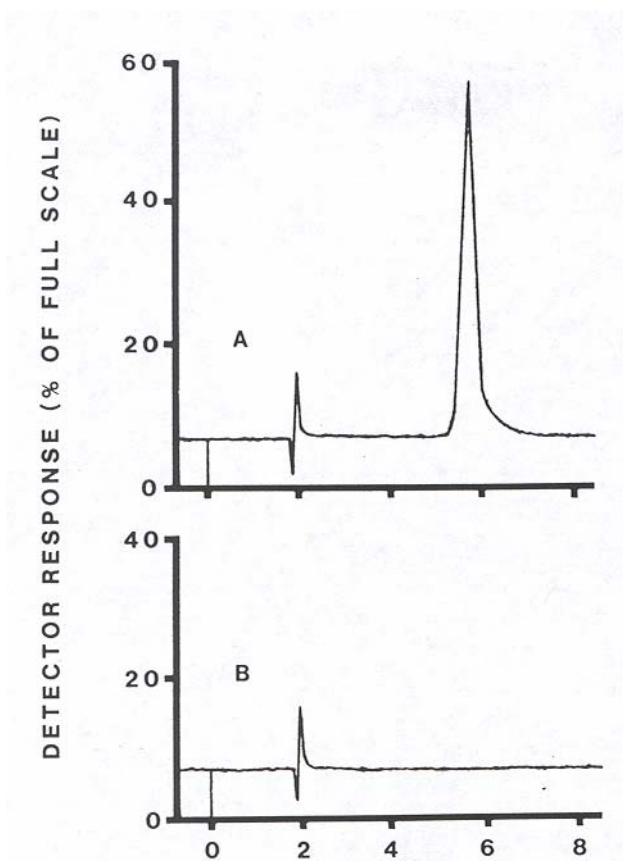


FIGURE 2.—Liquid chromatograms of (A) pond water sample fortified with rotenone (0.1 mg/liter) and (B) unfortified pond water; mobile phase—methanol:water (75:25, volume:volume); flow rate—1.5 ml/minute; wavelength—295 nm; attenuation—0.04 absorbance full scale. The water sample (50 ml) was concentrated 25 times on Sep Pak by elution with 2 ml methanol

Five replicate sample of pond water fortified with rotenone (0.1 mg/liter) were analyzed to evaluate the consistence of the method. The mean percentage of recovery and standard error were 97.6 ± 1.6 .

The use of a micro-processor data system, such as a Varian CDS-111L, greatly facilitates the analysis by integrating peak areas and converting values directly into concentration units.

References

- BOWMAN, M. C., C. L. HOLDER, AND L. I. BONE. 1978. High pressure liquid chromatographic determination of rotenone and degradation products in animal chow and tissues. *Journal of the Association of Official Analytical Chemists* 61:1445- 1455.
- BUSHWAY, R. J., B. S. ENGDAHL, B. M. COLVIN, AND A. R. HANKS. 1975. Separation of rotenoids and the determination of rotenone in pesticide formulations by high-performance liquid chromatography. *Journal of the Association of Official Analytical Chemists* 58:965-970.
- DAWSON, V. K. 1982. A rapid high-performance liquid-chromatographic method for simultaneously determining the concentrations of TFM and Bayer 73 in water during lampricide treatments. *Canadian Journal of Fisheries and Aquatic Sciences* 39:778-782.
- DELFEI, N. E. 1973. Gas-liquid chromatographic determination of rotenone and deguelin in plant extracts and commercial insecticides. *Journal of the Association of Official Analytical Chemists* 56:1343-1349.
- DELFEI, N. E. 1976. Ultraviolet and infrared analysis of rotenone: effect of other rotenoids. *Journal of the Association of Official Analytical Chemists* 59:703-707.
- DELFEI, N. E., AND W. H. TALLENT. 1969. Thin layer densitometric determination of rotenone and deguelin. *Journal of the Association of Official Analytical Chemists* 52:182-187.
- FREUDENTHAL, R. I., AND D. C. EMMERLING. 1977. Separation of rotenoids by high-pressure liquid chromatography. *Journal of Chromatography* 134:207-209.
- GOODHUE, L. D. 1936. An improvement on the Gross and Smith colorimetric method for the determination of rotenone and deguelin. *Journal of the Association of Official Agricultural Chemists* 19:703-707.
- GROSS, C. R., AND C. M. Smith. 1934. Colorimetric method for determination of rotenone. *Journal of the Association of Official Agricultural Chemists* 17:336-339.
- KOBAYASHI, H., O. MATANO, AND S. GOTO. 1980. Determination of rotenoids in soil and crops by high-performance liquid chromatography. *Journal of Pesticide Science* 5:89-92.
- SCHNICK, R. A. 1974. A review of the literature on use of rotenone in fisheries. United States Fish and Wildlife Service Literature Review 74-15. NTIS (National Technical Information Service) PB-235 454/AS, Springfield, Virginia, USA.

APPENDIX B

Sampling Protocols for Zooplankton

The new approach to measure uses on a given lake includes a need to evaluate the health of a fishery. A widely utilized tool on the east coast of the United States is the measuring of zooplankton as a cost effective surrogate to collecting and measuring fish. An index has been developed in order to determine the predator/prey balance in the fish communities within a given lake (Mills and Schavone, 1982). In a study of 18 natural lakes in upstate New York, Mills and Schavone (1982) demonstrated a strong correlation between mean length of cladocerans and planktivore weight ($r^2 = .70$; $P < 0.05$). In other words, the presence of large zooplankton indicate predator fish are keeping prey species in balance. Dominance of smaller zooplankton suggests an ineffective amount of predators to suppress planktivore density.

A standard approach to sampling zooplankton was followed in the field. Methods for collecting, storage, and enumeration are patterned after the "Zooplankton Workshop Reference Guide" prepared by BSA Environmental Services, Inc. (Beaver, 1997).

Sampling Period

Five vertical tows were pulled in June and five were pulled in August from the deep site of each selected lake. Tows were composited into one 125ml sample bottle. Five tows were not necessary if there were an abundance of zooplankton in the first few tows. Duplicate samples (again, five tows if necessary) were taken at duplicate TP sample sites.

Field Procedure

The Wisconsin net was pulled from a depth of one meter off the bottom or 20 meters, whichever was less. The depth was rounded to the most conservative meter to ensure bottom sediments weren't disturbed. Nets were retrieved at a rate of one meter per three seconds.

Upon retrieval of the sample, a squirt bottle filled with tap or distilled water was used to dislodge any zooplankton that may have been clinging to the mesh. Samples were discharged into a 125 mL amber, Lugol-treated sample container and preserved with approximately 15 mls of Lugol's solution.

Sample Analysis

Samples were analyzed for relative abundance of cladocerans and copepods and their mean length. Relative abundance was determined using a Sedgewick-Rafter counting chamber and a compound microscope. Subsamples were analyzed to estimate mean length of the zooplankton using a compound microscope and an ocular equipped with a reticle. Measurements were recorded to the nearest 0.2mm. Results were tabulated as the ratio of total cladocerans:total copepods.

Data Interpretation

Due to time constraints in 1998, it was not possible to fully analyze the collected samples of zooplankton but the following provides possibilities for future data interpretation. A subset of lakes sampled by Ecology in 1998 were also surveyed by the Washington State Department of Fish and Wildlife. Zooplankton mean length data should be compared to fish length-frequency distributions to evaluate whether there is a particular mean zooplankton length that could be used as a pivot indicator of a balanced predator/prey fish population in a given lake (e.g. 1.0 mm is used in some states). An index with a range of mean lengths within given categories may be the most effective use of the zooplankton data. For example, mean zooplankton lengths between 0.9 mm and 1.0 mm may be rated as “fair” for predator/prey populations and mean lengths between 1.0 mm and 1.1 mm may rate “good” and above 1.1 mm rated as “fair,” etc. A fair rating or worse could then be used to demonstrate impairment of a beneficial use.

Relative zooplankton abundance data may be correlated with nutrient and Secchi data. It is uncertain at this time whether or not zooplankton abundance is a good indicator of predator/prey balance. However, correlations with traditional water chemistry data and additional fish population data may demonstrate whether or not trophic cascade effects are present in Washington lakes (Brett and Goldman, 1996). Zooplankton data may also explain differences between total phosphorus concentrations and expected correlated values for chlorophyll *a*/Secchi measurements.

*Appendix B Sampling Protocols for Zooplankton was taken from pages 4-5 of *Water Quality Assessments of Selected Lakes Within Washington State 1998*, Washington State Department of Ecology. December 2000. Publication No. 00-03-039.

APPENDIX C

Table 3. Actions and Timelines for WDFW Lake and Stream Rehabilitation Projects

| STEP | SPECIFIC ACTION | APPX TIMELINE | ACTION BY |
|-------------|--|----------------------|------------------|
| 1 | Prioritized list of waters to Resident Fish Program Manager | By March 1 | Regions |
| 2 | Statewide prioritized list of waters to be treated in current year | By March 1 | Regions & HQ |
| 3 | Treatment list based on available piscicide | By April 30 | HQ |
| 4 | Order piscicide based on available budget | By April 30 | HQ |
| 5 | Pre-rehabilitation materials to Resident Fish Program Manager | May-June 30 | Regions |
| 6 | Landowner and water rights search | May-June 30 | Regions |
| 7 | First contact letters to landowners and water rights holders announcing intent to treat and meeting date | May-June 30 | Regions |
| 8 | Inform District & Regional Teams of potential rehabilitations | May-June 30 | Regions |
| 9 | Survey shoreline for water withdrawals | May-July 31 | Regions |
| 10 | Final list of waters for public meetings including an alternative list of waters as “back-up” | June-July 31 | Regions |
| 11 | Begin collection water withdrawal agreement letters | June-July 31 | Regions |
| 12 | Regional approval letter and signoff | June-July 31 | Regions |
| 13 | General public meetings | July 1-31 | Regions & HQ |
| 14 | Preparation of SEPA Addendum (done 7/1) | July 7-11 | HQ |
| 15 | Schedule meetings with Program Director and Director/Deputy Director | July 14-18 | HQ |
| 16 | Publish SEPA Addendum for 30-day public review | July 14-18 | HQ |
| 17 | Safety Equipment: Review inventory & Assess Condition | By July 31 | Regions |
| 18 | Completion of 30-day SEPA public review | By August 18 | HQ |
| 19 | Obtain bids for VOC analysis | August 18-31 | HQ |

| | | | |
|----|---|------------------------------------|--------------|
| 20 | Schedule treatments | August 18-31 | Regions |
| 21 | WDFW Fish Program review and approval | By August 14 | HQ |
| 22 | Draft emergency fishing regulations to HQ | August 19-25 | Regions |
| 23 | WDFW Director review and approval | By August 26 | HQ |
| 24 | Emergency fishing regulations and news release | ASAP after #23 | HQ |
| 25 | Rehabilitation project lead notebook updates | ASAP after #23 | HQ |
| 26 | Update spill response plans | By August 29 | Regions & HQ |
| 27 | Public legal notifications regarding rehabilitations | 10-21 days prior to treatment | Regions |
| 28 | Notification of residents and businesses | 10-21 days prior to treatments | Regions |
| 29 | Posting of waters to be treated | 24-48 hours prior to treatments | Regions |
| 30 | Treatment | See #20 | Regions |
| 31 | Pre-treatment macroinvertebrate and water chemistry sampling | Immediately prior to treatments | Regions |
| 32 | Post-treatment VOC and semi-VOC sampling | 24 hour and 1-month post treatment | Regions |
| 33 | Post-treatment bioassay | 3-8 weeks post-treatment | Regions |
| 34 | Post-treatment macroinvertebrate sampling | 6 and 12 months post treatment | Regions |
| 35 | Post-rehabilitation critique | December-January 31 | Regions & HQ |
| 36 | DJ & WB reports to USFWS for federally funded rehabilitations | By January 28 | Regions & HQ |
| 37 | Post-rehabilitation reports of HQ | By May 1 | Regions |
| 38 | Post-treatment discharge report to Ecology | By May 31 | HQ |