Rainbow trout harvested from Sevena Lake circa 1970's (pre-northern pike introduction). Photo courtesy Clyde Mullican.

Soldotna Creek Drainage Restoration Project:

Environmental Assessment

Alaska Department of Fish and Game

Division of Sport Fish

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APPENDICES

1.0 INTRODUCTION

The northern pike *Esox lucius* is native to Alaska north and west of the Alaska Range and near Yakutat in the southeast. Northern pike do not naturally occur in Southcentral Alaska (Figure 1) and first arrived there from an illegal introduction into Bulchitna Lake in the Yentna River drainage in the 1950's (ADFG 2007).

Northern pike are considered an invasive species in Southcentral Alaska because they are not native to the region, and their introduction has the ability to cause economic and/or environmental harm (ADFG 2002). Northern pike have been implicated in the decline of localized salmonid abundance in Southcentral Alaska (Rutz 1999, McKinley *In prep*., Pantankar 2006) and prefer soft-finned juvenile salmonids over other available prey species (Rutz, 1996 and 1999, Sepulveda et.al. 2012). Consumption of native juvenile salmonids by introduced northern pike has also been observed elsewhere in the northwestern United States (Rich 1992, McMahon and Bennett 1996, Schmetterling 2001, Muhlfeld et al. 2008). In Southcentral Alaska, northern pike prey may be particularly vulnerable to predation because they evolved in the absence of these predators whereas in interior Alaska, northern pike share an evolutionary history with their prey which evolved adaptations for predator-avoidance (Oswood et al. 2000).

Kenai Peninsula northern pike are believed to have originated from an illegal introduction to the Soldotna Creek drainage (a Kenai River Tributary) during the 1970s and quickly spread from their initial introduction site (ADFG undated). Kenai Peninsula water bodies where self-sustaining populations of northern pike currently or previously existed are shown in Figure 2.

Northern pike on the Kenai Peninsula have already reduced or eliminated native wild fish populations from some Kenai Peninsula lakes (McKinley *In prep*.) and caused the cessation of Alaska Department of Fish and Game (ADFG) fish stocking in three other lakes. A total of eighteen Kenai Peninsula lakes and Soldotna Creek have been confirmed with self-sustaining populations of northern pike although only twelve lakes and Soldotna Creek are believed to still contain them. Of the six lakes where northern pike no longer exist, three (Arc Lake, Scout Lake and Stormy Lake) had their northern pike populations removed by ADFG via chemical treatment (rotenone). ADFG also removed northern pike populations from two lakes through intensive gillnetting efforts (Hall Lake and Tiny Lake), and another lake (Denise Lake) apparently lost its northern pike population by winterkill or other natural event. The status of northern pike in Tree Lake is unclear although it appears that population may have disappeared though a natural event as recent efforts to detect them have been unsuccessful despite confirmation of their presence in 2000.

The northern pike in the Soldotna Creek drainage are the highest priority concern ADFG has for invasive northern pike on the Kenai Peninsula. Northern pike in the Soldotna Creek drainage have eradicated all native fish populations from the western branch of the drainage (McKinley *In prep.*), have impacted native fish populations in the remainder of the drainage and serve as a source for northern pike to spread into other vulnerable habitats within the Kenai River drainage such as the Moose River.

ADFG developed this Environmental Assessment (EA) to address controlling or eradicating the illegally introduced northern pike population in the Soldotna Creek drainage. The objectives are to prevent northern pike in the Soldotna Creek drainage from dispersing into new areas and to foster restoration of the native fish populations historically found in the drainage. Successfully completing these objectives will restore angling opportunities for the public and help protect

valuable wild fisheries throughout the Kenai River drainage. Four alternatives for accomplishing this are discussed in this EA. The first, the no action alternative, will not achieve the objective as the northern pike population will remain in the drainage preventing native fishery restoration. The second alternative will involve installing a fish passage barrier to prevent northern pike from entering the Kenai River from Soldotna Creek, the third alternative will involve using mechanical removal methods (netting) to reduce the northern pike population, and the fourth method will use a piscicide called "rotenone" to remove all the northern pike.

1.1 Purpose and Need for Action

The purposes of this EA are to: (1) present and evaluate alternative approaches for invasive northern pike eradication in the Soldotna Creek drainage; (2) propose selection of the alternative that best meets the needs of the ADFG invasive northern pike eradication objectives while minimizing potential environmental impacts; (3) provide an opportunity for public input on the control and eradication options presented; and (4) determine whether the scope and magnitude of impacts expected from implementation of the preferred alternative warrant preparation of an environmental impact statement (EIS). If significant impacts are expected, an EIS will be prepared. If not, the ADFG will select the preferred alternative. In either case, the U.S. Fish and Wildlife Service (USFWS; the agency tasked with granting Federal authority for the preferred alternative) will disclose its final decision and supporting rationale in a separate decision document.

1.2 Background

Northern pike are currently distributed throughout most of the Soldotna Creek drainage which includes the mainstem of the creek and six of its open lakes. The western branch of the Soldotna Creek drainage, where the majority of the northern pike population exists, encompasses Union Lake, West Mackey Lake, East Mackey Lake and Derks Lake which are all linked by streams. The western branch also contains numerous closed small lakes, two of which once had northern pike populations (Denise Lake and Tiny Lake) (Figure 2.). The northern pike population in Denise Lake disappeared from an unknown cause, and its status of being northern pike-free was confirmed by an intensive gillnetting survey conducted in 2010. A small population of northern pike was discovered in Tiny Lake in 2010, and intensive gillnetting effort by ADFG succeeded in removing that population by 2011.

The native fish assemblage of the Soldotna Creek drainage includes threespine stickleback *Gasterousteus aculeatus*, lamprey *Lampetra* spp, sculpin *Cottus* spp, rainbow trout *Oncorhyncus mykis*, Dolly Varden *Salvelinus malma*, round whitefish *Prosopium cylindraceum,* hooligan *Thaleichthys pacificus*, sockeye salmon *O. nerka*, pink salmon *O. gorbuscha,* coho salmon *O. kisutch* and Chinook salmon *O. tshawytscha.* Steelhead (anadromous rainbow trout) *O. mykiss* are also present, although it is unknown if they are native to the drainage.

Predation by northern pike has resulted in the complete loss of native wild rainbow trout, Dolly Varden, coho salmon, and three spine stickleback populations in the western branch of the Soldotna Creek drainage (McKinley *In Prep*.). Union Lake, linked by an ephemeral stream to West Mackey Lake, was once a popular fishery for stocked hatchery-raised coho salmon, but stocking was discontinued by ADFG after northern pike were discovered in the lake in the mid 1990's.

Other locations in the Soldotna Creek drainage where northern pike have been detected include Sevena Lake and Tree Lake and the mainstem of Soldotna Creek. Northern pike have not been

detected in Tree Lake since their initial discovery in 2001. Low dissolved oxygen levels observed in the lake during the winter of 2011 suggests Tree Lake is prone to winterkill which may offer an explanation for the apparent loss of northern pike there. Because Tree Lake is an open lake, it is likely northern pike already have, or will, recolonize the lake. Likewise, Sevena Lake supported a northern pike population for decades until 2009 when an apparent winterkill event decimated the population. Despite annual spring gillnet surveys, no northern pike were detected in Sevena Lake until 2012 when a single female was captured. By the fall of 2013, northern pike were once again plentiful in the lake. During the 1990's and early 2000's, Sevena Lake supported the most robust northern pike sport fishery on the Kenai Peninsula. It is expected that northern pike will soon dominate the fish assemblage in Sevena Lake at the expense of coho salmon, Dolly Varden and rainbow trout populations that were recovering following the temporary collapse of the northern pike population.

Several northern pike have been observed entering the Kenai River from Soldotna Creek at a video weir operated by the USFWS during the open water seasons of 2009 and 2010 (Gates et al. 2011). Northern pike are occasionally reported harvested by anglers in the Kenai River and Moose River in the past three decades. Of primary concern is that northern pike dispersing from Soldotna Creek could establish a self-sustaining population in the Moose River drainage which is a tributary of the Kenai River. The Moose River currently supports up to 40% of the annual Kenai River drainage-wide coho salmon smolt production and has long been considered vulnerable to northern pike infestation because of the massive amount of suitable habitat available (i.e. shallow vegetated slow-moving water; Casselman & Lewis 1996, Inskip 1986). Habitat preferences of some juvenile salmonid species overlap with that of northern pike, particularly rainbow trout and coho salmon, which makes them highly susceptible to northern pike predation. To date, there is no evidence that a self-sustaining population of northern pike exists in the Kenai River drainage outside the Soldotna Creek drainage despite ADFG and USFW efforts to detect them (Palmer 1996)[1]. No northern pike harvests have been reported from the Kenai River or Moose River by ADFG angler surveys between 2005 and 2011 (Jennings 2009; 2010a,b; 2011a,b; Jennings In Prep, a, b). The 2012 ADFG angler survey estimated 11 northern pike were caught in the Kenai River. This estimate was based on one angler reporting the capture of one northern pike.

[1] ADFG surveyed Bear Lake (Upper Moose River) in 2010, and most of the lakes in the East Fork of the Moose River in 2001 and no northern pike were detected. ADFG signage placed at select public access locations in the Kenai River drainage since 2008 requesting anglers to retain and report any northern pike caught has not resulted in any confirmed reports.

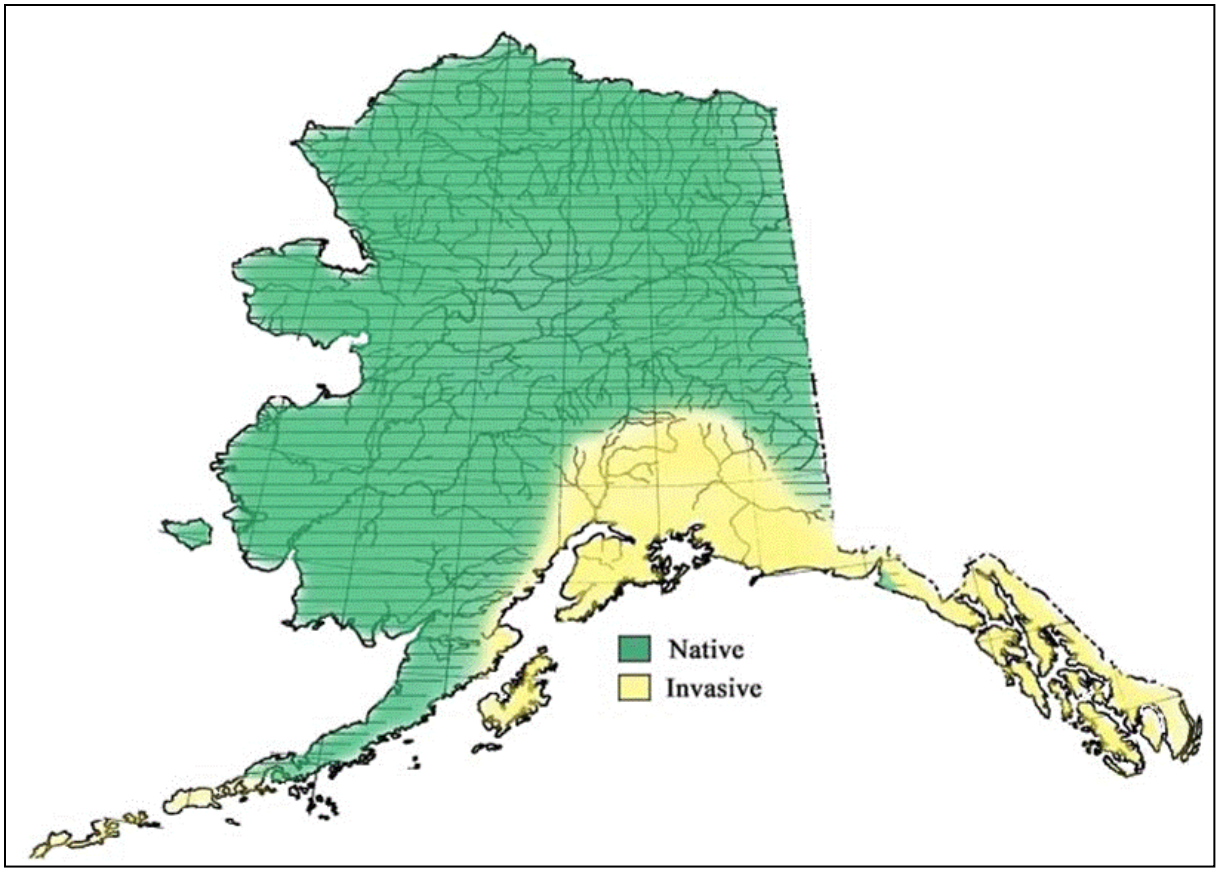

Figure 1. Map of Alaska showing native and invasive ranges of northern pike.

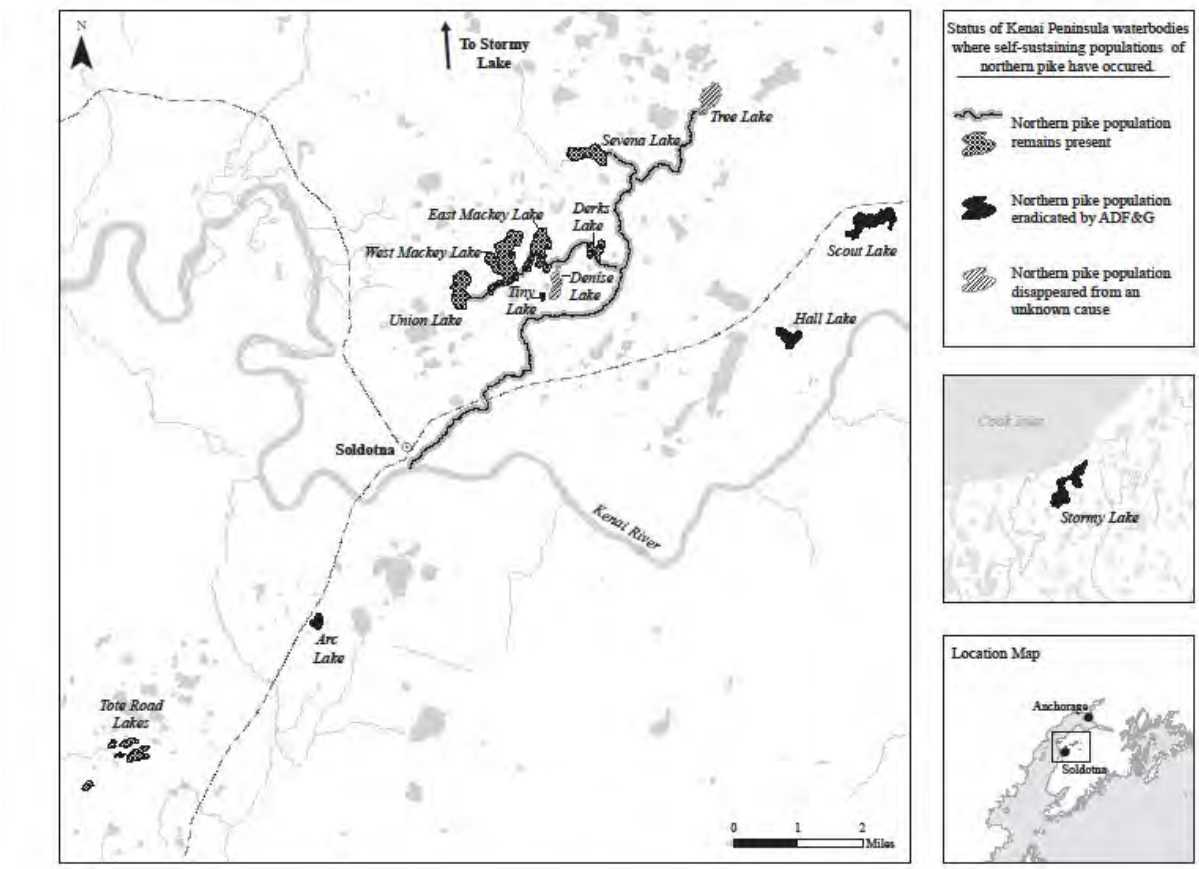

Figure 2. Status of Kenai Peninsula waterbodies that contain or have contained self-sustaining populations of northern pike.

Because a self-sustaining northern pike population is not known to exist in the Kenai River drainage outside of Soldotna Creek, ADFG has an opportunity to remove them before they become established elsewhere in the drainage and cause irrevocable damage to native fishes and the valuable fisheries dependent upon them.

1.3 Legal Authorities

By consent of the Alaska Board of Fisheries, the ADFG is authorized to perform acts leading to the eradication of fish populations per Alaska Statute (AS 16.35.200). Further, ADFG is mandated by law to "Manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state…" (Alaska Fish and Game Laws and Regulations, Section 16.05.020). Removing invasive northern pike from the Soldotna Creek drainage will serve to restore native wild salmonid fisheries and aquatic habitat, reduce the likelihood of northern pike expanding elsewhere in the Kenai River drainage, and support ADFG's long-term goal of eradicating invasive northern pike from the entire Kenai Peninsula. It is the ADFG's legal responsibility to remove the threat imposed by invasive northern pike to protect the fisheries in the Kenai River drainage and improve the recreational fishing quality of the Soldotna Creek drainage.

Additionally, the ADFG Division of Sport Fish has developed planning documents to guide ADFG actions regarding invasive northern pike. These documents include the Management Plan for Invasive Northern Pike located online at: http://www.adfg.alaska.gov/static/species/nonnative/invasive/pike/pdfs/invasive_pike_management_plan.pdf and the Alaska Aquatic Nuisance Species Management Plan located online at: http://www.adfg.alaska.gov/static/species/nonnative/invasive/pdfs/ak_ansmp.pdf .

These plans aid in identifying specific threats from invasive northern pike, lists the statutes and regulations pertinent to invasive species, and outlines the processes to follow when planning projects to evaluate, prevent, control and/ or eradicate invasive northern pike. The Division's strategic plan also lists "minimizing impacts of invasive species on fish stocks, recreational fisheries, and fish habitat" as one of its objectives: (http://www.adfg.alaska.gov/static/fishing/PDFs/sport/StrategicPlan2010Final.pdf). Finally, the Division's invasive northern pike planning team has identified eradicating northern pike from the Soldotna Creek drainage as its top priority on the Kenai Peninsula.

1.4 Issues

1.4.1 Issues Selected for Detailed Analysis

In March of 2012, ADFG began a public scoping process to solicit public comment on a course of action regarding invasive northern pike removal or control in the Soldotna Creek drainage. Among the participants of the scoping process, opinions varied greatly, but input gathered during the public scoping process generally represented broad support for a proposed phased rotenone treatment and fisheries restoration of the Soldotna Creek Drainage. Concerns expressed during public scoping were considered in ADFG's analysis of the alternative actions, and a detailed report of the public scoping comments and concerns can be found in Appendix 1.

In the spring of 2014, ADFG posted a public notice in a local newspaper (Peninsula Clarion) for two consecutive days announcing a thirty day public commenting period for the Soldotna Creek drainage Environmental Assessment (Appendix 2). Courtesy notices were also hand delivered to all waterfront residences of Union Lake, West Mackey Lake and East Mackey Lake (Appendix 3) during April 25-28, 2014. A similar courtesy notice was made available to the public at the Soldotna Sport Show on May 4, 2014 (Appendix 4). These notices explained when and how to comment on the Environmental Assessment. Public comments received for this environmental assessment during the commenting period are summarized Appendix 5. In addition to the public notice posted in the Peninsula Clarion for the Environmental Assessment, a public notice was also concurrently posted in the Peninsula Clarion for the project's Alaska Department of Environmental Conservation Pesticide Use Permit Application.

Specific to rotenone, concerns received during the scoping process and public commenting period are detailed below.

1.4.2 Comments on Ecological Effects

During the public scoping and public commenting period, concern was expressed about the potential of rotenone to:

- Affect non-target wildlife
- Cause impacts to gardens
- Cause fish kills outside the treatment area
- Persist for long periods in cold weather

1.4.3 Comments on Human Health

During public scoping and public commenting period, concern was expressed about perceptions that rotenone could:

- Cause possible short of long-term health effects to humans including Parkinson's Disease
- Contaminate potable water sources (i.e. well water)

1.4.4 Comments on Effectiveness of Rotenone

During the public commenting period, concern was expressed that a rotenone treatment could:

- Fail to eradicate all the northern pike eradiation due to the difficulty of treating the complex habitat comprising the Soldotna Creek drainage

2.0 ALTERNATIVES

In this section, a range of alternatives are described for the removal or control of invasive northern pike in the Soldotna Creek drainage. A "no action" alternative, two control alternatives and one eradication alternative are presented.

2.1 Alternative 1: No Northern Pike Eradication or Control (no action alternative)

Alternative 1 will discontinue management of invasive northern pike in the Soldotna Creek drainage. ADFG will not make any attempt to remove or control northern pike in the drainage, restore its native fish populations, or improve recreational angling opportunities in the drainage. Because lost or severely depleted native fish populations would remain in that state and northern pike remaining in the drainage could disperse into new vulnerable habitats, the no action alternative is not deemed a preferred alternative.

2.2 Alternative 2: Fish Barrier

HDR Alaska Inc. designed several fish passage barrier options for ADFG for a similar northern pike control project at Stormy Lake near Nikiski (ADFG 2009). The barrier designs for the Stormy Lake outlet creek provided useful insight into barrier options applicable to other locations such as Soldotna Creek. The HDR Alaska Inc. designs ranged from a simple fish trap to a complex facility designed to collect and sort fish.

Ideally, a barrier will allow passage of native fish while prohibiting movement of all life stages/sizes of northern pike. It is unclear how effective any barrier design will be at preventing juvenile or larval pike movement. Icing and debris loading of a barrier will require expensive and time-consuming maintenance that will be incurred annually. The estimated construction costs for a barrier at the outlet of Stormy Lake ranged from $390K to $610K not including annual maintenance costs, but even those designs may not be capable of incorporating features needed to exclude all life stages of northern pike (ADFG 2009). Soldotna Creek discharge is often an order of magnitude greater than the Stormy Lake outlet creek so cost estimates for construction of a barrier in Soldotna Creek will undoubtedly greatly exceed those for the Stormy Lake outflow creek.

A barrier will also require permanent landscape impacts that could include an access road for construction and maintenance of the barrier, and potentially the addition of a building to protect the barrier from damage and keep it functioning during the winter. Besides the high cost and

associated landscape impacts a barrier may have, the barrier option will still allow northern pike to remain in the Soldotna Creek drainage and will not allow native fish populations to recover in many areas where they were historically present. In summary, a fish passage barrier capable of containing northern pike to the Soldotna Creek drainage will potentially cost millions of dollars to construct, maintenance costs will be ongoing, and northern pike will still be present in the drainage. A control barrier is not considered a preferred alternative to restore the Soldotna Creek drainage.

2.3 Alternative 3: Control Netting

This alternative will involve using gill nets and/or trap nets to remove northern pike. Under specific conditions, gillnets have been successfully used to remove unwanted fish from lakes. Bighorn Lake, a 5.2-acre lake located in Banff National Park in Alberta, Canada, was gillnetted from 1997 to 2000 to remove an invasive population of brook trout (Parker et al. 2001). Over 10,000 net nights (1 net night = 1 net set overnight for at least 12 hours) were conducted over a four-year period to remove the population that totaled 261 fish. The researchers concluded that the removal of nonnative trout using gillnets was impractical for larger lakes (> 5 acres). In clear lakes, fish have the ability to acclimate to the presence of gillnets and avoid them. These researchers reported observing brook trout avoiding gillnets within two hours of being set.

Knapp and Matthews (1998) reported that Maul Lake, a 3.9-acre lake in the Inyo National Forest in California, was gillnetted from 1992 to 1994 to remove a brook trout population. The population consisted of 97 fish that were removed after 108 net days of effort. Following the removal of brook trout Maul Lake was mistakenly restocked with rainbow trout. Efforts to remove them using gillnets were implemented immediately. From 1994 through 1997, 4,562 net days were required to remove 477 rainbow trout from the lake. Knapp and Matthews (1998) reported that gillnets could be used as an alternative to chemical treatment, but they acknowledged that the small size and shallow depth of Maul Lake leant itself to a successful fish eradication using gillnets. Their criteria for successful fish removal using gillnets included lakes that were less than 3.9 surface acres, were less than 19 feet deep, and had little or no inflow or outflow to perpetuate reinvasion, and no natural reproduction of the fish population.

ADFG has successfully removed two very small populations of northern pike on the Kenai Peninsula using gillnets (Hall Lake and Tiny Lake). Both populations were small (<30 individuals), and complete removal required months of continual gillnetting under the ice throughout the winter. Unique features of these populations that may have contributed to the success of gillnetting include: 1) the Hall Lake population showed no evidence that reproduction was occurring (i.e. complete lack of juvenile or immature pike in the population) and 2) Tiny Lake was an extremely small waterbody (~4.5 surface acres).

Countering this success, several years of intensive seasonal gillnetting efforts failed to completely remove northern pike from Derks Lake or Sevena Lake on the Kenai Peninsula (Begich and McKinley, 2005, Massengill 2010, Massengill 2011). In fact, at Derks Lake, the northern pike population appeared stable or growing despite intensive netting efforts (Massengill 2011). The implementation of this alternative will not eliminate the possibility that northern pike migrate out of the Soldotna Creek drainage. To be most effective, the netting effort will need to continue indefinitely taxing ADFG resources. Removing northern pike populations from flowing waters (Soldotna Creek and associated tributaries) would likely be ineffective because of the

following factors: 1) poor access to most of the creek creating untenable logistics, 2) current-carried debris fouling the nets, 3) shallow water preventing adequate gillnet deployment.

Netting will result in bycatch of native fish species (i.e. rainbow trout, Dolly Varden and juvenile coho salmon), particularly in Sevena Lake where these species have rebounded following depressed northern pike abundance and also in Tree Lake where juvenile coho salmon are currently abundant. Native fish may attempt to recolonize waters with depressed pike abundance, but recovery of native fish populations will be retarded by the same gillnetting effort required to keep northern pike populations suppressed. It is likely that the unintentional take of migratory birds and other aquatic animals could occur during an extensive and long-term gillnetting operation in the Soldotna Creek drainage. Netting or a similar mechanical removal method is not deemed a preferred alternative to restore the Soldotna Creek drainage.

2.4 Alternative 4: Rotenone Treatment (Preferred Alternative)

ADFG's preferred alternative involves removing all invasive northern pike from the Soldotna Creek drainage using rotenone: CFT Legumine™ and Prentox® Prenfish™ Fish Toxicant Powder. The treatment design will include rescuing representative native fish from the drainage so they can be used to recolonize the drainage and help restore its native fish assemblage posttreatment.

2.4.1 Description of Rotenone

Rotenone is a naturally occurring substance derived from the roots of tropical plants in the bean and pea family including jewel vine (*Derris* spp.) and lacepod (*Lonchocarpus* spp.) that are found in Australia, Oceania, southern Asia, and South America (Ling 2003). People have used rotenone for centuries to capture fish for food in areas where these plants are naturally found (Quigley 1956, Bearez 1998, Robertson and Smith-Vaniz 2008), and it has been used in fisheries management in North America since the 1930s (Finlayson et al. 2000).

Rotenone acts by inhibiting oxygen transfer needed for cellular respiration. The biochemical process affected by rotenone takes place within the cell mitochondria and involves blocking electron transport by inhibiting NADH-ubiquinone reductase, resulting in the uncoupling of the metabolic pathway oxidative phosphorylation (Singer and Ramsay 1994, USEPA 2007). Fish die from tissue anoxia due to cardiac and neurological failure (Ling 2003). It is effective at low concentrations with fish because it is readily absorbed into the bloodstream through the thin cell layer of the gills. Mammals and other non-gill breathing animals lack this rapid absorption route into the bloodstream and can tolerate exposure to concentrations much higher than those used to kill fish. Non-target organisms that do not have this rapid absorption route are not negatively affected at these concentrations (Finlayson 2000, Ling 2003, NPS 2006, USEPA 2007, MFW&P 2008).

2.3.2 Description of the Proposed Rotenone Treatment

The boundary for this treatment will be six lakes in the Soldotna Creek drainage (Union Lake, West Mackey Lake, East Mackey Lake, Derks Lake, Sevena Lake and Tree Lake) and up to 22 miles of streams, including inundated wetlands adjacent to these waters (Figure 3). All lakes will be treated with a combination of Prentox® Prenfish™ Fish Toxicant Powder (EPA reg# 655-691) and CFT Legumine™ (EPA reg# 75338-2). Streams and wetlands will only be treated with CFT Legumine™.

Prentox® Prenfish™ Fish Toxicant Powder is pure ground plant material typically containing 7.4% rotenone (Appendices 5 and 6). CFT Legumine™ (Appendices 7 and 8) is a liquid rotenone formulation containing 5% rotenone with additives (described in detail in section 4.3.3) that increase dispersion and emulsification in water. About two-thirds of the water volume in Union Lake, West Mackey Lake, East Mackey Lake and Derks Lake will be treated with powdered product and about one-third will be treated with liquid formulation and liquid formulation alone will be used in all wetlands and stream applications. Using a combination of the two products makes the overall project more cost effective than using liquid rotenone, alone. The powder rotenone product (Prentox®) will be used in main lake basin areas of the lake whereas the liquid product (CFT Legumine™) will be used to treat the deepest areas (> 20 feet in depth), shorelines, and areas most protected from wave action (weedy bays, etc.). For all treated waters, the target rotenone concentration using either the liquid, powder or a combination thereof will be 1 part per million (ppm) of formulated product (.05 ppm active ingredient/rotenone) which is the concentration prescribed for normal pond use by the manufacturers (Finlayson 2010). All of Area Two, including Sevena Lake and Tree Lake would be treated entirely with CFT Legumine™.

Because of the large and complex nature of the Soldotna Creek drainage, it is prohibitive to treat all the waterbodies that require treatment in a single year with current ADFG resources. It is also a preferred strategy to treat one area of the drainage about two years earlier than the remainder so it can later serve as a “safe” pike-free area where native fish collected from other parts of the drainage can be relocated. A method to accomplish this goal is to partition the drainage into two treatment areas using temporary fish passage barriers that will prevent fish movement between areas and allow each to be treated at different times.

The western branch of the Soldotna Creek drainage (referred to hereafter as Area One) will be partitioned from the rest of the drainage (referred to hereafter as Area Two) with a series of fish passage barriers. Area One will consist of the following waterbodies: Union Lake, West Mackey Lake, East Mackey Lake, Derks Lake, inundated wetlands adjacent to these lakes and the short streams linking these lakes together in series (Figure 3). Area Two (Figure 4) will consist of the entirety of the mainstem of Soldotna Creek including the northern headwater lakes of Tree Lake and Sevena Lake and any wetlands or tributaries outside of Area One that have surface waters linking them to Soldotna Creek.

Fish will be prevented from traveling between Area One and Two by temporary fish barriers constructed near the Derks Lake outlet. One barrier will span the Derks Lake outlet creek below a beaver dam at the Derks Lake outlet. This barrier will consist of a fyke net incorporated into weir fencing made from ¼-inch mesh hardware cloth. Metal screening/fencing will surround the fyke net to prevent animal damage. This barrier will be inspected and maintained regularly for the duration of the project (likely four years). In addition to the construction of this lower barrier, an existing fish barrier is already present at the lake outlet and consists of a large beaver dam built upon an old gravel road bed that spans the entire Derks Lake outlet area (Figure 5). This existing dam frequently raises the height of Derks Lake three feet above static height, and it serves as a fish barrier most of the time except when rare high water events occur that temporarily breach the beaver dam.

To prevent the dam from breaching and failing as a fish barrier, the lake will be lowered to static height, and a water control structure will be built into the beaver dam/road bed. First, a segment of the beaver dam will be removed so that Derks Lake can drain to static height. A temporary water control structure will then be installed that will raise the water level of Derks Lake about one foot and create a vertical drop barrier for upstream migrating fish. The water

control structure will consist of a culvert pipe resting on a one-foot deep bed of sandbags built into the dam opening. Additional sandbags will be used to fill in spaces around and above the culvert pipes and to secure the culvert into the dam face. Wooden 4”x4” support posts will be used to keep the downstream exposed culvert ends elevated one foot above static height. To reduce washout at the downstream suspended culvert ends, plywood sheeting weighted with sandbags will be set on the stream bottom. To increase the integrity of the existing beaver dam/road barrier, a geomembrane or similar impermeable liner will be used to cover the dam face in the area of the culverts to reduce erosion and water percolation through the dam.

Although the vertical leaping ability of northern pike is not well published and is variable based on fish size and environmental factors, a barrier drop of about 0.8 feet has been demonstrated to prevent all upstream movement of juvenile chain pickerel, a closely related species very similar in size and appearance to the small northern pike typically found in the Soldotna Creek drainage (Nedeau 2006).

Besides preventing upstream fish passage, the vertical drop barrier will maintain a lower lake height than is currently present and, thus, the amount of rotenone needed to treat the lake. Lowering the lake height will also reduce the amount of inundated vegetation and bog habitat at Derks Lake that could serve as possible refugia for northern pike trying to escape the treatment.

Abundant native fish populations still exist throughout much of Area Two, and a thorough effort will be made to collect and relocate representatives of each species prior to its treatment. To accomplish this, after the successful restoration of Area One is confirmed and its waters detoxified, native fish will be collected from throughout Area Two and relocated into Area One. These fish will be collected with minnow traps, fyke nets and electrofishing. It is anticipated that fish rescue efforts will occur regularly throughout the open water season of 2015. Eventually, when the northern pike population is removed from the entire drainage, all fish barriers will be removed and rescued native fish will be free to move throughout the drainage.

Area Two will require two rotenone treatments. This will be accomplished by conducting a single treatment during each of two successive years (2016 and 2017). Treating Area Two twice is appropriate because the treatment area contains a vast amount of flowing waters and complex wetland habitat which can decrease the effectiveness of a single treatment (Finlayson et.al. 2010). Area One will likely be treated once, however, a second full or partial treatment may be warranted (one year after the first) if posttreatment evaluations indicate the first treatment alone was inadequate.

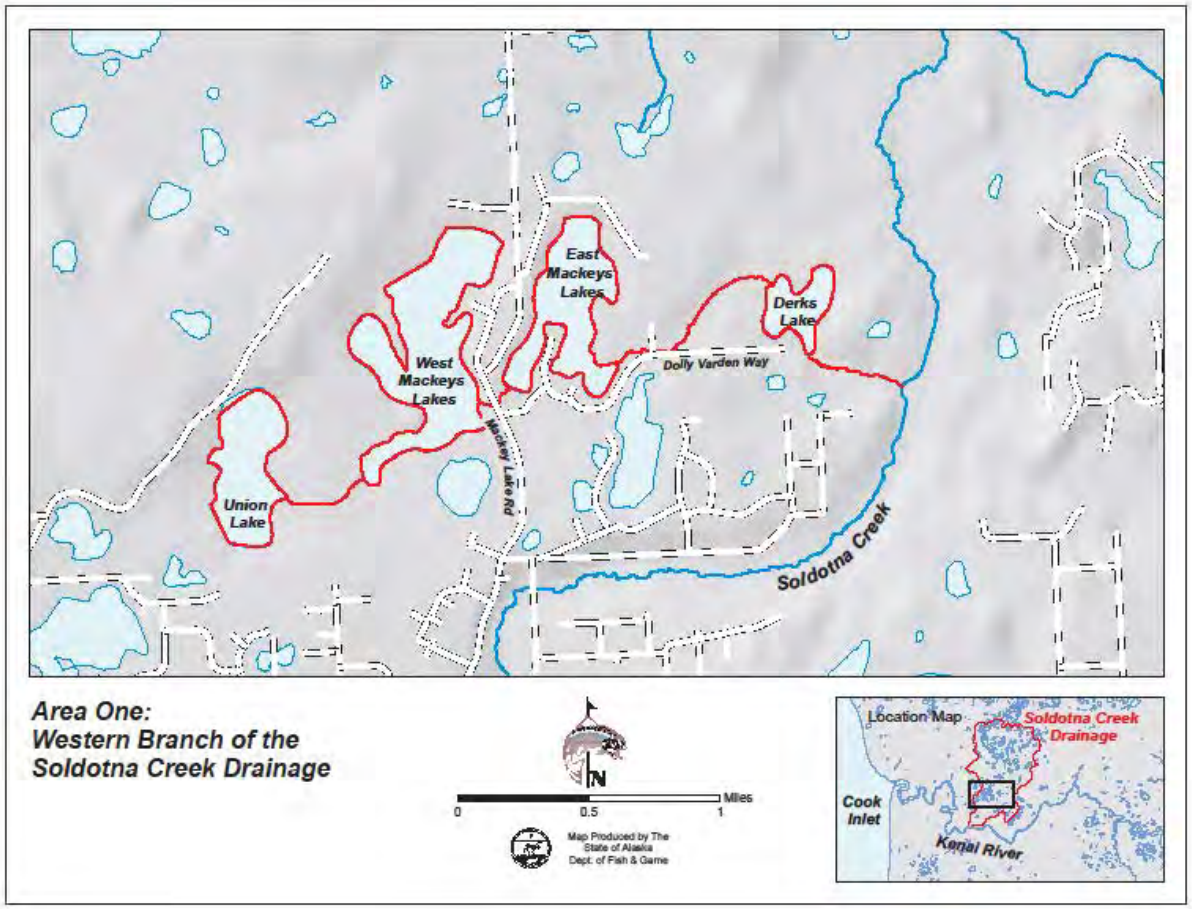

Figure 3. Map of the four stream-linked lakes in the western branch of the Soldotna Creek referred to as Area One.

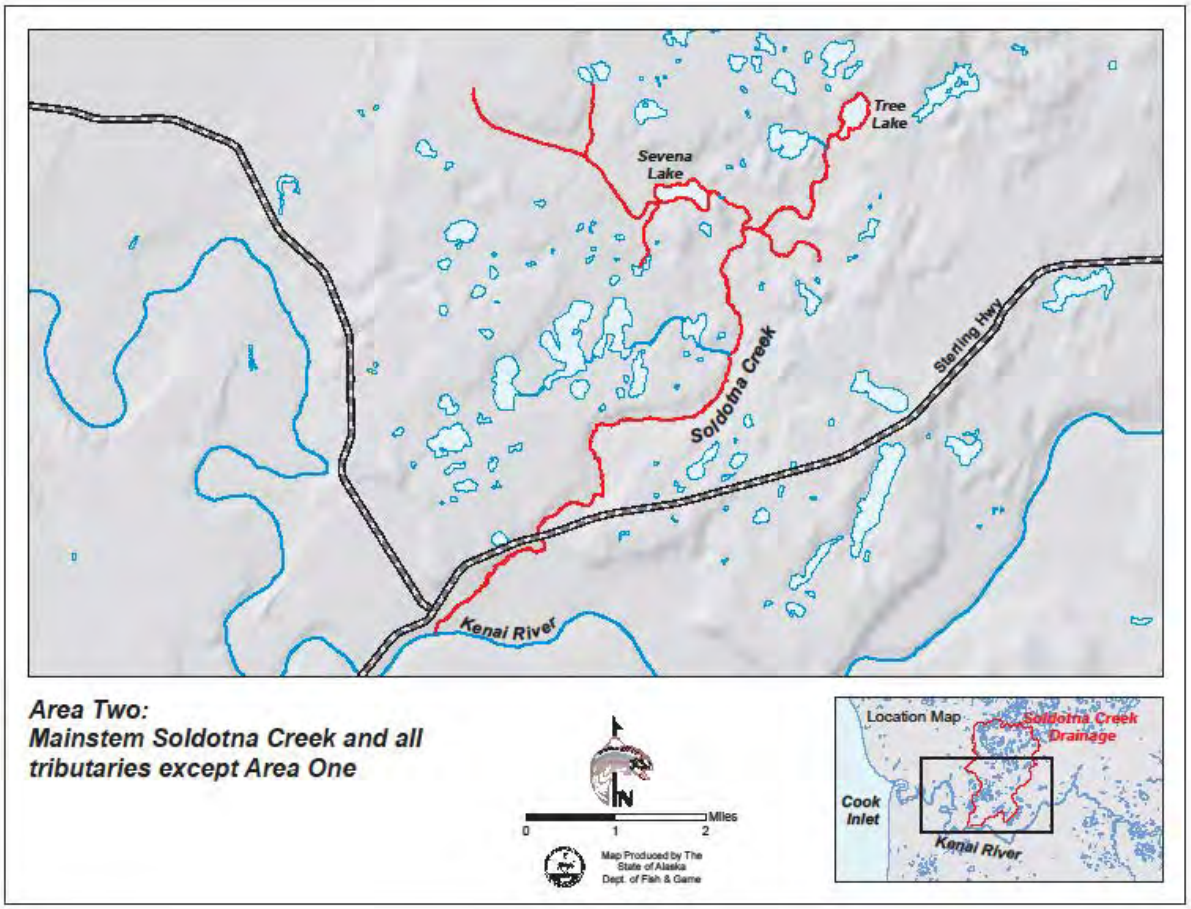

Figure 4. Map of the area of the Soldotna Creek drainage referred to as Area Two shown in blue highlighting.

The Area One rotenone treatment will be conducted in the fall of 2014. The benefit of a fall (cool weather) treatment for this particularly area is that the rotenone will be expected to persist for months instead of just days or weeks as cold water (~5C or colder), greatly impedes rotenone degradation. Such was the case for recent ADFG rotenone treatments at Arc Lake, Scout Lake and Stormy Lake (Massengill *In Prep*. a, b). In Area One, there is substantial floating bog and inundated wetlands surrounding some lakes that could be difficult to treat. Both lack of wind or wind-shielding aquatic vegetation can decrease wind mixing of rotenone. Therefore, it is desirable to prolong the persistence of rotenone so it can penetrate and diffuse and enter all areas to its full extent before it degrades substantially. Prolonging the rotenone persistence deep into winter will also allow some shallow wetlands to freeze solid thus limiting the potential northern pike refugia available. During winter much of the wetland areas that don't freeze solid will be expected to have greatly decrease dissolved oxygen levels due to microbial degradation of organics which should also impede fish survival.

Ideally, the rotenone will be applied at least one week before ice forms to provide time for winds to aid in mixing the rotenone. An early to mid-October treatment is preferred because there would be less impact to water recreationists compared to a summer treatment. All the lakes in Area One are relatively shallow (15' to 35' maximum depths), and strong thermoclines capable

of limiting the rotenone distribution throughout the water column are not expected during October.

Figure 5. Existing road bed/beaver dam barrier at the outlet of Derks Lake, 2010.

The Area Two rotenone treatments will preferably be scheduled to occur during early to mid-summer when stream flows are typically lowest. Area Two will be treated twice with rotenone with the first treatment planned for 2016 and the second treatment in 2017. A warm weather treatment for Area Two is preferred because: 1) the relatively warm water available that time of year will promote faster natural deactivation of rotenone in Soldotna Creek prior to entering the Kenai River, and 2) expected low stream discharges will reduce both the amount of rotenone and potassium permanganate (rotenone deactivator) required for the treatment, 3) low water conditions will desiccate some adjacent wetlands and reduce the amount of habitat available to northern pike, and 4) rotenone is typically more effective at warmer temperatures which is of considerable importance for relative brief stream treatments (typically 4-8 hour treatment periods, Finlayson et al. 2010).

Prior to all rotenone treatments, signage will be placed at common access locations (roadway or trail crossings, overlooks, etc.) to the treatment areas in compliance with all applicable legal requirements related to pesticide applications. An attempt will be made to notify all waterfront landowners beforehand of the time when the treatments will happen in the area that their property is adjacent to. Notifications will be made by mail, phone, email or personal visit at least one week prior to the treatments.

Materials and equipment required to complete the rotenone application will be transported to the Soldotna Creek drainage by truck. Secure overnight storage of rotenone products will be accomplished by storing the rotenone in an enclosed trailer or truck that will be parked in a locked fenced compound at the ADFG Soldotna Office. An impermeable ground liner bermed around its perimeter will be in place to contain any spill at both the treatment site staging areas and at the Soldotna ADFG fenced storage compound. The offsite rotenone storage at the Soldotna ADFG fenced storage compound could last for one to two weeks during each treatment.

Rotenone will be applied to the lakes in each treatment area primarily by applicators using outboard-powered motorboats. Boats will be equipped with gas-powered pumping systems that premix lake water with the rotenone products (liquid or powdered products) and then discharge the premixture to the surface waters and propeller wash of the boat. Applicators will also use backpack sprayers and a craft capable of traveling over dense emergent aquatic vegetation (airboat, mud buddy and/or ATV) to apply rotenone to heavily vegetated nearshore areas and adjacent inundated wetlands. For treating waters underlying floating bog, a long probe capable of spraying a stream of rotenone mixture at high pressure may be used. The probe could be used to pierce the floating bog from above, and it could be extended underneath the bog at its waterline edge to inject rotenone into water cavities.

Small fyke nets, surrounded by wire mesh fencing, will be placed in the outlet streams of each treated lake to prevent fish movement, and these will remain in place in each area until the treatment success is confirmed. Drip stations may be used to treat some of the streams in Area One if backpack spraying alone is deemed inadequate due to stream flow discharge conditions.

For treating flowing waters in Area Two, Soldotna Creek will be divided into sections with each section being treated individually for four to eight hours using multiple drip stations that are spaced throughout each section. A helicopter may be used to transport staff and equipment to drip station sites along the more inaccessible areas of Soldotna Creek. A helicopter may also be used to transport staff to conduct backpack spraying of wetlands adjacent to Soldotna Creek that could potentially harbor juvenile northern pike. If there are inundated wetlands linked to Soldotna Creek during the treatment period that backpack spraying alone can't effectively treat, limited helicopter aerial spraying (up to 200 surface acres total; average depth <1 foot) will be conducted to treat those areas in accordance with EPA guidelines (USEPA 2007).

Precautions will be taken to minimize pesticide drift during helicopter applications which includes: not allowing the spray boom width to exceed 90% of the rotor blade diameter, spray release height will be at the lowest consistent with flight safety, swath path adjustments will compensate for crosswinds and no aerial applications will occur if wind is >12 mph and the use of low drift spray nozzles that apply a course spray and avoid fewer driftable fines. Finally, the helicopter pilot will be an ADEC-certified aerial pesticide applicator working from an enclosed cockpit using a GPS guidance system to aid in targeting and tracking of the application swaths.Fyke nets will be used to temporarily partition Soldotna Creek into discrete treatment sections so that fish movement cannot occur between stream sections. All fyke nets or other barriers used in the Area Two treatment will be removed following the treatment with the exception of those placed near the outlets of Sevena, Tree Lakes and all barriers in Area One. Those fish barriers will be maintained until the second treatment of Area Two is successfully completed.

Streams typically require multiple treatments because in moving water, concentrations of rotenone dissipate and decline by dispersion, dilution, hydrolysis, and photolysis and possibly induced chemical deactivation (Finlayson et al. 2010). Rotenone applied to streams can potentially travel outside the treatment area and cause undesirable effects to fish downstream. To prevent this, there are two solutions. One solution is for the rotenone to be diluted below 2.0 ppb (2.0ppb = rotenone concentration deemed undetectable, Finlayson et al. 2010) by mixing with untreated water. The other solution is to chemically deactivate the rotenone with potassium permanganate ($KMNO_4$) before it leaves the treatment area.

Using historical discharge data for both Soldotna Creek and the Kenai River, it is calculated that rotenone leaving Soldotna Creek following the treatments of either Area One or Area Two will be diluted below the 2.0ppb threshold after mixing with the Kenai River. Regardless, as a precaution ADFG will chemically deactivate the rotenone in Soldotna Creek with $KMNO_4$ before it enters the Kenai River during both Area Two treatments of the Soldotna Creek mainstem. Caged sentinel fish (coho salmon or rainbow trout with similar tolerances to rotenone as northern pike) will be placed just below the confluence of Soldotna Creek and the Kenai River. If these fish exhibit rotenone-related stress (rolling, surface swimming, mortality), adjustments can be made to the application rate of $KMNO_4$ to achieve full rotenone deactivation. In the unlikely event that rotenone does enter the Kenai River at a dangerous concentration for fish, wild fish do have the ability to detect rotenone and move away (Finlayson 2000). Within the Soldotna Creek drainage treatment area, caged sentinel fish will be used regularly to evaluate the effectiveness of the treatments in real-time. Water samples will be collected periodically following all treatments, and these samples will be shipped to a laboratory with extensive pesticide testing experience for analysis of rotenone concentrations. A rotenone deactivation station will be installed and on standby status in the lower reach of all treatment areas as a precaution.

Following each treatment and after the rotenone completely deactivates, an evaluation of each area's treatment success at eradicating the northern pike population will be conducted using gillnets, and possibly the analysis of water samples to detect northern pike DNA. To ensure compliance with the Migratory Bird Treaty Act, gillnets will be monitored daily during daylight hours and owl decoys will be positioned near gillnets to discourage waterbirds from using the area being netted. Net monitoring has been successful in increasing bycatch survival during previous gillnetting efforts.

Water quality and macroinvertebrate presence/absence will be sampled before and after the treatments of both Area One and Area Two. Doing so will help document biological impacts of the treatment to invertebrates and to verify water quality (dissolved oxygen, pH, temperature, specific conductivity and turbidity). If the Soldotna Creek drainage treatments successfully eradicate the northern pike population (as determined by posttreatment evaluations) and when water quality and macroinvertebrate populations resemble those observed pretreatment, all fish barriers will be removed,. Removal of remaining fish barriers will allow wild native fish to migrate throughout the drainage from the Kenai River and it will allow for the dispersal of rescued native fish released into Area One.

3.0 AFFECTED ENVIRONMENT

3.1 Land Status

The Soldotna Creek Drainage Restoration Project is located in T05N R10W and T05N R9W, Seward Meridian, Kenai Peninsula. The Soldotna Creek drainage encompasses 46 $mi.^2$ and

enters the Kenai River near rivermile 22. The land surrounding the Soldotna Creek drainage is a mixture of municipal, State, Borough, Private and Native owned lands (Figure 6). The lower portion of the creek is within the Soldotna City limits (Figure 7). The drainage has substantial residential development, particularly in its southern half**.**

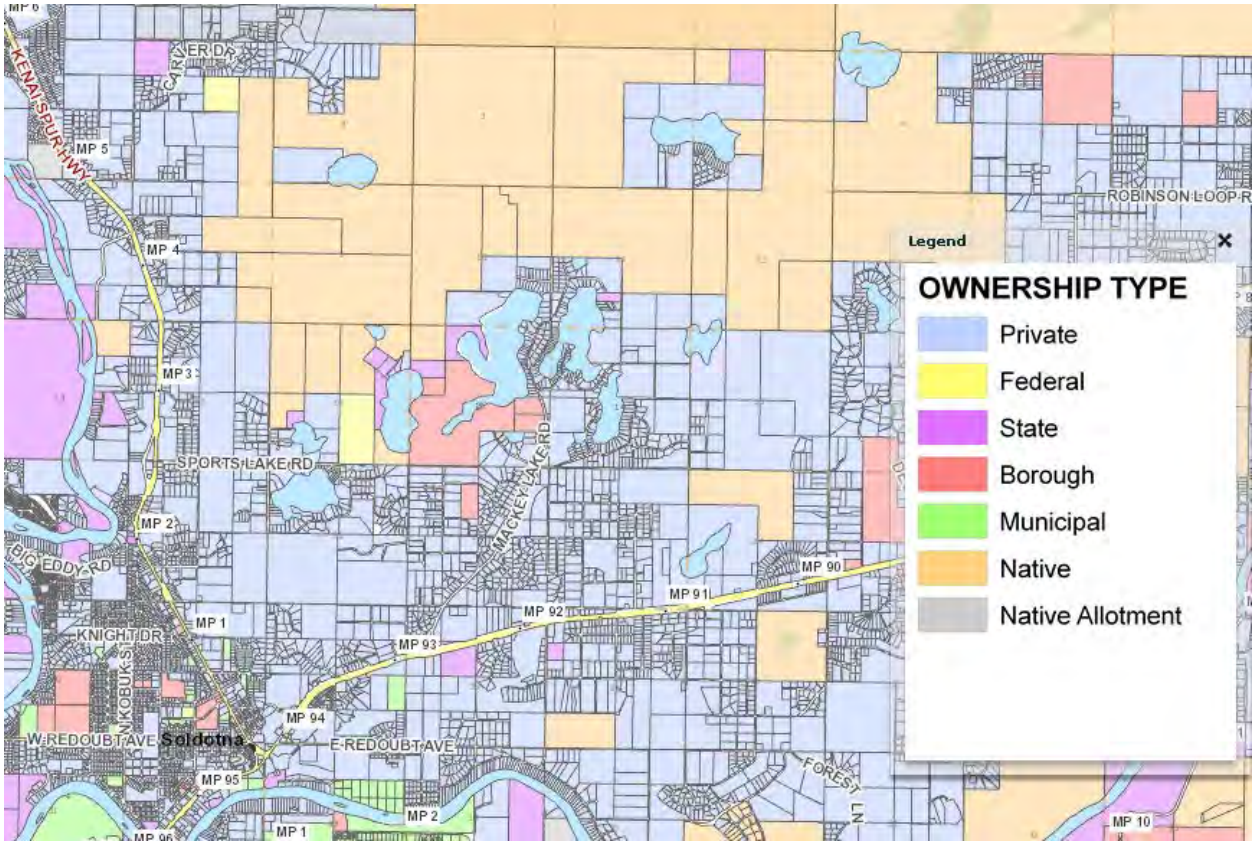

Figure 6. Kenai Peninsula Borough land ownership map of the Soldotna Creek drainage area.

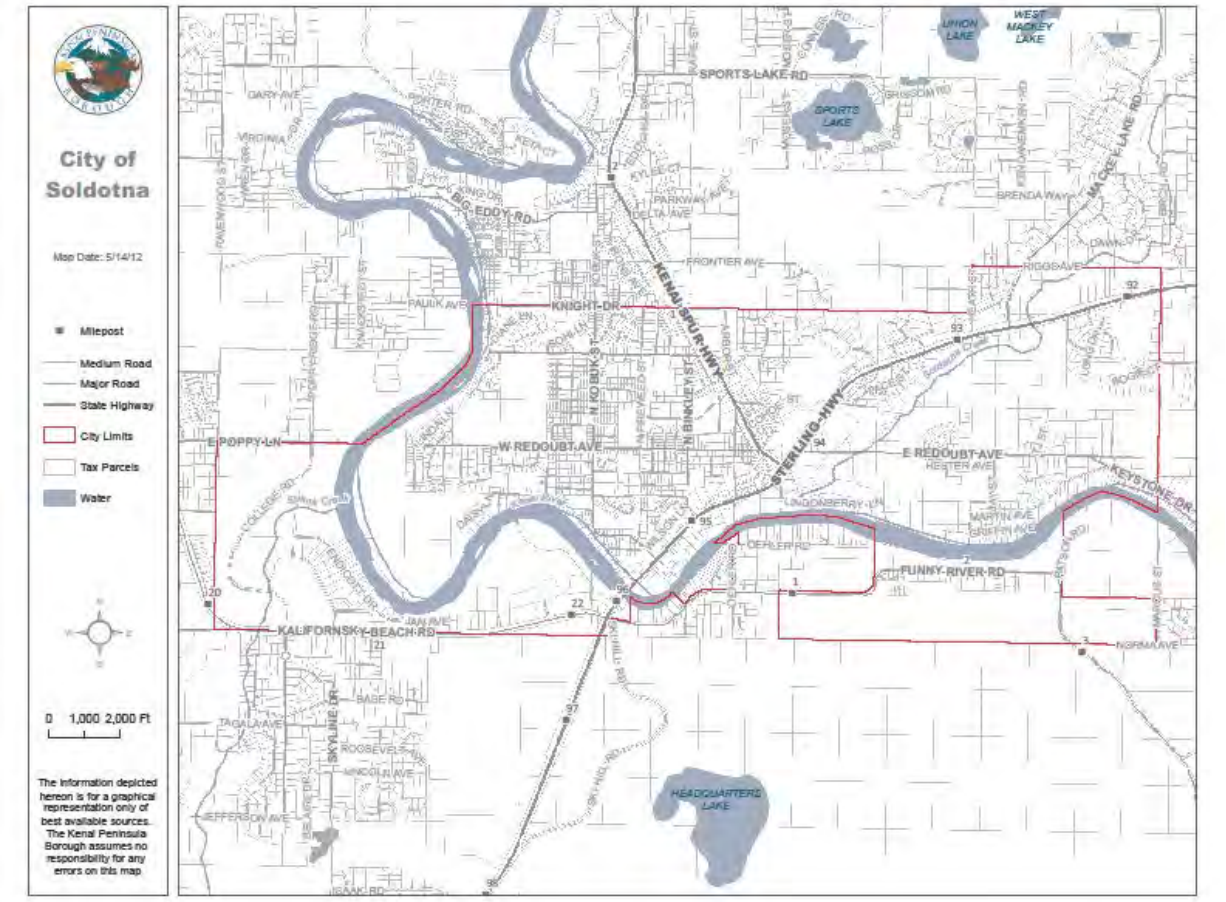

Figure 7. Kenai Peninsula Borough showing the Soldotna city limits.

3.2 Physical Environment

Soldotna Creek is a meandering low-gradient, third-order stream. Soldotna Creek, from its mouth to Sevena Lake, is 11.5 miles in length, and its discharge ranges from 6.0 to 68 cfs (Massengill 2011; Kenai Watershed Forum unpublished 2012 discharge data). In aggregate, there are an additional 10.5 miles of first and second-order streams in the drainage that potentially contain northern pike because they either link to lakes with northern pike or to Soldotna Creek . These first and second order streams are small (typically 0.1 to 2.7 cfs) and some are ephemeral (Massengill 2011). All lakes in the drainage with confirmed existing northern pike populations are open lakes. Four of these lakes (Union L., West Mackey L., East Mackey L., Derks L.) are linked in series by small, sometimes ephemeral stream connections. Sevena Lake is the northwestern most lake in the drainage with a confirmed existing pike population, and Tree Lake to the northeast of Sevena Lake may contain northern pike despite a lack of recent evidence.

Sevena Lake drains directly into Soldotna Creek and functions as the creek's largest water input. The total volume of exposed water of the five confirmed northern pike lakes and Tree Lake (where northern pike presence is unknown) totals 5,109 acre-feet and covers in total about 550 surface acres. Maximum lake depths range from 17 to 33 feet. Substrate in the northern pike lakes is mostly organic muck and sand/fine gravels, and Soldotna Creek

contains a mixture of muck, sand, gravels and, in its lower half, large cobble/boulders are present. Based on visual and vegetative characteristics of the northern pike lakes, they would be classified as a mixture of mesotrophic and eutrophic morphology. There is an estimated 655 acre-feet of bog-covered lake and inundated wetlands adjacent to lakes and creeks containing northern pike that likely will require treatment.

3.3 Biological Environment

3.3.1 Vegetation

The watershed encompassing the Soldotna Creek drainage is mostly comprised of lowland boreal forest and wetlands. The wetlands are primarily vegetated with grasses, dwarf birch, willow and alder which can be seasonally inundated. Higher grounds are typically vegetated with black and/or white spruce, aspen, birch and alder.

3.3.2 Fish

The native fish assemblage of the Soldotna Creek drainage includes threespine stickleback, lamprey spp, sculpin spp, rainbow trout, Dolly Varden, round whitefish, hooligan, sockeye salmon, pink salmon, coho salmon and Chinook salmon. Steelhead are also present, although it is unknown if they are native to the drainage. A 1976 ADFG survey of the larger lakes in the drainage (East and West Mackey Lakes, Denise Lake, Derks Lake, Sevena Lake, Tree Lake and Cisca Lake) revealed all of them contained at least rainbow trout and threespine stickleback (Hammarstrom 1977). The ADFG anadromous catalog lists Sevena Lake, Derks Lake, Tree Lake and East Mackey Lake as anadromous lakes for juvenile coho salmon, and ADFG Soldotna Office lake files indicate West Mackey Lake historically contained coho salmon.

3.3.3 Wildlife

Mammals common to the Soldotna Creek drainage include brown and black bear, moose, caribou, wolf, coyote, snowshoe hare, lynx, muskrat, beaver, mink, river otter, weasel, red squirrels, porcupine, flying squirrel, shrews, voles and domesticated dogs and cats. Piscivorous birds common to the area include bald eagle, herring gull, Bonaparte's gull, parasitic jaeger, common loon, horned grebe, red-necked grebe, crow, raven, magpie, stellar jay, gray jay and osprey. Additionally, several non-piscivorous species of birds including various passerines, woodpeckers, geese, ducks, plovers, owls, etc. are present in the area. The wood frog is the only amphibian in the Soldotna Creek drainage. There is a varied assemblage of aquatic invertebrate species in the drainage's lakes and streams.

3.3.4 Threatened and Endangered Species

There are no threatened or endangered species in the Soldotna Creek drainage. However, the Cook Inlet Beluga whale is endangered and is found in nearby Cook Inlet.

3.4 Human Environment

3.4.1 Economy

The Soldotna Creek drainage is centrally located on the Kenai Peninsula where major economic drivers include oil and gas extraction, oil and gas processing facilities, sport and commercial fishing and tourism. The drainage is a tributary of the Kenai River which is world-renowned for

its trout and salmon sport fisheries. Salmon stocks originating from the Kenai River are the largest contributor to the Upper Cook Inlet commercial fishing harvest and these stocks provide fish for the most popular and productive personal use and sport fisheries in the state.

3.4.2 Recreational Use

Public access to the Soldotna Creek drainage is varied and is available through the City of Soldotna (Soldotna Creek Park near the creek mouth) and through undeveloped State and Borough lands scattered within the drainage. Soldotna Creek Park is a popular fishing destination for shore anglers and has a day-use picnic and playground area. Private landowners and other recreationists have historically utilized many of the larger lakes in the drainage for all types of water recreation and float plane operation. Union Lake supported a popular hatchery-stocked coho salmon fishery until 1995 when northern pike were discovered and stocking discontinued. Many of the open lakes in the drainage currently support only northern pike fisheries but previously supported productive wild rainbow trout fisheries.

4.0 ENVIRONMENTAL CONSEQUENCES

The purpose of this section is to identify and describe the ecological and human health impacts of the alternatives. Potential impacts are discussed within three broad subject areas: physical environment, biological environment, and human environment. The discussion, especially pertaining to the preferred alternative, focuses largely on issues that were identified during public scoping and commenting periods or that ADFG recognizes as potential concerns likely to arise.

4.1 Physical Environment

4.1.1 Impacts from Alternative 1 to Soils

The soils underlying the Soldotna Creek drainage will not be affected if the northern pike population remained in the lake.

4.1.2 Impacts from Alternative 2 to Soils

Impacts from placing a fish barrier in Soldotna Creek to the underlying soils would not be significant except at the barrier site where land alteration, construction activities and fill could occur depending on the barrier design. A barrier could also cause an increase in the static height of the creek upstream of the barrier leading to an increase in soil saturation for a short reach of the stream.

4.1.3 Impacts from Alternative 3 to Soils

The soils underlying the Soldotna Creek drainage will not be affected if the northern pike population was targeted with long-term netting or other mechanical control methods.

4.1.4 Impacts from Alternative 4 to Soils

No rotenone contamination of soils and/ or groundwater is anticipated to result from this project. Rotenone binds readily to sediments and is ultimately broken down in soil and water (Engstrom-Heg 1971; Skaar 2001; 1976; Ware 2002). Rotenone penetrates approximately one inch in most soil types; the only exception is sandy soil where movement is about three inches (Hisata 2002). The primary soil types in the Soldotna Creek drainage area consists of decaying

organics (0-4 inches from the surface) overlaying a silt and loam mixture (2-16 inches from the surface) and gravelly loamy sand/sandy loam (8-60 inches from the surface) with most soils classified as moderately to highly permeable (Van Patten 2005). Therefore, it is expected that, at the very maximum, rotenone will only penetrate soil about three inches in the Soldotna Creek drainage area. Rotenone that is bound in the soils underlying the lake will naturally break down. Rotenone degradation rates in soil are dependent on soil temperature, soil physicochemical properties and sunlight exposure. Rotenone embedded on soil surfaces but exposed to sunlight has been shown to degrade 50% after five to seven hours (Cavoski et al. 2007). Rotenone embedded in soil without sunlight exposure was shown to degrade 50% in 8 days at 20C° and 25 days at 10C° (Cavoski et al. 2008).

4.1.5 Impacts from Alternative 1 to Water Quality

Allowing northern pike to remain in the Soldotna Creek drainage is not expected to directly affect water quality. At least one lakeside resident in the Soldotna Creek drainage claims the clarity of the water in West Mackey Lake increased following the introduction of northern pike. A speculative but plausible explanation for this is that northern pike predation caused the extirpation of all other fish species which preyed on zooplankton. As zooplankton numbers increased so did their consumption of phytoplankton. Phytoplankton can discolor and increase turbidity.

4.1.6 Impacts from Alternative 2 to Water Quality

A permanent fish barrier in Soldotna Creek would not be expected to significantly alter the water quality of the creek. Depending on the barrier design, a barrier could intentionally create a small water impoundment which could slightly increase water temperature along with a corresponding slight decrease in dissolved oxygen content. Some barrier designs would be prone to debris loading which could also cause water to be impounded temporarily.

4.1.7 Impacts from Alternative 3 to Water Quality

Mechanical removal/netting of northern pike would not be expected to impact the water quality in the Soldotna Creek drainage.

4.1.8 Impacts from Alternative 4 to Water Quality

This alternative will intentionally introduce rotenone, a natural botanical piscicide, to surface waters to kill invasive fish, but the anticipated impacts will be short-term. CFT Legumine™ (5% rotenone) and Prentox® Prenfish™ Fish Toxicant powder (~7.4% rotenone) are registered by both the Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation and are deemed safe to use to eradicate invasive fish when applied according to label instructions. The proposed treatment will result in a peak rotenone concentration of 0.05 ppm active ingredient (rotenone). Depending on the site-specific habitat (water depth, vegetation present, flowing water, etc.) liquid or powdered rotenone formulation will be used alone or in combination. According to the EPA's re-registration of rotenone, there are no adverse environmental or human health effects from rotenone when is used at these concentrations (USEPA 2007). The greatest risk to the environment is from a catastrophic spill. Spill prevention measures will reduce the likelihood of a catastrophic spill such as covering the ground with a bermed impermeable liner where rotenone is staged onsite. Spill risk will also be lowered by applicators observing standard operating procedures for the proper handling and transferring of rotenone products as detailed in Finlayson et.al. 2010. Spill response equipment will accompany any transport or storage of rotenone products.

There are three ways in which rotenone can be detoxified once applied. The first detoxification method involves dilution by other water sources. This may be accomplished by groundwater or surface water mixing with treated water and diluting the rotenone below 2.0 parts per billion (ppb) which is the threshold that requires deactivation if it moves outside the treatment area (Finlayson et al. 2010). It is estimated that rotenone entering the Kenai River from Soldotna Creek following the Area Two treatment will quickly dilute well below the 2.0 ppb threshold (additional details on this are discussed in section 4.3.6). However, dilution will be expected to be a minor contributing factor to the overall detoxification of rotenone in the Soldotna Creek drainage, itself.

The more common method of rotenone detoxification is to allow the rotenone to naturally breakdown. Rotenone is susceptible to natural detoxification through a variety of mechanisms, but warm water temperatures and exposure to sunlight are the two factors with the greatest influence on degradation rate (Ware 2002; ODFW 2008; Loeb and Engstrom-Heg 1970; Engstrom-Heg 1972; Gilderhus et a1. 1986). Rotenone released into relatively warm water (~15°C) is expected to fully detoxify within two to four weeks (Dawson et al. 1991; Brian Finlayson retired California DFG pesticide specialist, personal communication). Available Soldotna Creek water temperature data indicates the temperature of Soldotna Creek from mid-June through early August ranges from 11.5ºC Celsius to 13.5ºC (Kenai Watershed Forum 2007-2011 unpublished data). Water temperatures in the drainage's northern pike lakes during this same period, on average, ranged between 11ºC and 19ºC (Appendix 10). Between 2000 and 2013, rotenone applied to other Kenai Peninsula lakes during September and October, when water temperatures ranged from 3.5ºC to 12ºC at the time of application, experienced rotenone persistence ranging from a couple of weeks to nine months, and, sometimes the rotenone did not fully deactivate until shortly after ice-out the following year.

The third method of detoxification involves the application of potassium permanganate ($KMNO_4$), an oxidizing agent (Appendix 11). This dry crystalline substance is mixed with water to detoxify the rotenone. Detoxification is typically accomplished after about 60 minutes of mixing between the two compounds at a 1:1 ratio (Finlayson et al. 2010) but can be accelerated by increasing the ratio of $KMNO_4$. Detoxification by this method will be used during the Area Two treatment (mainstem Soldotna Creek treatment) and will be additive to the natural detoxification occurring. Detoxification using potassium permanganate will be initiated at the start of the Soldotna Creek mainstem treatment during the Area Two treatments and will be continued for as long as sentinel fish held just above the deactivation station show rotenone-related stress after four hours of exposure. The duration that potassium permanganate would be used is anticipated to be a few days or less but could be longer. A potassium permanganate dispensing station will be installed at the lower end of Soldotna Creek and remain on operational standby status throughout the duration of the entire Area Two treatment as a precaution.

During the Area One treatment, a $KMNO_4$ deactivation station will be set up below Derks Lake. If needed at any time during the Area One treatment, $KMNO_4$ will be applied to the water to deactivate rotenone heading downstream. The need for chemical deactivation will be determined by the response of sentinel fish held in Soldotna Creek just downstream of the Derks Lake outlet. Once started, deactivation of stream discharge with $KMNO_4$ will be continued until sentinel fish in Soldotna Creek just downstream of the Derks Lake outlet no longer demonstrate rotenone-related stress symptoms for four consecutive hours as suggested by Finlayson et al. (2010). To assess the need to continue deactivation with $KMNO_4$ once initiated in Area One, the release of $KMNO_4$ will be temporarily halted every couple of days for a

4-5 hour period while sentinel fish are monitored in Soldotna Creek. $KMNO_4$ release will be immediately restored if sentinel fish show any sign of rotenone stress during that period.

KMN04 is toxic to fish at relatively low concentrations and is more toxic in alkaline waters than soft water (Markings and Bills 1975). Acute toxicity exposure time (LC50 value) to rainbow trout at 12°C, pH of 7.5 when at a concentration of 5 mg/L, is about 11 hours (Markings and Bills 1975). If $KMNO_4$ concentrations are in balance with rotenone concentrations, then toxic levels of $KMNO_4$ are reduced through the oxidation of rotenone and other organic components (Finlayson et al. 2010). In flowing water treatments, this balance usually limits aquatic exposure to KMNO4 and rotneone to 0.25 to 0.5 miles downstream of the neutralization site (Hobbs et al. 2006). $KMNO_4$ deactivates rotenone in distilled water at approximately a 1:1 ratio after 60 minutes of contact time (Finlayson et al. 2010). During deactivation, adjustments to $KMNO_4$ concentrations must be made to account for varying water temperature, exposure time and background oxygen demand as explained in Finlayson et al. (2010). Finlayson et al. (2010) also explains that the $KMNO_4$ concentration in the stream must be measured periodically during the deactivation process so the correct ratio of rotenone: $KMNO_4$ can be maintained. The anticipated $KMNO_4$ residual that will remain in the water during the periods when chemical deactivation will be employed for this project is 1 mg/L and is well below the LC50 value for rainbow trout. $KMNO^4$ testing is done in the field with portable test kits and will occur every half hour until streambed oxidation stabilizes (typically stabilization is achieved within 1-2 hours) then testing is scaled back to every 1-2 hours or less.

Potassium permanganate has a low estimated lifetime in the environment, being readily converted by oxidizable materials to insoluble manganese oxide (MnO_2). MnO_2, formed during the oxidation of the rotenone, is a biologically inactive compound (USFS 2011). For the most part, MnO_2 formed from potassium permanganate reaction is inert, insoluble and chemically similar to the original MnO_2 found naturally in the crust and is present in rock, soil and water (USFS 2011).

Mitigating actions will reduce the amount of chemicals (rotenone or $KMNO_4$) required for this project. These actions include timing the Area Two treatment to coincide with summertime low stream flows and the dewatering of adjacent wetlands so less rotenone and $KMNO_4$ will be needed. Also, the Area One treatment will temporarily impound water at Derks Lake and allow the rotenone to degrade significantly prior to release, thus reducing the amount of $KMNO_4$ potentially needed for deactivation.

The degradation of rotenone can result in at least 20 different products of which only one is toxic (rotenolone) (Cheng et al. 1972). Rotenolone is approximately one order of magnitude less toxic than rotenone (Finlayson 2000). The ultimate breakdown products of rotenone are carbon dioxide and water (http://www.dfw.state.or.us/fish/local_fisheries/diamond_lake/FAQs.asp).

There are several formulations of rotenone available as a piscicide, including liquid and powder products. Prentox® Prenfish™ Fish Toxicant Powder is pure ground root product and contains no additives. CFT Legumine™ is a liquid rotenone mixture, and its other ingredients facilitate the emulsification and dispersion of rotenone in water. The CFT Legumine™ formulation was analyzed for the California Fish and Game Department (CFGD) in 2007 (Fisher 2007). This analysis showed that the primary ingredients (carrier compounds) are soluble organic compounds (SOCs) such as diethylene glycol ethyl ether (DGEE) (61.1%), Fennedefo 99™ (17.1%), N-methyl pyrrolidone (9.8%), rotenone (5.12%) and rotenolone (0.72%). These compounds in the formulation will naturally biodegrade and are expected to reach undetectable levels within a week to several weeks. However, N-methyl pyrrolidone and DGEE will be

expected to dissipate more slowly because they are water soluble and will not readily dissipate through volatilization.
A thorough description of the toxicity or these compounds can be found in section 4.3.3.

Studies indicate that the other compounds in liquid rotenone formulations have not been detected at harmful levels in groundwater associated with rotenone application (Finlayson et al. 2000; Ridley et al. 2006; Fisher 2007). Case studies in Montana have concluded that rotenone movement through groundwater does not occur (MFWP 2008). Private drinking water wells exist in the Soldotna Creek drainage including some Department of Environmental Conservation (DEC) protected public drinking water sources found south of the Sterling Highway (Appendix 11). Because the drainage's surface waters must travel through sediments, soils, and gravels to reach ground aquifers, and rotenone is known to bind readily with these materials, no contamination of ground water is anticipated. Available well logs and USGS information for the Soldotna Creek drainage area were evaluated by an Alaska Department of Natural Resources hydrologist for potential groundwater concerns related to treating the Soldotna Creek drainage with rotenone (Appendix 13). In summary, the hydrologist stated there is sufficient information to show that the confined aquifers should be protected from surface effects of the treatment.

Following any rotenone treatment, there may be a substantial number of fish carcasses present. Bradbury (1986) reported that approximately 70% of rotenone-killed fish in Washington lakes immediately sink. Parker (1970) reported that at water temperatures of 5° C and cooler, dead fish required 20-41 days to surface. The most important factors inhibiting fish from surfacing are cooler water (<10° C) and deep water (> 15 feet). Most lakes in the Soldotna Creek drainage are shallow with limited areas exceeding 20 feet in depth, the desired treatment period for Area One will be late September to early October, and water temperatures will likely be <10°C (Massengill 2011). Because of the relatively cold water temperatures expected during the Area One treatment and the planned pretreatment fish removal for the area using gillnets, few dead fish are expected to be visible following the Area One treatment, and the subsequent odor from decaying fish should be limited.

The Area Two treatment will likely result in a higher number of fish carcasses as this area still supports robust native fish populations. Fyke nets will be placed throughout all the creeks to be treated during the Area Two treatment. These fyke nets will limit fish movement throughout the area and will help collect impaired native fish for rescue and dead fish so they can be disposed of. Nonetheless, significant numbers of dead fish, mostly juvenile salmonids, threespine sticklebacks and sculpins are expected to be present in the creek for a short period of time following the Area Two treatment. Efforts will be made to remove fish carcasses that occur near residences when feasible.

Bradbury (1986) reported that nine of eleven water bodies in Washington treated with rotenone experienced an algae bloom shortly after treatment. This occurred from the input of phosphorus to the water as fish decayed. Bradbury further noted that approximately 70% of the phosphorus content in the dead fish will be released into the lake through bacterial decay. This stimulates phytoplankton production which in turn increases zooplankton production, providing prey for macroinvertebrates and fish. This change in water chemistry is viewed as a benefit to stimulate plankton growth (UDWR 2007). Any changes or impacts to water quality resulting from decaying fish are expected to be short-term and minor.

Fish in the Kenai River are not expected to be affected by the treatments of Area One or Area Two. Regardless, ADFG will monitor caged sentinel fish in Soldotna Creek periodically each day during the Area One treatment until it is evident that rotenone is not impacting fish below

the Derks Lake outlet creek mouth. Likewise, during the Area Two treatment, caged sentinel fish in the Kenai River held just below the Soldotna Creek confluence and others held just above the deactivation station will be monitored daily until it is evident that rotenone is not impacting fish in the Kenai River or lower Soldotna Creek when $KMNO_4$ is not being applied.

In summary, all rotenone treatments conducted during this project will be confined to the Soldotna Creek drainage. Waters discharging from Derks Lake (Area One) and mixing with the mainstem of Soldotna Creek should result in a rotenone concentration of about one-third of the target concentration (50.0 ppb target concentration) under a worst-case scenarion where Derks Lake discharge is high relative to the discharge of the mainstem of Soldotna Creek. This rotenone concentration will further decrease as treated water travels downstream and eventually mixes with the Kenai River where it will be rapidly diluted far below 2.0ppb. Likewise, rotenone treated discharge from Soldotna Creek during the Area Two treatment will mix with the Kenai River and result in a rotenone concentration below 2.0 ppb, however, $KMNO_4$ deactivation of rotenone in lower Soldotna Creek is planned to occur during the mainstem creek treatments to provide additional assurance that rotenone will remain below 2.0 ppb in the Kenai River and not harmful to fish. A rotenone deactivation station using $KMNO_4$ will be ready to operate in the lower section of Soldotna Creek at all times during all Area Two treatments as well as a redundant backup deactivation station.

As required by state regulation, ADFG will submit a pesticide permit application to the Alaska Department of Environmental Conservation (ADEC) which must be approved prior to treating the Soldotna Creek drainage with rotenone. This project will also be conducted in compliance with the federal Clean Water Act National Pollution Discharge Elimination System (NPDES), where authority to administer the program in Alaska was recently delegated to the Alaska Department of Environmental Conservation under the Alaska Pollution Discharge Elimination System (APDES).

4.2 Biological Environment

4.2.1 Impacts from Alternative 1 to Vegetation

Aquatic macrophyte populations in the Soldotna Creek drainage will not be directly affected by northern pike if they remain in the drainage.

4.2.2 Impacts from Alternative 2 to Vegetation

Any impacts to vegetation from a fish barrier will be attributed mainly to heavy equipment used during the construction. However, this could partially be mitigated by constructing an ice road to the site during the winter or selecting a site that already provides access. The long-term ecological impacts from this would likely be minor.

4.2.3 Impacts from Alternative 4 to Vegetation

Aquatic macrophyte populations in the Soldotna Creek drainage will not be directly affected by gillnetting or other mechanical removal options.

4.2.4 Impacts from Alternative 4 to Vegetation

The Soldotna Creek drainage has substantial lakeside residential development, some with lakeside residences having private boat launches. At all the northern pike lakes with lakeside residences, ADFG has been offered private boat access for northern pike control purposes. Tree Lake has no lakeside residences but does have an unimproved ATV trail that leads to the

lakeshore that can serve as a boat launch for small watercraft. Basing lake treatment operations (boat and equipment/supply staging) from private boat launches should greatly reduce trampling of vegetation around the lakes caused by the rotenone application/staging activities. However, the use of drip stations or ATV's for treating streams and wetlands could result in some temporary trampling of grasses and shrubs along the creek banks. Visual inspections of all equipment for the presence of aquatic invasive plants, particularly Elodea, will be done to reduce the chance this project is a vector for the spread of invasive aquatic plants to the drainage.

Locations with inundated wetlands adjacent to northern pike infested waters will require rotenone treatment. This can be accomplished with a variety of application equipment depending on water conditions, and could include the use of backpack applicators, a surface drive outboard boat, airboat, ATV or a helicopter (helicopter use would occur in Area Two only). In most cases, the only practical way to apply rotenone to very small creeks having little discernible discharge is to apply rotenone using backpack sprayers. Lakeside-submerged wetlands and dense emergent weed beds in lakes will best be treated using a surface drive outboard boat or airboat equipped with a pumping/application system. Larger submerged wetlands that are not easily accessed with watercraft will be best treated with an ATV equipped with a portable pumping system or by aerial application using a helicopter (Area Two only). The application method to be selected for individual wetlands will depend on the field conditions present just prior to the treatment. Aerial applications by helicopter will not be used in Area One as the amount of difficult to access wetlands is far less than in Area Two.

To minimize trampling if an ATV is used, the ATV will be equipped with a high pressure pumping system and lengthy spray hose (50-75 feet) that essentially increases the application swath and reduces the need to drive over as much area. Any ATV vegetation trampling effects are expected to be minimal and short-term in duration and will occur at a time of year when many grasses will have already experienced most of their growth. Any application done by backpack spraying would have little impact to vegetation. Impacts to vegetation are not anticipated following aerial application by helicopter.

Dense beds of emergent lake vegetation will likely require the use of an airboat or surface drive outboard. It is anticipated that some beds of emergent vegetation (lily pads, inundated grass and bulrushes, etc.) will sustain some damage from boat propellers during the application. No direct, immediate, or long-term impacts to vegetation are anticipated from the rotenone, itself, because rotenone does not negatively affect plants.

4.2.5 Impacts from Alternative 1 to Wildlife

Northern pike are top predators in aquatic environments, and they are very opportunistic in their diet. Besides fish, northern pike will prey on invertebrates, frogs, small mammals and birds. Northern pike are non-native predators in the Soldotna Creek drainage, so if their population remains, predation on native animals will continue. Should northern pike from Soldotna Creek expand their range and establish reproducing populations elsewhere in the Kenai River drainage, additional losses to wildlife are likely.

4.2.6 Impacts from Alternative 2 to Wildlife

Wildlife species characteristic to the area are described in 4.2.8. A fish barrier in the Soldotna Creek drainage would likely not significantly impact wildlife. A barrier could cause some aquatic animals to detour around the barrier, and during ice cover conditions detouring by swimming wildlife could be difficult or impossible. A barrier could potentially entrap some aquatic wildlife.

4.2.7 Impacts from Alternative 3 to Wildlife

Gillnetting or other mechanical removal methods would not be expected to impact large mammals, but the incidental bycatch of small mammals, such as muskrats is likely to occasionally occur.

4.2.8 Impacts from Alternative 4 to Wildlife

Large Mammals: Grizzly bears, black bears, and wolves are found in the Soldotna Creek drainage area but are not exclusively dependent on fish from the drainage for food although some salmon predation/scavenging and ingestion of water by these predators likely occurs in the Soldotna Creek drainage. The removal of visible dead fish, where feasible, should reduce the potential for these species to consume rotenone-killed fish in great quantity. Even if rotenone-killed fish were consumed by mammals, there should be no adverse effects because rotenone at trace dosages is expected to be degraded by enzymes in the animals' digestive tracts (Finlayson et al. 2000; USEPA 2007). The LC50 to female rats from oral ingestion is 320 mg/Kg (Lowe 2006). No evidence of carcinogenicity has been documented in mice/rat studies (National Toxicology Program 1986). Following rotenone treatment, frequent monitoring of the waterbodies, particularly those close to residences, to collect dead fish should limit fish carcasses from becoming an attractant to bears.

There is a year-round common presence of moose in the Soldotna Creek drainage and to a lesser degree a year-round presence of caribou. It is possible that either of these species may ingest treated water or that moose feed on aquatic vegetation in the treated waterbodies. EPA-approved bioassays indicate that, at the proposed concentrations, rotenone will have no effect on mammals that drink the treated water (Schnick 1974a, 1974b; Herr et al. 1967). Ingestion of treated waters by any terrestrial wildlife will have no adverse effects because of the low rotenone concentration found in the lake water and the enzymatic action in the animals' digestive tracts. Particularly, the gastrointestinal absorption of rotenone is inefficient (Finlayson et al. 2000).

Finally, rotenone has a low acute toxicity via the dermal route of exposure and receives a toxicity category IV rating; in rabbits, the LD50 is >5000 mg/kg (USEPA 2007). Risk of inhalation exposure to rotenone from the liquid CFT Legumine™ to wildlife is nonexistent because the vapors rapidly dissipate, and the application method for powdered rotenone, which involves using a semi-closed system pumping apparatus, prevents exposure hazard to wildlife. In conclusion, this project will have no significant impact on game mammals.

$KMNO_4$ used to deactivate rotenone breaks down into potassium, manganese and water. Both potassium and manganese are common in nature and have few harmful environmental effects at the concentrations used in the rotenone deactivation processes: http://wildlife.utah.gov/millcreek-restoration/millcreek-restoration-faq.html. Concentrated $KMNO_4$ does pose a potential risk to wildlife as it is quite caustic. The reported acute oral LD50 (rat) = 780 mg/kg Male (14 days); 525 mg/kg Female (14 days): http://www.fws.gov/fisheries/aadap/14_potassium%20permanganate/06_msdss/msds_9246_potassium%20permanganate.pdf. To prevent ingestion or contact of undiluted $KMNO_4$ by wildlife, onsite storage of $KMNO_4$ will be in a locked safe box.

Other mammals: Coyote, lynx, muskrat, beaver, mink, otter, weasel, snowshoe hare, red squirrel, porcupine, flying squirrel, shrew, vole and domesticated dogs and cats are present in the area. Some of these mammals could scavenge on rotenone killed fish or drink treated lake water. The effects of rotenone on non-target organisms have been studied extensively. Again

mammals, in general, are not affected by rotenone in fisheries treatment concentrations because they neutralize rotenone by enzymatic action in their stomach and intestines (Finlayson 2000: AFS 2002; USEPA 2007). Laboratory tests have been conducted in which rats and dogs have been fed forms of rotenone as part of their diet for periods of six months to two years (Marking 1988). Observed effects included diarrhea, decreased food consumption, and weight loss. Researchers reported that despite the unusually high treatment concentrations of rotenone fed to rats and dogs, the chemical did not cause tumors or reproductive problems in these mammals.

CDFG (1994) studies of potential risks to terrestrial animals found that a 22-pound dog will have to drink thousands of gallons of lake water or eat thousands of pounds of rotenone killed fish in 24 hours to receive a lethal dose. The State of Washington reported that a half-pound mammal (red squirrel size) will need to consume 12.5 mg of pure rotenone to receive a lethal dose (Bradbury 1986). It is important to note that nearly all of the aforementioned examples were based upon subjecting laboratory specimens to unusually high concentrations of rotenone that are far above concentrations used in fisheries management uses. For this project, ADFG will use rotenone products containing 5% to 7.4% rotenone. Assuming the primary way an animal may consume the compound under field conditions is by drinking lake water, a half-pound animal will need to drink 66 gallons of Soldotna Creek drainage water treated at 0.05 ppm rotenone to receive a lethal dose. Based on this information, we expect the impacts to non-target organisms to range from non-existent to minimal and short-term.

Migratory waterfowl/ Birds: Birds common to the area that could potentially consume dead fish following treatment include bald eagles, herring gull, Bonaparte's gull, parasitic jaeger, common loon, horned grebe, red-necked grebe, crow, raven, magpie, stellar jay, gray jay and osprey. Additionally, non-piscivorous birds such as passerines, woodpeckers, geese, ducks, plovers, owls, etc. are present in the area. During the proposed Area One treatment period (October), many piscivorous waterfowl will have migrated from the drainage. During the summer treatments of Area Two, project activities may cause some water birds to temporarily relocate to non-treated neighboring lakes for feeding. Following the treatment, it is likely that some birds will remain and forage on rotenone-killed fish, however research has indicated it is not physiologically possible for birds to consume sufficient quantities of rotenone-killed fish to result in a lethal dose (Finlayson 2000: USEPA 2007).

Rotenone residues in dead fish are generally very low (<0.1 ppm), unstable, and not readily absorbed through the gut of the animal eating the fish (Finlayson et al. 2000). A bird weighing ¼ pound will have to consume 100 quarts of treated water or more than 40 pounds of fish and invertebrates within 24 hours to receive a lethal dose. This same size bird will normally consume 0.2 ounces of water and 0.32 ounces of food daily, thus a safety factor of 1,000 to 10,000 fold exists under normal conditions for birds and mammals. The LD50 values for mallard ducks and ring-necked pheasants were 2200 mg/kg and 1680 mg/kg, respectively, as found online at: http://pmep.cce.cornell.edu/profiles/extoxnet/pyrethrins-ziram/rotenone-ext.html. Regardless, ADFG efforts to remove rotenone-killed fish that surface following treatment will minimize potential risks to birds; thus, impacts (if any) should be negligible.

Human activity associated with the application of rotenone in the Soldotna Creek drainage and the related pre and posttreatment gillnetting could temporarily disrupt bird use in the area. Further, some birds could be lost to net entanglement. To mitigate this, owl decoys will be placed near gillnets fished in open water to discourage bird use.

Nearly all post-treatment gillnetting will be done by fishing the nets under the ice. Doing so essentially eliminates the risk of incidental bird bycatch. ADFG has successfully employed this tactic on Kenai Peninsula lakes in recent years to reduce northern pike abundance. To be successful at avoiding bird bycatch, the gillnets must be set during the freeze-up period (or shortly following when ice can still be broken by a skiff) and then all nets must be removed immediately at ice-out. ADFG will monitor ice conditions during the spring to ensure nets are removed as quickly as practical at ice-out. Nets will not be set within 100 yards of lake inlets or outlets which are prone to remaining ice-free. All open water gillnets will be tended daily at a minimum so entangled birds can be released alive when possible.

Because northern pike are known to opportunistically prey on birds (Solomon 1945, Brown 2005) the eradication of these fish from the drainage could actually benefit avian populations in the long-term. Noise, particularly from low-flying helicopter use in Area two, could temporarily disrupt bird behavior in the Soldotna Creek drainage for up to a one week period during both Area Two treatments.

Threatened or Endangered Species: The Cook Inlet beluga whale is the only endangered species found in the area of Cook Inlet. No direct impacts to beluga whales are expected because the Soldotna Creek drainage is not utilized by beluga whales. Any rotenone that may enter Cook Inlet via discharge from the Soldotna Creek drainage will be well below detectable limits and will pose no threat to fish, birds or mammals. Rotenone, at fish management concentrations, poses no known threat to wild mammals or birds.

A possible indirect benefit to beluga whale from this proposed piscicide application is the restoration of the coho salmon habitat in the Soldotna Creek drainage which may result in an increase in coho salmon production. Adult coho salmon are a forage species for Cook Inlet beluga whales during summer and fall when salmon migrate through Cook Inlet to natal spawning destinations.

4.2.7 Impacts from Alternative 1 to Aquatic Resources

Though northern pike are opportunistic feeders, their preference is for fish. They have already decimated entire native fish populations in East Mackey Lake, West Mackey Lake and Derks Lake and severely depleted native fish populations in Sevena Lake. Northern pike also destroyed the stocked coho salmon fishery in Union Lake. Sevena Lake has recently experienced a rebound of its native fish populations which is believed to be the result of ADFG northern pike netting efforts coupled with a fish winterkill event during the winter of 2008 that nearly eliminated the northern pike population there. The reduction of northern pike abundance and increase in native fish populations will likely be temporary. As long as northern pike remain in the Soldotna Creek drainage, native fish populations will remain absent or greatly suppressed, particularly in lakes.

4.2.8 Impacts from Alternative 2 to Aquatic Resources

Constructing a permanent fish passage barrier in Soldotna Creek to contain the northern pike population would likely impede or prevent, at least temporarily, upstream and downstream fish movement for many native fish species. In order to prevent passage of northern pike and allow native fish movement, manual collection, identification and passage of fish at the barrier would be needed. Depending on barrier design and long-term funding availability, controlling fish passage may be difficult or impossible, especially during the winter when icing is an issue or during high water events.

Ultimately, should northern pike continue to be the dominant fish species present in many lakes in the drainage, the restoration of native fish populations in those lakes would be limited at best.

4.2.9 Impacts from Alternative 3 to Aquatic Resources

Netting to reduce northern pike abundance in the Soldotna Creek drainage would only be feasible for the drainage's lakes as the limited access and inherent difficulties of netting shallow flowing waters would prevent the effectiveness of this control option in streams. Gillnetting was utilized by ADFG to reduce northern pike abundance in four lakes (West and East Mackey Lakes, Sevena Lake and Derks Lake) between 2002 and 2008 with the effort focusing on Derks and Sevena Lakes in later years (McKinley In prep, Begich 2010, Massengill 2010, 2011). Although northern pike catch-per-unit-of-effort trends suggested pike abundance was greatly reduced in some lakes, at Derks Lake it resulted in no significant reduction in abundance (Massengill 2011). In most lakes netted, no restoration of native fish species was detected with the exception of one (Sevena Lake) in which a winterkill event was suspected of playing an additive role in the near disappearance of the northern pike population and subsequent rapid recolonization of native fish species, particularly for juvenile coho salmon, rainbow trout and Dolly Varden.

ADFG recently experienced success in eradicating northern pike populations using gillnets in two small lakes that contained very small northern pike populations (<30 individuals) but only after thousands of net soak hours were expended in 2010 and 2011. It is not believed feasible to eradicate northern pike from the Soldotna Creek drainage using gillnets or other mechanical removal options. Therefore, restoration of native fish populations to pre-invasion densities and eliminating the threat of northern pike migrating into other parts of the Kenai River system would not be expected under this alternative. It is possible some native fish populations would recover to some limited degree, but these populations would be subject to the same netting pressure as northern pike further hindering their recovery.

Netting does pose a risk to birds and other wildlife and the incidental take of waterfowl and small aquatic mammals would occur.

4.2.10 Impacts from Alternative 4 to Aquatic Resources

Fish: This project is designed to eradicate invasive northern pike using rotenone. It is anticipated that all fish exposed to the rotenone will be killed. To prevent the complete loss of native fish populations that are still present in Area Two, an intensive effort will be made to collect and relocate representatives from Area Two prior to its rotenone treatment. These fish will be relocated to the previously treated Area One but only after northern pike are confirmed eradiated from that area. Relocating native fish from Area Two will not only prevent those fish from perishing, it will also help reestablish native fish populations in Area One. Although historic fish assemblage information is not well understood for Area One, it is established that rainbow trout inhabited, at a minimum, West Mackey Lake, East Lackey Lake and Derks Lake and supported popular fisheries. Derks Lake and East Mackey Lake are also listed in the ADFG anadromous waters catalog and coho o salmon were present in West Mackey Lake according to ADFG lake file data. It is likely that prior to road development in the area, rainbow trout and juvenile coho salmon occupied all the open waters within Area One that allowed fish passage. Three-spine stickleback were also present in Area One prior to the introduction of northern pike (ADFG Unpublished) and likely other species such as slimy sculpin, Dolly Varden, lamprey and other salmonids were present to some degree.

The primary sport fishery in the Soldotna Creek drainage is for northern pike in Area One. After native fish are reintroduced to Area One and have had time to fully rebuild their populations, these native fish should provide an increase in sport fishing opportunities beyond what currently exists. Removing northern pike from the drainage will result in a loss of fishing opportunity for this invasive species. Northern pike fishing has attracted some sport anglers who are enthusiastic about fishing for them.

There is limited information available on the toxicity of $KMNO_4$ to fish. Rainbow trout exposed to $KMNO_4$ at 2.0 ppm for two hours daily over a 14-day period exhibited no increase in mortality (Oplinger et al. 2010). Marking and Bills (1975) found that the toxicity of $KMNO_4$ to rainbow trout increased with increased total water hardness and that sustained exposure to concentrations in excess of 2 ppm was lethal.

The reported $KMNO_4$ LC50 for various species of fish range between 3.0 and 20 ppm for 1-hour exposures. Because rotenone will be used to kill fish in the treatment areas, native fish that are not collected and rescued are not expected to survive regardless if $KMNO_4$ is applied. Fish outside the treatment area (Kenai River) should only be exposed to $KMNO_4$ and rotenone concentrations diluted below detectable limits which are not harmful.

Invertebrates: Generally, zooplankton species are more vulnerable to rotenone than fish or macroinvertebrates (Bradbury 1986, Melaas et al. 2001, Vinson et al. 2010). However, many zooplankton species have life stages (eggs, resting stages) that are very rotenone-resistant so complete eradication is unlikely (Kiser et al. 1963, Melass et al. 2001). Zooplankton populations have been observed to fully recover to pretreatment levels in Southcentral Alaska within one to three years after a rotenone treatment with no observed loss of species (Chlupach 1977). Recent rotenone treatments at Arc Lake and Scout Lake on the Kenai Peninsula indicate invertebrate diversity remained comparable to pretreatment levels less than one year post treatment, but zooplankton abundance was temporarily reduced (Massengill In prep a, b). Chandler and Marking (1982) found that clams and snails were between 50 and 150 times more tolerant than fish to rotenone. Because of their short life cycles (Anderson and Wallace 1984), good dispersal ability (Pennack 1989) and generally high reproductive potential (Anderson and Wallace 1984), aquatic invertebrates are capable of rapid recovery from disturbance (Jacobi and Deegan 1977; Boulton et al. 1992; Matthaei et al. 1996). Recolonization will include aerial dispersal of adult invertebrates from adjacent areas to the project area (e.g., mayflies and caddis flies).

$KMNO_4$ can potentially affect non-target species although little data exists on the subject. Hobbs et.al. 2006 reported that organics in pond water had an ameliorating effect on $KMNO_4$ toxicity to fish and plankton (Daphnia sp.) and that there are species-specific differences to $KMNO_4$ toxicity. Water column herbivores (i.e. Cladocerans) are likely to be affected first by $KMNO_4$ followed by fish fry and sediment-associated organisms. The $KMNO_4$ 96-hour LC50 for Daphnia in pond water was nearly 2.0 ppm (Hobbs et al. 2006) and New Zealand mudsnails exposed to 2.0 ppm of $KMNO_4$ for 2-hours daily over a 14-day period exhibited no increase in mortality (Oplinger et al. 2010).

Once $KMNO_4$ is introduced to a waterbody, it rapidly disappears as it associates with organic material in the water, both abiotic and biotic. Because $KMNO_4$ may be applied for a long period for this project (days), it is likely that some invertebrate populations, particularly herbivores like Cladocerns, will be reduced or eliminated in two short stream sections (Derks Lake outlet stream and the lowest 1/4 mile of Soldotna Creek) where $KMNO_4$ may be used to deactivate

rotenone. Any $KMNO_4$ impacts to invertebrates are expected to be localized and temporary as recolonization of invertebrates from neighboring untreated waters should occur.

Amphibians: Wood frogs are the only amphibians on the Kenai Peninsula and are presumed to be common to the Soldotna Creek drainage. Wood frogs mate in the spring, and their offspring quickly develop from egg to tadpole to frog. This northern adaptation helps ensure complete metamorphosis before fall freeze-up (ADFG Wildlife Notebook Series: Frogs and Toads http://www.adfg.alaska.gov/static/education/wns/frogs_and_toads.pdf). Wood frogs are often migratory between breeding and non-breeding areas and may migrate up to several hundred meters between waterbodies:
http://www.adfg.alaska.gov/static/species/speciesinfo/_aknhp/Wood_Frog.pdf

Adult frogs are generally more resistant to the effects of rotenone than fish. Grisak et al. (2007) conducted laboratory studies on long-toed salamanders, Rocky Mountain tailed frogs, and Columbia spotted frogs and concluded that the adult life stages of these species will not suffer an acute response to rotenone, but larval and tadpole stages could be affected by rotenone at fish killing concentrations. Billman 2010 reported that two species of frog in Southwestern Montana suffered high larvae mortality rates when exposed to rotenone formulations of 1.0 ppm; however, 24-hour exposures were not lethal to frog metamorphs, juveniles and adults.

Of the two treatment areas, Area One contains the most standing water and potential frog habitat that will be subjected to rotenone treatment. The Area One treatment will occur in the fall so only adult frogs should be present, thus greatly reducing any impacts to their population from rotenone exposure. The Area Two treatments will occur in late spring/early summer when water levels are typically lowest. Much of the frog habitat (inundated wetlands) in Area Two during this period will likely be dewatered or isolated from other water sources thus reducing the amount of frog habitat requiring rotenone treatment. The Area Two treatment will coincide with relative warm temperatures which is expected to greatly accelerate the natural breakdown of rotenone and shorten the potential exposure period to wood frogs to perhaps days.

Regardless, mortality to wood frogs may be significant, particularly in Area Two where larval stages may be present in rotenone treated waters. Fortunately, the wood frog lifespan is up to three years: http://aknhp.uaa.alaska.edu/herps/pdf/spec_acct_wood_frog.pdf , so loss of a single larval brood year or two should not eliminate the population in an area. It is anticipated that surrounding ponds and wetlands that are not treated will also serve as recolonization sources that will help restore any depletion of wood frog populations in the Soldotna Creek drainage. Of relevance, ADFG collected live tadpoles in Scout Lake (Sterling, AK) on June 14th, 2010 three days after the lake fully detoxified from a rotenone treatment applied the previous fall (Robert Massengill, Soldotna ADFG fisheries biologist, personal observation).

4.3 Human Environment

4.3.1 Impacts from Alternative 1 to Public Safety and Health

Leaving the invasive northern pike population in Soldotna Creek drainage will not result in any human health or safety impacts.

4.3.2 Impacts from Alternative 2 to Public Safety and Health

Construction of a permanent fish barrier in the Soldotna Creek drainage will not result in significant public safety and health impacts.

4.3.3 Impacts from Alternative 3 to Public Safety and Health

Gillnetting poses a potential risk to public safety and health should watercraft or people become inadvertently entangled in nets. Risk of net entanglement is reduced if visual aids (i.e. colored buoys) identify net locations. Netting only nearshore areas and away from open waters that are heavily utilized by watercraft and float planes may reduce entanglement hazard. Restricting the time period when netting is conducted (i.e. winter or late fall) when water recreation is low is another strategy to reduce netting safety concerns.

4.3.4 Impacts from Alternative 4 to Public Safety and Health

Although pesticides are widely used to control unwanted species, legitimate public concerns have been raised regarding their health and human safety. The greatest risk to public safety is from a catastrophic spill. Spill prevention measures will greatly reduce the likelihood of a spill such as covering the ground with a bermed impermeable liner where rotenone is staged onsite and by all applicators and support personnel observing standard operating procedures for the proper handling and transferring of rotenone products as detailed in Finlayson et.al. 2010. Spill response equipment will accompany any transport or storage of rotenone products. A spill response plan for this project has incorporated into the projects treatment plan document archived at the Soldotna ADFG office.

As with any pesticide, direct exposure or consumption of piscicides can potentially have harmful or sometimes fatal effects on humans. Rotenone is an EPA-registered pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (USEPA 2007). Rotenone is also registered for use in Alaska by the Alaska Department of Environmental Conservation. Although Alaska does not have established water quality criteria for rotenone, the EPA's recent re-registration eligibility decision for rotenone (USEPA 2007) provides human health risk conclusions.

An EPA assessment of acute dietary risk was based on the maximum solubility of rotenone in water (200 ppb). Any additional rotenone in water will not further increase the concentration available for exposure. The EPA concluded that acute dietary exposure estimates for drinking water and eating fish from rotenone-treated waters was below the Agency's level of concern. The EPAs chronic dietary exposure assessment of rotenone was performed for only drinking water. Rotenone degrades rapidly and has a low propensity to bioaccumulate in fish reducing concerns that humans would sustain risk from consuming rotenone exposed fish. The EPA estimated the drinking water level of concern (DWLOC) to be 40 ppb (rotenone) for the most sensitive subgroup (infants and children). Therefore, at the anticipated rotenone concentration planned for the Soldotna Creek drainage and its outlet creek (~50 ppb), the DWLOC will be exceeded by 20% for a relatively short time (< two weeks) in Area Two until the rotenone degrades naturally below the DWLOC. The rotenone from the Area One treatment could persist above the DWLOC much longer (two weeks to months) if treated in the fall when water temperatures could range from 12 ºC to near 0ºC. However, the DWLOC (40 ppb) is for chronic long-term dietary exposure and is a scenario not likely to occur within the Soldotna Creek drainage because area residents will be advised to not drink treated waters until the rotenone is fully degraded. In addition, most, if not all, area residents get their drinking water from private subsurface wells that are protected from rotenone by the soil which limits subsurface rotenone movement to mere inches. However, as an example of rotenone toxicity relative to levels of concern, a 160-pound adult will have to drink thousands of gallons of treated lake water at one sitting to receive a lethal dose (Gleason et al. 1969).

Studies have indicated that rotenone is a strong mitochondrial inhibitor and, under some

conditions, produces features of Parkinson's disease (Betarbet et al. 2000). A review of published data since the initial study by Betarbet et al (2000) suggests that the rotenone-treated rat models used in the Betarbet study are based on atypical Parkinsonism rather than idiopathic Parkinson's disease, and that such studies are not applicable to piscicidal uses of rotenone (Höglinger et al. 2006). Hollingworth (2001) in his chapter on inhibitors of oxidative phosphorylation (including rotenone) does not consider rotenone a cause of Parkinson's disease. A recent study by Pan-Montojo et al. (2010) suggests that mice exposed to rotenone mixed with chloroform injected through a feeding tube developed Parkinson's-like symptoms, however rotenone was administered for three months at dosages far exceeding those used in fishery applications. Tanner et al. (2011) concluded that rotenone in agricultural applications was associated with an increased risk of Parkinson's disease, however, study participants were exposed to many different pesticides and their exposures were not actually measured, rather, exposures were based on self-reporting. Collectively, the toxicology and epidemiological studies present no clear evidence that rotenone is causally linked to Parkinson's disease (Finlayson et al. 2012). ADFG is not aware of any study claiming that rotenone causes Parkinson's disease or any other human health concern when used in fishery management concentrations.

As discussed in section 4.1.8, CFT Legumine™, the liquid rotenone mixture that will be used in the Soldotna Creek drainage, contains additives to facilitate its emulsification and dispersion in water. The other rotenone product, Prentox® Prenfish™ Fish Toxicant Powder, does not contain additives. CFT Legumine™ was analyzed for the California Fish and Game Department in 2007 (Fisher 2007), and the toxicities of the individual ingredients found in the formulation were identified during that analysis and are described below:

Diethylene glycol ethyl ether (DGEE) is the primary ingredient of CFT Legumine™. With respect to the environmental fate of this compound, volatilization, photolysis, and hydrolysis are all processes that are not expected to occur to a significant degree in surface waters (SPECTRUM, Chemical Fact Sheet, 2008). Rather, biodegradation is the most likely removal mechanism for the compound and 48-87% degradation will be expected in 20 days; DGEE was observed to degrade >90% after 28 days (information found online at: http://toxnet.nlm.nih.gov/). Because DGEE is water soluble, it will not bind to sediments and it has a low ability to bioconcentrate in aquatic organisms (http://toxnet.nlm.nih.gov/). When tested on rats, the oral LD50 (oral dose that kills 50% of test animals) was 5.54 g/kg (Bingham et al. 2001). In a lake treated with 1 mg/L of CFT Legumine™, it will be expected that the concentration of DGEE will be at a concentration of 0.61 mg/L or 0.00061 ml/L. The estimated lethal dose (LD) of the chemical to humans is ~1 ml/kg of body weight or about 70 ml (or 70 g) for a 70-kg person. A 70-kg person drinking two liters of water from the lake (normal daily water intake) will only consume 0.00122 ml/L of the compound, which is 1/57,000th of a fatal dose. The oral LD50 for dogs is around 3.0 g/kg, while for rats and mice the LD50 is 5.5-8.7 g/kg. A 10-kg (22 lb.) dog drinking one liter of treated lake water will only ingest 1/49,000th of the LD50.

Fennedefo 99™ is primarily a fatty acid ester mixture that contains polyethylene glycol (PEGs) and alcohol and is used with rotenone as an emulsifying agent. The fatty acid ester mixture is likely derived from "tall oil". Tall oil fatty acids are a byproduct of wood pulp. For more information on tall oil visit: http://www.harting.cl/talloil.html. PEGs are common ingredients in a variety of consumer products, including soft-drink syrups (as an antioxidant), lotions and antifreeze (Fisher 2007). PEGs are highly soluble, have low volatility and rapidly degrade within days. The fatty acids in the fatty acid ester mixture do not exhibit volatility, are virtually insoluble, and are readily biodegraded, although over a slightly longer period of time than the PEGs (Fisher 2007).

N-Methyl pyrrolidone is increasing in use as a solvent because of its low toxicity. It is used as a solvent for pharmaceuticals for oral ingestion (Ott 2008). This compound is expected to behave similarly to DGEE in an aquatic environment. Biodegradation is the pathway most likely to affect its removal from the environment, rather than volatilization, hydrolysis or photolysis (for more information visit http://toxnet.nlm.nih.gov/). The persistence of this compound in water has not been reported, but it has been found to have a half-life of 4.0, 8.7 and 11.5 days in clay, loam or sand, respectively. N-methyl pyrrolidone has been classified as readily biodegradable under aerobic conditions (Concise International Chemical Assessment document available at: http://www.inchem.org/. When rats and mice were tested, the oral LD50 reported values ranged from 3.9-7.7 g/kg. The LD50 of methyl pyrrolidone is similar to DGEE, but its concentration following lake treatment is expected to be only 1/6th that of DGEE, and acute toxic conditions should not arise for mammals drinking the water following treatment.

Other trace compounds in the formulation include an array of volatile organic compounds (VOCs), but all at very low concentrations. All compounds, with the exception of polyethylene glycols (PEG), will be below the reporting limits of California. At the diluted treatment concentration expected in Soldotna Creek drainage, PEG levels will be far below the California reporting limits.

The half-lives of the five major formulation constituents of CFT Legumine™ (rotenone, rotenolone, N-methyl pyrrolidone, diethylene glycol monoethyl ether and Fennedefo 99) in water following the 2007 treatment of Lake Davis in California ranged from 5 to 14 days (Vasques et.al. 2012).

Regarding exposure to trace constituents in liquid rotenone including CFT Legumine™, trichloroethylene and naphthalene are known carcinogens. Both have been detected in CFT Legumine™, but trichloroethylene was absent from most product lots recently analyzed (Fisher 2007) and the estimated concentration of trichloroethylene and naphthalene at treatment concentration is ~0.0000073 mg/L and 0.000255 mg/L respectively which is far below the Human Based Screening Level (HBSL) for exposure to surface waters for a child (CDFG 2007).

A study of airborne drift associated with two rotenone products (a liquid and a powdered formulation) was conducted in California (CARB, 1997), and results showed that the rotenone levels adjacent to a treatment area immediately following a treatment, were, at the highest, 1,000 fold lower than the estimated no observed effect level (NOEL) of 0.43 mg. of rotenone per cubic meter collected over a 24-hour period.

The use of $KMN0_4$ for this project will be quite limited in the area and concentration where it is applied. Peak $KMNO_4$ concentrations (1.0 ppm to 5.0 ppm) may be present for days or weeks in the lower 1/4 mile of two streams (Derks Lake outlet stream in Area One and the lower ¼ mile of Soldotna Creek in Area 2) with the concentration decreasing over stream distance from the deactivation stations. The target $KMNO_4$ residual after it oxidizes the rotenone is 1.0 ppm. The residual $KMNO_4$ leaving the treatment area (Soldotna Creek drainage) and entering the Kenai River will quickly fall below detectable levels due to the effects of dilution and the additional oxidative demands in the Kenai River.

The fatal adult human dose from ingestion of $KMNO_4$ is estimated to be 10 grams. http://www.fws.gov/fisheries/aadap/14_potassium%20permanganate/06_msdss/msds_9246_potassium%20permanganate.pdf. The amount of residual $KMNO_4$ remaining in the streams where it will be applied is anticipated to be ~1.0 ppm (1.0 mg/l); therefore, a fatal dose would require the improbable ingestion of ~10,000 liters of water having a concentration of $KMNO_4$ of 1.0 ppm.

According to the USEPA, when assessing risk from consuming manganese (a primary degradation product of $KMNO_4$), a reference dose (RfD) of 0.05 mg/kg/d is suggested: http://www.epa.gov/ttn/atw/hlthef/manganes.html. Therefore a 160-lb (72 kg.) person could theoretically consume 3.6 milligrams of manganese daily, roughly equivalent to a gallon of water containing 1.0 ppm $KMNO_4$ before exceeding this dosage. Although limited information exists on the risk $KMNO_4$ poses to human health, $KMNO_4$ is commonly used to control taste and odors, remove color and control biological growth in water treatment plants throughout the United States (USEPA 1999). $KMNO_4$ is only mildly irritating in dilute solutions (Gosselin et al. 1984).Mild odors from the rotenone products may be present following any of the treatments occurring in the Soldotna Creek drainage.

The odor from the solvents in liquid rotenone products could last from several hours to several days, depending on air conditions. However, the product manufacturer advertises that the newest CFT Legumine™ formulation is virtually odor free because it contains fewer solvents than other liquid rotenone formulations. Nonetheless, relatively "heavy" organic solvent compounds tend to sink or remain close to the ground and move downwind. The California Department of Pesticide Regulation (CDPR 1998, cited in Finlayson et al. 2000) found no health effects from odors from rotenone formulations that consisted of greater solvent concentrations than those found in current supplies of CFT Legumine™. Prentox® Prenfish™ Fish Toxicant Powder is pure ground root product and contains no additives although the product label states it has an odor similar to wet chalk or dirt.

Fish carcasses resulting from this project may cause objectionable odors. Collecting and removing visible carcasses near lakeside residences coupled with the likelihood many fish will sink (Bradbury 1986) should help mitigate odor concerns. Finally, because motorized equipment (boats, generators, ATVs and potentially a helicopter) will be used during the rotenone applications, there will be combustion emissions. Any impacts caused by objectionable odors from the rotenone, fish carcasses, or motor emissions are expected to be short-term and minor.

Recreational contact (swimming, wading, etc.) or drinking of treated lake or stream water will be discouraged until the rotenone is completely deactivated. Notification will be accomplished via land owner notifications, signage and the issuance of a news release. The length of time for complete rotenone deactivation varies and is mostly dependent on water temperature and sunlight. The product labeling states that recreational contact with treated water (<90 ppb rotenone) is allowed after the rotenone is applied. As an added precaution, ADFG will request that all contact, including drinking, of treated waters be avoided until the rotenone is no longer present based on lab analysis of water samples and the twenty-four hour survival of caged sentinel fish held in treated waters. Avoiding contact with treated water will eliminate any reasonable route for rotenone exposure and subsequent human health concerns.

To model the peak rotenone concentration that could exist in the Kenai River from Soldotna Creek discharge (treated with rotenone at 0.05 ppm), we applied historical stream discharge data for both systems (Appendix 14). This model used the historic low USGS monthly mean discharge for the Kenai River between 2001 and 2012 for the months of May though July and the maximum known discharge recorded by ADFG during May through October 2006. The model also ignored natural rotenone deactivation process that will also degrade the rotenone. The resulting estimated maximum rotenone concentration in the Kenai River (0.96 ppb) is well below the 2.0 ppb threshold (Finlayson et al. 2010) requiring chemical deactivation and nowhere near the EPA's Drinking Water Level of Concern of 40 ppb.

Impacts to the Kenai River sport fishery should be very limited but could involve the temporary discoloration (purple staining) of stream discharge near the Soldotna Creek mouth due to the residual presence of $KMNO_4$.

Noise, particularly from helicopter use in Area Two, could be disruptive and annoying to area residents for a one week period during both treatments of Area Two. Helicopter use for this project will not occur between 8:00pm and 6:00am. No helicopter use will occur in Area One where the majority of the residents in the drainage reside.

4.3.4 Impacts from Alternative 1 to Worker Safety and Health

There are no project activities with the "no action" alternative, so there will not be any impacts to worker safety and health.

4.3.5 Impacts from Alternative 2 to Worker Safety and Health

Impacts to worker safety will be similar to those experienced with typical construction activities. Contractors hired by ADFG to build a permanent fish barrier in Soldotna Creek would be required to follow best management practices for their work.

4.3.6 Impacts from Alternative 3 to Worker Safety and Health

Control netting or other similar mechanical fish removal methods pose a low risk to worker health and safety. Netting requires working from an open skiff and, as such, has safety risks common to other ADFG field work that can be reduced by observing basic boat safety guidelines.

4.3.7 Impacts from Alternative 4 to Worker Safety and Health

Any potential threats to worker safety and health (i.e. rotenone and $KMNO_4$ applicators) will be greatly reduced with proper use of safety equipment including personal protective equipment (PPE). PPE will be worn at all times by applicators and others working in direct contact with the rotenone products. The PPE includes Tyvek suits or raingear tops and bottoms (waders could substitute for bottoms), full face air-purifying respirators or half-mask respirators with safety goggles, and rubber or nitrile gloves.

Dry powdered rotenone products pose the greatest potential airborne risk, mostly to the applicators, because they are in direct contact with undiluted product and product particulates could become airborne. To reduce exposure risk, the product will be applied via a semi-closed pumping system that premixes the powder with lake water to form a slurry just prior to discharge from the boat. All applicators will adhere to the safety protocol suggested by Finlayson et al. (2010) and all product label requirements. Prentox® Prenfish™ Fish Toxicant Powder containers will only be opened in the boat and away from individuals not wearing PPE.

CFT Legumine™ is a liquid and the product Material Safety Data Sheet (MSDS) states "do not breathe spray mist" and identifies appropriate respirators for use by the product handlers/applicators. Only individuals working with the concentrated product could be at risk, and they will be protected with the appropriate protective respirators. Although volatile and semi-volatile organic compounds and ethylene glycol-based compounds have been identified in the CFT Legumine™ formulation, when compared to Health Based Screening Levels (HBSL) values, no compound in CFT Legumine™ exceeded the HBSLs. This indicates there are no significant inhalation risks from the vapors of this product (CDFG, 2007).

The $KMNO_4$ used for deactivating rotenone can pose a potential hazard to workers. $KMNO_4$ can be damaging to eye tissue, irritating to the skin and can cause damage to the respiratory tract if inhaled. To protect against accidental exposure, all workers handling $KMNO_4$ will adhere to the same PPE requirements as required for the rotenone applicators including having immediate access to eyewash solution.

All workers who directly handle rotenone or $KMNO_4$ products will be required to undergo training for pesticide/chemical safety and application methods. All such workers will attend a comprehensive half-day training course that covers the following information: safety procedures, pesticide labels, pesticide handling procedures, first aid and decontamination, emergency procedures, common symptoms of overexposure, exposure hazards, environmental concerns, laws and regulations, employee rights and location of project documents (i.e. pesticide records, training records, MSDS sheets, etc.) All training will be provided in both written and verbal format. All workers handling $KMNO_4$ or rotenone products will also be required to pass OSHA approved full-face respirator medical and fit testing. In addition, there will be multiple ADEC-certified applicators onsite during the rotenone treatments to provide instruction and supervision to workers regarding the proper use of application equipment and the safe handling of the rotenone and $KMNO_4$ products.

In general, the greatest potential human health risks associated with a rotenone treatment are associated with the applicators because they work directly with the undiluted, concentrated rotenone and $KMNO_4$ products. However, as stated, as long as safety protocols are adhered to, and proper PPE is utilized, exposure risks to applicators are minimal.

4.4 Conclusion

The factors that led to the identification of a preferred alternative are discussed in this section.

The no action alternative will essentially allow the status quo to continue which will prevent historical rainbow trout angling opportunities in Derks Lake, East and West Mackey Lakes and the continued loss of salmonid production throughout the drainage. As long as invasive northern pike remain in the Soldotna Creek drainage, ADFG will not have the ability to fully restore the fisheries there, and angling opportunities for the local public will continue to be limited. There will also be continued risk that northern pike could disperse from the Soldotna Creek drainage to the Kenai River and endanger other native wild salmonid fisheries. Finally, ADFG has a legal responsibility to protect, maintain, and improve fishery resources, and choosing to leave invasive northern pike in Soldotna Creek drainage, where they could eventually spread elsewhere in the Kenai River system, is contrary to this responsibility. The no action alternative was not selected as a preferred alternative.

Construction of a permanent fish barrier in the Soldotna Creek drainage as alternative #2 will not allow restoration of native fisheries and at best, will result in a reduced risk of northern pike dispersing from the drainage into the Kenai River or its tributaries. Preventing the passage of very small juvenile or larval forms of northern pike may be technically prohibitive with any barrier design. In addition to the initial cost of barrier construction, ongoing maintenance costs and staff time will be incurred indefinitely with this alternative. Other concerns with a barrier are that native fish movement will be temporarily impeded by a barrier and require some form of manual passage, and the overall effectiveness of the barrier could be compromised during extreme high water events. Alternative #2 was not selected as a preferred alternative.

Alternative #3 will conduct control netting which may result in a substantial reduction of the adult northern pike population in many of the drainage's lakes. It is feasible that some level of native fish restoration could be realized at some lakes if the northern pike population is greatly reduced and maintained at a low level for a period of years. Under this alternative, the ability of native fish populations to fully restore to pre-invasion levels is complicated because native fish would also be caught and killed by the netting operation. If the ADFG implements this alternative, it will likely result in the occasional loss of other non-target animals such as waterfowl and small mammals. As with alternative #2, control netting will not completely remove all northern pike from the drainage or eliminate the threat that northern pike could disperse from Soldotna Creek into other vulnerable habitats. Control netting will also require significant ADFG staff time and financial resources for the foreseeable future. Alternative #3 was not selected as a preferred alternative.

Alternative #4 will treat the Soldotna Creek drainage with rotenone to remove the entire northern pike population from the drainage. This alternative will allow the ADFG to restore native fish populations in all impacted lakes and result in the restoration of the fisheries that historically existed. Most importantly, eradication will prevent northern pike from spreading into new susceptible tributaries. If northern pike were to successfully establish in the Moose River drainage or another Kenai River tributary, there will likely be substantial and irreversible impacts to anadromous fishes and other wildlife. ADFG has a window of opportunity to prevent this from happening, and based on the mission of the agency, it has a legal responsibility to do so.

In contrast to other alternatives, a rotenone treatment of the Soldotna Creek drainage will be done in stages over at least a three year period and will ultimately be cheaper than alternatives #2 or #3 because no cost for maintenance or staff time will be incurred indefinitely.

ADFG evaluated the human health and ecological effects associated with the use of rotenone in this document. It is concluded that, in piscicidal concentrations and in accordance with label requirements and FIFRA, rotenone will not pose any unreasonable adverse ecological or human health risks. To further minimize risk, ADFG will recommend to the public via signage and public notices to not drink or have contact with treated waters until the rotenone is fully deactivated. Though this is not legally necessary, ADFG will prefer to take this conservative approach to ensure the highest level of public safety possible. This, of course, will temporarily affect recreation on some lakes, but it can be mitigated by timing the Area One lake treatments to occur just prior to freeze up when lake recreation is typically minimal.

If the public temporarily refrains from contact with treated waters, the only potential human health risks associated with the rotenone treatment will be to the applicators because they will be working with the pure, undiluted rotenone products. However, those risks will be minimized by proper use of personal protective equipment and by following best management practices. Rotenone applicators will all be fit tested for respirators and trained proper pesticide application techniques. Several ADFG pike biologists have been formally trained in the use of rotenone through the National Conservation Training Center. In addition, several ADFG biologists are also State of Alaska certified pesticide applicators. If a rotenone application occurs, all assisting personal will either be individually certified or supervised by a certified pesticide applicator. Emergency protocols will be established prior to the treatment activities in the event of an accident. Those protocols will be described in a detailed "treatment plan" that will be reviewed by all assisting project personal before the project begins. To date, the ADFG has safely and successfully used rotenone on five occasions to remove northern pike from lakes in southcentral Alaska with no adverse impacts to the general public or the applicator crews.

The ecological impacts from a rotenone treatment in the Soldotna Creek drainage will be temporary. As described in detail in this document, rotenone ultimately breaks down into carbon dioxide and water and does not impact most non-gilled organisms when used in fisheries management concentrations. Rotenone has recently been used on five other occasions for northern pike eradication in Southcentral Alaska. In these other treatments, rotenone was applied in the fall to minimize recreational losses for the public. This timing also maximized the duration that rotenone remained toxic to fish. In these cases, rotenone was detectable in the water bodies up to nine months after application. If rotenone is used for this project, the treatment will occur in early summer in Area Two to ensure water levels are lower and less rotenone will be needed, so any rotenone entering the Kenai River will dilute far below detectable levels. Area One will be treated just prior to freeze up to ensure the longest possible exposure time in the lakes where northern pike density is believed greatest and when recreational use is reduced. A summary of the Best Management Practices (BMP's) that will be adopted to protect the environment and promote the safe and effective implementation of alternative #4 can be found in Appendix 15.

Even with the longer rotenone persistence experienced during ADFG's previous late-fall rotenone projects, invertebrate populations were found to quickly rebound, and other species such as wood frogs and waterfowl also returned immediately after ice-out. Based on the vast literature available on rotenone projects and the Department's previous experience with the piscicide, ADFG expects no unreasonable long-term negative ecological impacts from treating the Soldotna Creek drainage with rotenone. Therefore, the rotenone treatment alternative was identified by ADFG as the preferred alternative to accomplish the goal of eradicating northern pike from the Soldotna Creek drainage and protecting the Kenai River system from this invasive predator.

5.0 CONSULTATION AND COORDINATION

As mentioned in section 1.4, ADFG conducted a public scoping process to solicit input on the alternatives described in 2.0. The public scoping process completed is evident in Appendix 1. There was also a thirty day public commenting period for this environmental assessment in which a summary of public comments are presented in Appendix 5.

This document will be submitted to the USFWS to comply with the National Environmental Policy Act (NEPA) process to determine whether a Finding of No Significant Impact (FONSI) will be issued for the preferred alternative. Other major authorizations required to approve the preferred alternative include ADEC issuance of a Pesticide Use Permit, issuance of an Alaska Department of Natural Resources Division of Mining, Land and Water Land Use Permit (LUP), compliance with the Alaska Pollutant Discharge Elimination System (APDES), and approval by the Alaska Board of Fisheries and ADFG Division of Sport Fish director.

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Appendix 1. Summary report of public scoping and comments received during the Soldotna Creek drainage Restoration public scoping period.

Soldotna Creek Drainage Invasive Northern Pike

Public Scoping Summary Report

To: Rob Massengill, ADFG

Date: September 25, 2012

From: Sara Wilson Doyle, USKH, Planner & Public Involvement

Subject: Soldotna Creek Drainage Invasive Northern Pike Public Scoping Process Input Summary

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Scoping Process

In March 2012, the Alaska Department of Fish and Game (ADFG) contracted USKH, a multi-discipline design firm, to facilitate a public scoping process to gather input in order to guide the Department's response to invasive northern pike in the Soldotna Creek Drainage. This memo presents a summary of public input gathered in March and April 2012, based on the following outreach and scoping process:

- **Property owner mailing:** ADFG obtained an address list of 447 property owners adjoining or proximate to the Soldotna Creek drainage. In early March, 2012 each property owner was mailed a letter notifying them of the upcoming public meetings, and encouraging them to participate in the scoping process.
- **Stakeholder interviews:** ADFG provided USKH with a contact list of organizations and individuals identified as having a specific interest or likely concerns around invasive northern pike in the Soldotna Creek Drainage. Phone conversations were held with twenty-five stakeholders to both inform them about the scoping process, and to gather input on northern pike's presence and measures to remove the invasive species from the Soldotna Creek Drainage.
- **Public meetings:** Three public scoping meetings were held in March 2012 at the Kenai National Wildlife Refuge's Environmental Education Center in Soldotna, at a location

easily accessible to Soldotna Creek Drainage property owners, and interested citizens and organizations. An effort was made to enable broader participation by hosting three separate meetings at varied times:

> ***Scoping Meeting #1, March 22, 2012*** *- 12:00 pm to 1:30 pm (slide show at 12:15 pm)*
>
> ***Scoping Meeting #2, March 22, 2012*** *- 6:30 pm to 8:00 pm (slide show at 6:45 pm)*
>
> ***Scoping Meeting #3, March 24, 2012*** *- 10:30 am to 12:00 pm (slide show at 10:45 pm)*

Scoping meeting outreach and advertisements included phone contact and/or email to 465 individuals and organizations, a press release, newspaper advertisements, and the posting of fliers in key locations. Thirty-four individuals attended the series of meetings, which had a consistent format as outlined following:

Meeting Agenda

1. WELCOME AND INTRODUCTIONS (≈ 10 minutes)

The meeting began with a statement of the meeting purpose, and ADFG's goals for the overall scoping process.

Meeting Purpose: ADFG's Goals

1) To help participants learn more about Soldotna Creek Drainage northern pike and the Department's concern about their presence;
2) To help participants understand different actions the Department is considering to control or remove northern pike from the Soldotna Creek Drainage; and
3) To seek participant's input specific to the Department's assessment and potential actions to control or remove northern pike from Soldotna Creek Drainage.

Participants were reminded that this was a scoping, education, and outreach meeting, not a formal hearing. Attendees were encouraged to take advantage of the less formal setting to ask questions, seek clarification, and provide thoughts and input. ADFG staff and participants then all introduced themselves as follows:

a) ADFG Staff

Rob Massengill, Fisheries Biologist for ADFG Sport Fish Division

Tim McKinley, Area Research Supervisor for ADFG Sport Fish Division

Jason Pawluk, Assistant Area Management Biologist for ADFG Sport Fish Division

Kristine Dunker, Regional Invasive Species Coordinator for ADFG Sport Fish Division

Robert Begich, Area Management Biologist for ADFG Sport Fish Division

b) Attendees

Scoping meeting attendees were asked: *"Please tell us who you are: Your name, Where you live, Why you are here, and What you value about Soldotna*

Creek Drainage?" In response, individuals explained their association with the Soldotna Creek drainage, and/or their interests.

2. PUBLIC SCOPING PROCESS (≈ 5 minutes)

ADFG's facilitator described the Soldotna Creek Drainage northern pike scoping process, meeting ground rules, how to provide input, and how the input will be used to help ADFG to consider potential actions to control or remove northern pike from the Soldotna Creek Drainage.

3. PRESENTATION (≈ 40 minutes)

A slide show was presented by ADFG providing in-depth information regarding northern pike's introduction to the region, its impacts, and the possible actions being considered by ADFG to control or remove northern pike from the Soldotna Creek Drainage.

4. INPUT AND INFORMATION OPEN HOUSE (≈ 30 minutes)

An open house was held where participants could pick up handouts with more detailed information, review posters and displays, ask further questions of ADFG staff, and provide input to the facilitator.

- **Input forms/written comments:** Eight individuals completed written input forms regarding northern pike's presence and potential measures to remove northern pike from the Soldotna Creek Drainage. In addition, one regional organization wrote a letter thanking ADFG for their scoping effort and voicing support for the proposed plan to remove northern pike from the Soldotna Creek Drainage. Finally, one individual provided a detailed letter outlining a technical suggestion for controlling pike by adding a water level control structure at the Sevena Lake outlet.

Public Input Summary

During the scoping process several major categories of input and public opinion emerged. Following is an aggregated summary, specific to broader categories, covering the issues and public opinions shared by members of the public and interested organizations. The statements that follow are directly based from individual's comments and opinions provided over the course of the public scoping process.

1. Soldotna Creek Drainage

Public input provided background on the Soldotna Creek Drainage and its relationship to residents and the region. Key themes include:

- **Community Context:** Soldotna Creek is a small stream that flows approximately 14 km before it drains into the Kenai River. It is located in the lowlands of the western Kenai Peninsula and encompasses bog meadows, ponds, and several lakes. Land ownership surrounding Soldotna Creek and its lakes is predominantly private, with single family residential homes located along the waterfront to take advantage of recreational and scenic values. The Alaska Department of Natural Resources has some undeveloped easements to allow public access to some of the drainage's bigger lakes; however, these remain undeveloped at this time. According to some residents, these public access easements support occasional foot traffic to the lakes by the public, and allow

the use of small crafts (canoes, kayaks, etc.). However, because of the small size and quiet residential atmosphere of the lakes, attempts to provide more formal, developed public access (e.g., boat launches, parking, formal trails) have not been supported by residents when they have been advocated in the past.

- **Historical Conditions:** A number of longtime residents of East and West Mackey lakes and the Soldotna Creek Drainage participated in the scoping process. In their collective memory, dating to the early 1970's and prior, the drainage was very different when residents first arrived. According to anecdotes, the drainage was "thick with rainbows" until the early 1980s, when the first pike were intentionally and illegally introduced to the drainage by a resident. By the mid-1980s, some huge pike were present in the drainage. However, within a matter of years, the pike apparently ate out the rainbow trout, Dolly Varden, and other native fish, because residents were no longer seeing or catching native fish species from Soldotna Creek Drainage waters. At the same time, as stocks of native fish declined, pike visibly began eating dragonflies, water birds, and each other. Within a few years, the size of pike in the system apparently dropped as they ate out food supplies. One resident raised concern that during this same time period, migratory bird populations on the drainage's lakes began a significant decline that continues to be of concern today. Other residents noted observations about pike's predatory taking of young water bids including young loons and Bonaparte's gulls. One final historical observation by some residents focused on "illegal blockages between lakes" by property owners in past decades. Scoping participants mentioned that this could have affected the original fish populations and may be impacting the overall ecological functioning of the drainage.
- **Current Conditions:** Many residents participating in the scoping process compare the drainage today with their memory of past conditions, and expressed deep concerns and a heightened sense of loss. The lakes today, according to many, are a shadow of the recreational attraction they once were. Currently, the "only fishing value of the drainage's larger lakes are for small pike," which according to some, "at least give kids something to fish." Additionally, the drainage's lakes are popular for recreation with residents for swimming, boating, bird watching and wildlife viewing.

2. Regional Pike Infestation Concerns

Because of the regional implications associated with pike infestations, public input also focused on concerns around the threat of pike spreading from the Soldotna Creek Drainage to other Kenai Peninsula fisheries. Key concerns include:

- **Threats to the Kenai River, and other Peninsula Fisheries:** A number of scoping participants stated that the presence of northern pike in the Soldotna Creek drainage is especially alarming because it empties into the Kenai River and Cook Inlet. The spread of pike into these systems can directly impact other fish stocks that serve as a significant economic engine on the Kenai Peninsula. The Kenai region is branded as one of the world's few premier fishing destinations for salmon and rainbow trout. Along this same theme, during the scoping process several organizations representing commercial fisheries, anglers, and tourism expressed strong concerns about the potential for invasive pike to spread from the Soldotna Creek Drainage, and to impact these opportunities and compromise their livelihoods. A common view was expressed that if pike populations get out of control, it may not be possible to retain the world class angling and commercial fishing that is vital to the Kenai Peninsula's economy. Moreover, one semi-retired fisheries biologist described how the Soldotna Creek Drainage's

invasive Pike "has been and continues to be the source of the few pike that have been captured or reported in the Kenai River watershed. If nothing is done to remove pike from Soldotna Creek it is only a matter of time before reproducing pike populations will become established in additional Kenai River tributaries." This individual is especially concerned about reproducing pike populations becoming established in the Beaver Creek or Moose River watersheds, as these are important rearing areas for Coho salmon that also contribute to the Kenai River Coho salmon run. During the scoping process, a majority of participants shared concern over the further spread of invasive pike and expressed a strong desire for ADFG to act quickly to eliminate pike from all locations on the Kenai Peninsula, and in the Soldotna Creek Drainage, to keep negative fisheries impacts from accelerating through the entire region.

- **Intentional Pike Spreading:** Participants in the scoping process remember pike's introduction to the drainage several decades ago by a "well meaning, but ill-informed" resident (ADFG verified the presence of pike were in the drainage as early as the mid-1970's). Some participants who have been eye-witnesses to the impacts of pike in the drainage are surprised at the "misinformation and lack of awareness of pike as a problem" even today among the greater population on the Kenai Peninsula. In their opinion, well-funded pike education programs are just as critical as any eradication efforts, and need to be a priority of ADFG, especially within all of the region's schools. One organization recommended that ADFG's scoping meeting presentation needs to be given at public venues across the region (Kenai Peninsula Borough, Cities, Chambers, Boards of Directors for key organizations (KRSMA), Kenai Peninsula College, etc.) and also via public relations and media campaigns, including through guest articles in the region's newspapers. A final point is that the presence of pike in the Soldotna Creek Drainage retains an ongoing threat to other waterways, as it creates an ongoing possible source for the intentional or unintentional spreading of northern pike on the Kenai Peninsula through catch and release into other waterways.
- **The Susitna Drainage Example:** The northern pike's penetration into the Susitna Drainage across Cook Inlet was highlighted by scoping participants as a potential example of what could happen on the Kenai Peninsula as a result of unchecked pike populations in the Soldotna Creek Drainage over time. A regional stakeholder representing the fishing sector noted, "We have been following the Soldotna Creek Pike issue for quite some time and understand the implications to Kenai River juvenile fish and resident species stocks if this issue isn't resolved sooner rather than later. We have seen the devastation unchecked pike stocks have caused in other Cook Inlet regions to salmon stocks and resident species over the last decade, and recognize the importance of invasive pike removal in instances where they jeopardize the rearing capabilities of other native stocks." A resident in the drainage echoed this sentiment: "It is critical to act NOW or we will end up like the Susitna Drainage." At the same time, one individual refutes that there is any pike problem in the Susitna Drainage, and alleges that the public is being "fed lies" in order to vilify pike and take attention away from environmental changes, as well as tremendous commercial and recreational fishing pressures, which are the real culprit in the decline of native fish populations.

3. Pike Eradication Challenges

The scoping process solicited public input on pike removal in the Susitna Drainage, and a number of stakeholders and citizens provided comments around pike eradication challenges generally:

- **Political and institutional support.** A strong concern was voiced that ADFG will find it politically and socially challenging to move forward with pike eradication efforts in the Soldotna Creek drainage: “It has been tried and shot down before.” According to some residents “NIMBYs” have kept ADFG from addressing the pike infestation, starting long ago when eradication plans were first considered (in the 1990s). In their words, “Eradication efforts have always been shut down by a vocal minority.” Pike fishing advocates were also noted as having a strong role in undermining past eradication plans. During the scoping process, a few individuals commented that they will publically oppose eradication efforts, including one pike advocate who expressed their dismay that ADFG only cares about a single species (salmon), and vilifies pike. Two other individuals cited their reasons for opposing the current pike eradication plan as being rotenone’s possible health effects on people and wildlife.
- **Financial resources.** Several individuals were concerned at the lack of in-hand funding for ADFG to implement proposed plans to remove pike in the Soldotna Creek Drainage. Moreover, permitting timeframes will limit the speed with which anything can be undertaken to address the pike infestation, allowing the problem to expand potentially “beyond a point of no return.” Also, a few individuals commented that eradication efforts are “a waste of a lot of money,” either because invasive pike are “Too tough to get rid of” or because “Just one individual has the potential to illegally reintroduce pike, making eradication efforts expensive and useless.”
- **Eradication effectiveness:** A number of residents expressed concern that given the longstanding spread of pike, and the openness of the Soldotna Creek Drainage system, any efforts to eradicate pike can only slow, not stop pike. Pike were noted to be extremely hardy fish, and there is some concern whether eradication efforts and any money invested will really work. One individual mentioned that perhaps the lakes can be treated, but expressed their opinion that treating the creek will not work.
- **Netting is not working (and is hurting migratory birds):** In the recent past ADFG conducted seasonal pike netting in some of the lakes in the Soldotna Creek Drainage to remove pike, and ADFG continues to conduct net surveys nets on some lakes. Residents in the region mentioned that this did not measurably reduce pike populations, but more importantly, it unintentionally affects migratory birds, which many residents enjoy watching as they settle in and nest every year. There is a concern that netting needs to stop because of migratory bird population declines. Additionally, there was one complaint that money invested in this activity is not very effective, as it requires effort and expense year to year, and also adds nuisance traffic in and out of the neighborhoods and lakes.
- **Limited eradication methods and options:** A number of individuals expressed frustration that there are so few effective methods for pike eradication, and that the methods available are “so drastic.” Some individuals holding this opinion wanted ADFG to invest heavily in prevention through public education “So we don’t have to do this again.” One individual expressed their opinion that ADFG has not truly explored ecologically sensitive approaches. In their words, “The introduction of pike into the Soldotna Creek Drainage has created a change in the ecological habitat which warrants sensitive, intense, and really open and honest dialogue by fish and game officials. I am interested in environmentally safe solutions to problems which will affect my children and grandchildren.”

4. Proposed Rotenone Treatment to address Pike in Soldotna Creek Drainage

The public scoping process focused to a large extent on ADFG sharing what they believe to be the only potentially effective pike eradication option for the Soldotna Creek Drainage: a phased rotenone treatment combined with measures to preserve native fish stocks to re-populate the drainage, along with controls to ensure that rotenone does not enter or impact the Kenai River. Eradication and other measures to eliminate pike risks are being considered by ADFG in response to the departments' legal mandate to:

- Protect Alaska's fisheries within Alaska Fish and Game Laws and Regulations (Section 16.05.020);
- Control invasive species in its *2010-2014 Sport Fish Division Strategic Plan*; and
- Provide sustained yield fisheries within the State of Alaska Constitution.

Responses to the proposed phased rotenone treatment plan included the following:

- **Support for rotenone treatment based on its historical track record:** A majority of the scoping meeting participants expressed support for the proposed phased rotenone treatment of Soldotna Creek to eradicate pike. Often cited reasons were the "ADFG's well-thought out plan" and the long track-record of rotenone's successful use for pike eradication. A number of individuals reflected that they are resigned to using rotenone since it is the only potentially effective tool for addressing invasive pike in the Soldotna Creek Drainage. Moreover, several individuals commented that rotenone is not a persistent chemical (the mechanism of action is disruption of a cellular process that enables the utilization of oxygen in their blood) and so its use in the drainage is an acceptable risk, acknowledging that, "Although rotenone is not the best thing, it is the only alternative." Specific comments expressing support include:
  - "The development of the ADFG plan is insightful, thoughtful, technically sound, well-researched, and without question our best bet."
  - "You have my support. I like your presentation and really encourage the rotenone."
  - "After reviewing your plans for this pike mitigation program, we feel confident that the Department can accomplish its goals of removing all pike from the Soldotna Creek drainage without harm to Kenai river fish stocks. We also appreciate your plan to re-establish all native stocks to these waters so they will mirror the fish stocks in these waters prior to the entry of invasive pike."
  - "I support the proposed plan of rotenone introduction. The experiences of the people who are yet to come here and our children and future generations deserve to inherit an intact, healthy system."
  - "I strongly support ADFG's efforts to remove pike from the Soldotna Creek basin."
- **Questions, concerns and opposition to rotenone:** A number of rotenone treatment plan supporters, and a couple of individuals who are against the use of rotenone raised a broad range of questions, issues, and concerns specific to the treatment plan:
  - **Potential broader rotenone impacts:** During the scoping process, residents had a number of general questions and concerns about rotenone's potential impacts beyond its targeted use, including:
    - Possible impacts to non-target species both short- and long-term (other fish species, invertebrates, migratory bird populations, wildlife, pets, etc.) both directly

through exposure to rotenone, and impacts due to die off of food supplies, or ingesting food and water which has been exposed to rotenone.

  - Possible impacts to potable water sources, including water wells in the vicinity of the application.
  - Potential garden impacts.
  - Short-term and long-term possible human health possible impacts. One resident asked ADFG to research rotenone's potential for causing human cancer. Another individual expressed strong concern based on their interpretation of research that "Rotenone is used to cause Parkinson's disease in lab animals."
  - Fish-Kills outside the treatment area. One person mentioned that "Using potassium permanganate and adjusting the rotenone concentration to protect the Kenai is a great idea in a closed system. But in an open system such as Soldotna Creek, protecting Kenai River is inexact at best."

- **Alleged misrepresentation of rotenone's safety:** Although rotenone has a history of use, a few individuals are highly concerned that "we don't really know the chemical effects of this toxin." One input form sited the Material Safety Data Sheet statement for rotenone that, "To the best of our knowledge, the chemical, physical, and toxicological properties (of rotenone) have not been thoroughly investigated." This individual further expressed concern that untrue or incomplete information was presented by ADFG during the scoping meetings regarding rotenone, including:
  - Chemical impacts to waterways, habitat, potable water, and human health were minimized.
  - Information about fish kills outside the treatment area were not covered, such as at Lake Davis in California.
  - Allegedly, misstatements were given in the public presentation about the amount of rotenone used to exhibit Parkinson's disease symptoms in lab animals (e.g., huge vs. undetectable levels).
- **Rotenone treatment timing:** During the scoping process, both supporters of rotenone use and individuals opposed to rotenone treatment raised questions and concerns about rotenone treatment timing in the Soldotna Creek Drainage, including:
  - **Persistence in cold water:** Rotenone was cited by participants as being persistent in cold environments "where it might remain at levels causing effects for 160 days." In the view of some individuals, this extends the health and wildlife threats to an unacceptable level, especially given that Alaska's summer waterways are still cold environments. Other individuals believe that winter application and the persistence of rotenone is a positive attribute, given how tough pike are and the expense of the application. In their view, a longer treatment time will allow better mixing of rotenone within the entire treatment area, and is more likely to make the treatment successful.
  - **Swimming and contact recreation**: Residents in the drainage, and particularly along the lakes, cited concerns that treatment during the summer will impact their activities. Some individuals swim daily.
  - **Timing with migratory bird arrival:** One individual requested that ADFG needed to work with migratory bird population efforts to plan a better treatment window of time. Because birds decide to nest based on the availability of food, in

their view, a late fall/winter treatment will be best so that arriving birds could find nesting sites off of the drainage. There was also a strong concern that any spring, summer, or early fall treatments (prior to migration) could threaten individual bird's food sources within the Soldotna Creek drainage. Although the birds can fly to find other food in the vicinity, this may interfere with successful nesting and rearing of young. Since these populations are "Already in trouble" and are protected under treaty, it is important to make the extra consideration. Finally, it was unknown whether birds will consume die-off fish and invertebrates following a rotenone treatment. This should also be considered in treatment timing planning.

- **Sevena Lake Outlet Water Control:** During the scoping process, a semi-retired fishery biologist recommended that ADFG Sport Fish Division investigate the feasibility of a water level control structure at the outlet of Sevena Lake. This could be used in conjunction with rotenone to eliminate the Sevena Lake pike population, by manipulating water levels to leave shallow pike spawning areas high and dry. This individual cites the Cook Inlet Aquaculture Association's water level control structure at the outlet of Daniels Lake as a demonstration that this is feasible (although that structure is used to create high water levels in the outlet stream to enable lake spawning sockeye salmon to reach Daniels Lake from Bishop Creek).

5. Scoping Process related input

A final category of public comments relate to the scoping process and ADFG generally:

- **Presentation** – The scoping meetings included an in-depth presentation by ADFG staff, which many meeting participants cited as being well-developed and highly informative. Several participants thanked ADFG for the "great presentation" and requested that it be shared more widely so that citizens in the broader region, not just the residents in the drainage attending scoping meetings, can better understand the issues and alternatives.

- **Meeting Format** – During one scoping meeting, two individuals expressed a strong desire to change the scheduled meeting format so that audience questions and commentary could be directed at ADFG staff, rather than breaking into an open house format for one-on-one questioning and input. The facilitator responded that the open house format was intentionally selected because of past meetings where vocal individuals sought to intimidate other participants and ADFG staff. Moreover, ADFG staff will be available to respond to and discuss any specific issues and comments by attendees. During the open house that followed, several participants individually thanked the facilitator for retaining the open house format, and creating a comfortable atmosphere for all participants, regardless of their opinion so that "A few individuals couldn't dominate the meeting."

- **Facilitation** – One scoping participant alleged that public relations strategies were used by the facilitator and in the ADFG presentation to "subtly slant the public scoping process, and present "an argument for using rotenone in the Soldotna Creek Drainage." They found this "as an affront to those citizens not in favor of rotenone usage." In their opinion, the change in the ecological habitat through the introduction of pike warrants a "sensitive, intense, and really open and honest dialogue by Fish and Game officials." Rather than ADFG proposing rotenone, they want "An ecologically sound solution to be found to this issue."
- **Fisheries Management** – One individual expressed an opinion that ADFG is pro-salmon, and pro-commercial fishing, and is using the pike as a cover-up for their mismanagement of the

inlet and hatchery related fisheries. The individual expressed concern that this scoping process was set up to convince people that pike are bad, and to obtain more funding for ADFG, rather than address the underlying fisheries management causes effecting regional fisheries, and salmon especially.

- **A Need for Action** – Several individuals voiced their concern that ADFG has ignored the pike issue for decades, and even since the agency "got concerned" about a decade ago, it has been slow to do anything about northern pike in the Soldotna Creek drainage. These individuals expressed their appreciation that this scoping effort is taking place, but were highly concerned that there is no funding in place for pike eradication, and that more years of inaction are likely to make the problem worse. A number of individuals expressed a sense of immediacy, and concern that "Time is of the essence:"
  - "This is a man-made disaster. Inaction is NOT an option. It is critical to act now."
  - "We are in an unfortunate situation, but it is one that will not get better unless aggressively addressed."
  - "We need to get rid of pike as soon as possible for future generations and to save our river."

Summary

Input gathered during the public scoping process represents broad support for proposed phased rotenone treatment and fisheries restoration of the Soldotna Creek Drainage. At the same time, as ADFG considers options, members of the public largely expressed a common interest in a course of action that if possible, achieves the following outcomes:

- Action is timed and completed in a manner that minimizes impacts to all forms of recreation that occur near and surrounding the Soldotna Creek Drainage and especially fishing, swimming, and boating in the lakes.
- Preserves the Kenai Peninsula's world class fisheries, including important populations of rainbow trout, Dolly Varden, lamprey, round whitefish, eulachon, Coho salmon, pink salmon, Sockeye salmon, Chinook salmon, steelhead, and sticklebacks.
- Minimizes health risks to humans and water supplies, while considering issues related to both direct exposure and long term potential effects.
- Minimizes health and food supply impacts to migratory birds and other wildlife.
- Presents a reasonable cost with a reasonable likelihood of effectiveness.
- Limits environmental impacts and site impact to the drainage, and unintentional impacts to the Kenai River.
- Enhancement of the ecology of the whole system by addressing illegal barriers between lakes, and approaching efforts in the drainage holistically.

Appendix 2. Copy of the Soldotna Creek drainage environmental assessment public notice printed in the Peninsula Clarion.

PUBLISHER'S AFFIDAVIT

UNITED STATES OF AMERICA,
STATE OF ALASKA } ss:

Becky Thomas being first duly sworn, on oath deposes and says:

That I am and was at all times here in this affidavit mentions, Supervisor of Legals of the Peninsula Clarion, a newspaper of general circulation and published at Kenai, Alaska, that the

Public Notice

a printed copy of which is hereto annexed was published in said paper one each and every day for two successive and consecutive days in the issues on the following dates:

April 20 & 21, 2014

x Becky Thomas

SUBSCRIBED AND SWORN to me before this 22nd day of April, 2014

Jane Russell

NOTARY PUBLIC in favor for the State of Alaska.

My Commission expires 27-Aug-16

The Alaska Department of Fish and Game requests comments from the public regarding the Soldotna Creek Drainage Restoration Project Environmental Assessment (EA).

A copy of the EA is available upon request, or can be viewed online at:

http://www.adfg.alaska.gov/index.cfm?adfg=rotenone.currentprojects

COMMENTS: Comments must be received no later than 4:00 p.m. Alaska Standard Time on May 21, 2014. To be considered, comments can be submitted in writing by postal mail, fax or e-mail. Mailed comments must be postmarked prior to May 22, 2012.

Mailing Address: Robert Massengill
43961 K-Beach Road, Suite B
Soldotna, AK 99669
Fax: 907-262-4709
E-mail: robert.massengill@alaska.gov

PROJECT NAME: Soldotna Creek Drainage Restoration Project

PROJECT SUMMARY AND LOCATION: Northern pike have caused the extinction of native fish species in several lakes within the Soldotna Creek drainage and have been documented entering the Kenai River from Soldotna Creek. Currently, there is no known self-sustaining population of northern pike in the Kenai River drainage outside of Soldotna Creek. If nothing is done to control the spread of northern pike, native fish species will be threatened. The Alaska Department of Fish and Game has, with public input, evaluated alternatives for addressing the invasive northern pike issue and believes the use of rotenone (a plant-based pesticide;

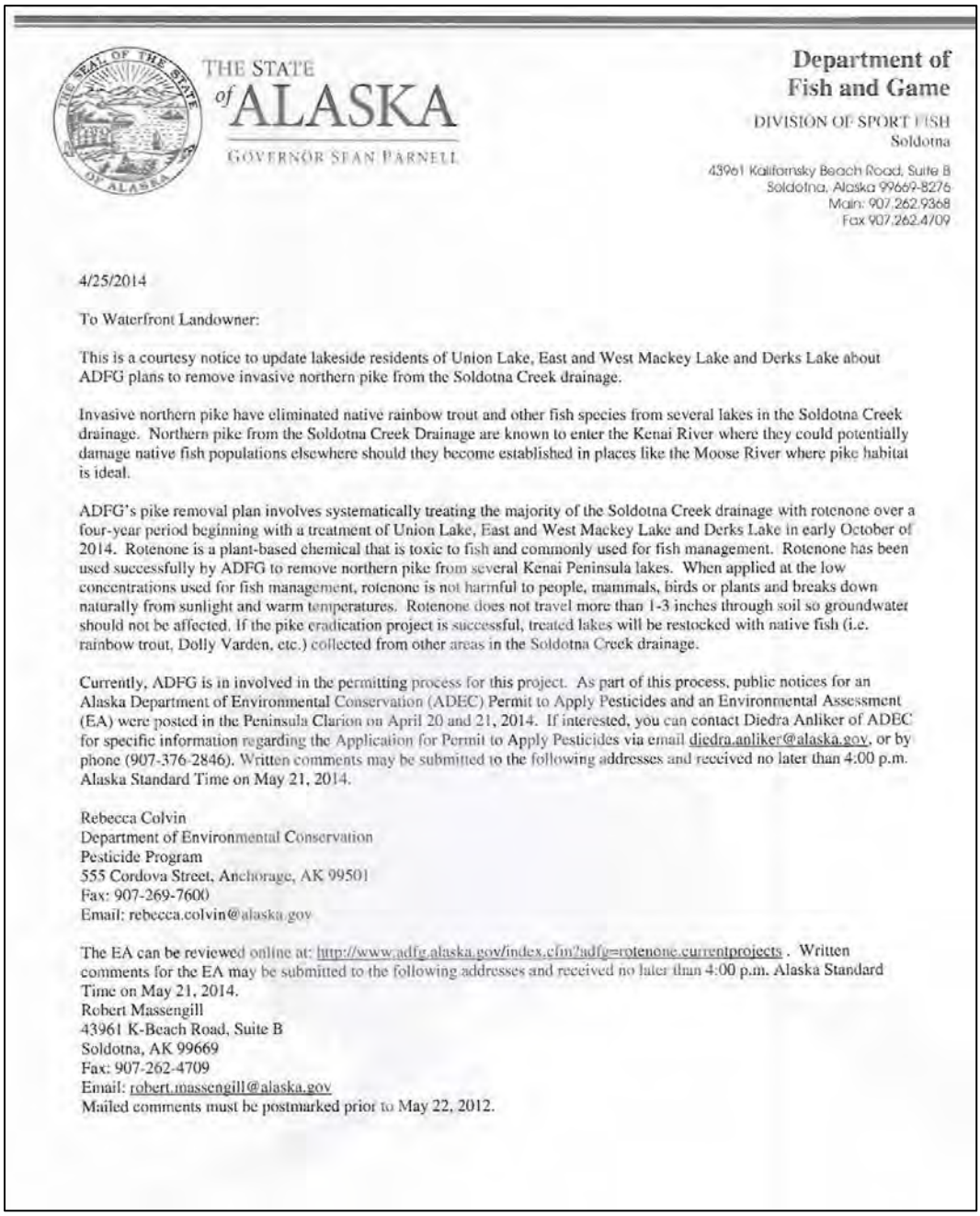
http://www.adfg.alaska.gov/index.cfm?adfg=rotenone.main)

is the most cost effective and efficient method to remove them. The Alaska Department of Fish and Game is planning a multi-year northern pike eradication project, where the western branch of the Soldotna Creek drainage, including Union Lake, West Mackey Lake, East Mackey Lake and Derks Lake will be treated with rotenone to remove northern pike. This project is set to begin in the fall of 2014. The reminder of the Soldotna Creek drainage (mainstem creek and headwater lakes) will likely be treated with rotenone during the summer of 2016 and 2017. ADF&G has produced an EA for the Soldotna Creek Drainage Restoration Project and is requesting public comments.

PROJECT NEED: The Soldotna Creek Drainage is directly connected to the Kenai River. Should northern pike populations expand beyond the Soldotna Creek Drainage into the Kenai River Drainage, the productivity of wild trout and salmon fisheries would be threatened. The objectives of this treatment are to protect critical wild fish habitat by completely removing northern pike from the Soldotna Creek Drainage.

PUBLISHED: 4/20, 21, 2014 **1687/1036**

Appendix 3. Lake waterfront landowner courtesy letter announcing the public commenting periods for the Soldotna Creek drainage environmental assessment and related ADEC pesticide use permit application.



THE STATE of ALASKA
GOVERNOR SEAN PARNELL

Department of Fish and Game
DIVISION OF SPORT FISH
Soldotna
43961 Kalifornsky Beach Road, Suite B
Soldotna, Alaska 99669-8276
Main: 907.262.9368
Fax 907.262.4709

4/25/2014

To Waterfront Landowner:

This is a courtesy notice to update lakeside residents of Union Lake, East and West Mackey Lake and Derks Lake about ADFG plans to remove invasive northern pike from the Soldotna Creek drainage.

Invasive northern pike have eliminated native rainbow trout and other fish species from several lakes in the Soldotna Creek drainage. Northern pike from the Soldotna Creek Drainage are known to enter the Kenai River where they could potentially damage native fish populations elsewhere should they become established in places like the Moose River where pike habitat is ideal.

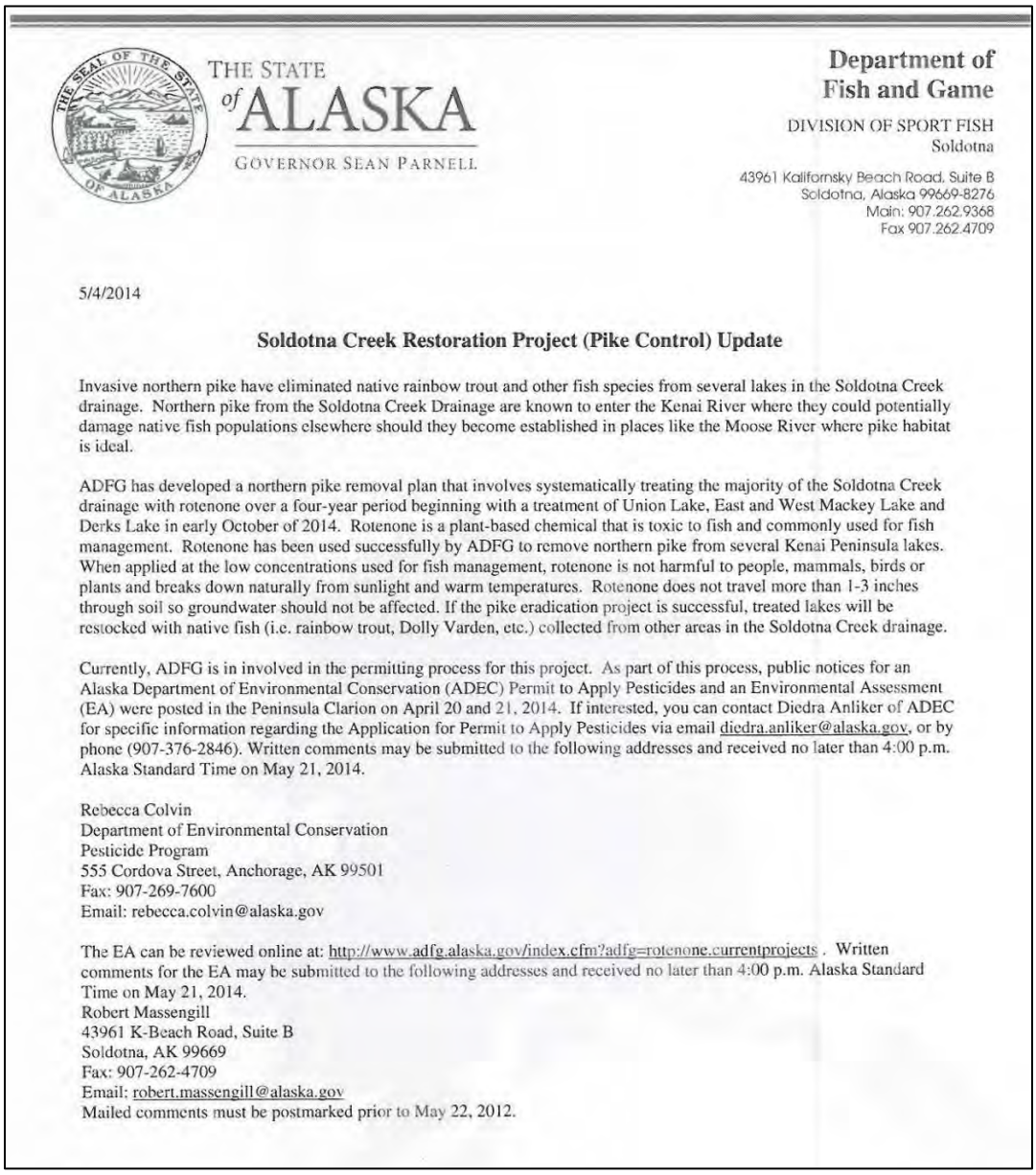
ADFG's pike removal plan involves systematically treating the majority of the Soldotna Creek drainage with rotenone over a four-year period beginning with a treatment of Union Lake, East and West Mackey Lake and Derks Lake in early October of 2014. Rotenone is a plant-based chemical that is toxic to fish and commonly used for fish management. Rotenone has been used successfully by ADFG to remove northern pike from several Kenai Peninsula lakes. When applied at the low concentrations used for fish management, rotenone is not harmful to people, mammals, birds or plants and breaks down naturally from sunlight and warm temperatures. Rotenone does not travel more than 1-3 inches through soil so groundwater should not be affected. If the pike eradication project is successful, treated lakes will be restocked with native fish (i.e. rainbow trout, Dolly Varden, etc.) collected from other areas in the Soldotna Creek drainage.

Currently, ADFG is in involved in the permitting process for this project. As part of this process, public notices for an Alaska Department of Environmental Conservation (ADEC) Permit to Apply Pesticides and an Environmental Assessment (EA) were posted in the Peninsula Clarion on April 20 and 21, 2014. If interested, you can contact Diedra Anliker of ADEC for specific information regarding the Application for Permit to Apply Pesticides via email diedra.anliker@alaska.gov, or by phone (907-376-2846). Written comments may be submitted to the following addresses and received no later than 4:00 p.m. Alaska Standard Time on May 21, 2014.

Rebecca Colvin
Department of Environmental Conservation
Pesticide Program
555 Cordova Street, Anchorage, AK 99501
Fax: 907-269-7600
Email: rebecca.colvin@alaska.gov

The EA can be reviewed online at: http://www.adfg.alaska.gov/index.cfm?adfg=rotenone.currentprojects . Written comments for the EA may be submitted to the following addresses and received no later than 4:00 p.m. Alaska Standard Time on May 21, 2014.
Robert Massengill
43961 K-Beach Road, Suite B
Soldotna, AK 99669
Fax: 907-262-4709
Email: robert.massengill@alaska.gov
Mailed comments must be postmarked prior to May 22, 2012.

Appendix 4. ADFG courtesy notice provided at the Soldotna Sport Show on May 4, 2014 announcing the public commenting periods for the Soldotna Creek drainage environmental assessment and related ADEC pesticide use permit application.



THE STATE of ALASKA
GOVERNOR SEAN PARNELL

Department of Fish and Game
DIVISION OF SPORT FISH
Soldotna
43961 Kalifornsky Beach Road, Suite B
Soldotna, Alaska 99669-8276
Main: 907.262.9368
Fax 907.262.4709

5/4/2014

Soldotna Creek Restoration Project (Pike Control) Update

Invasive northern pike have eliminated native rainbow trout and other fish species from several lakes in the Soldotna Creek drainage. Northern pike from the Soldotna Creek Drainage are known to enter the Kenai River where they could potentially damage native fish populations elsewhere should they become established in places like the Moose River where pike habitat is ideal.

ADFG has developed a northern pike removal plan that involves systematically treating the majority of the Soldotna Creek drainage with rotenone over a four-year period beginning with a treatment of Union Lake, East and West Mackey Lake and Derks Lake in early October of 2014. Rotenone is a plant-based chemical that is toxic to fish and commonly used for fish management. Rotenone has been used successfully by ADFG to remove northern pike from several Kenai Peninsula lakes. When applied at the low concentrations used for fish management, rotenone is not harmful to people, mammals, birds or plants and breaks down naturally from sunlight and warm temperatures. Rotenone does not travel more than 1-3 inches through soil so groundwater should not be affected. If the pike eradication project is successful, treated lakes will be restocked with native fish (i.e. rainbow trout, Dolly Varden, etc.) collected from other areas in the Soldotna Creek drainage.

Currently, ADFG is in involved in the permitting process for this project. As part of this process, public notices for an Alaska Department of Environmental Conservation (ADEC) Permit to Apply Pesticides and an Environmental Assessment (EA) were posted in the Peninsula Clarion on April 20 and 21, 2014. If interested, you can contact Diedra Anliker of ADEC for specific information regarding the Application for Permit to Apply Pesticides via email diedra.anliker@alaska.gov, or by phone (907-376-2846). Written comments may be submitted to the following addresses and received no later than 4:00 p.m. Alaska Standard Time on May 21, 2014.

Rebecca Colvin
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The EA can be reviewed online at: http://www.adfg.alaska.gov/index.cfm?adfg=rotenone.currentprojects . Written comments for the EA may be submitted to the following addresses and received no later than 4:00 p.m. Alaska Standard Time on May 21, 2014.
Robert Massengill
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Soldotna, AK 99669
Fax: 907-262-4709
Email: robert.massengill@alaska.gov
Mailed comments must be postmarked prior to May 22, 2012.

Appendix 5. Summary of comments received during the Soldotna Creek drainage Environmental Assessment public commenting period and department responses.

Two private individuals provided responses during the Soldotna Creek Restoration Project Environmental Assessment public commenting period (April 20 through May 21, 2014). One comment voiced strong general support for the preferred alternative. A second comment opposed the preferred alternative (rotenone treatment) for the following reasons: 1) concerns about rotenone causing human health issues such as Parkinson's Disease 2) the timing of the rotenone treatment (fall/cold weather)that could cause the rotenone to persist for months in the environment, and 3) the potential for to rotenone enter potable water supplies.

The department has already addressed the human health concerns in Sections 4.1.8, 4.3.4 and 4.3.7 of this environmental assessment. Justification for the timing of the treatment and anticipated rotenone persistence is discussed on section 2.3.2. Risk associated with rotenone entering potable water supplies was addressed in section 4.1.8 and Appendix 13.

Appendix 6. Prentox Rotenone Fish Toxicant Powder product label.

RESTRICTED USE PESTICIDE
DUE TO AQUATIC, ACUTE ORAL AND INHALATION TOXICITY
For retail sale to, and use by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

ROTENONE FISH TOXICANT POWDER

ACTIVE INGREDIENTS:	
Rotenone- Minimum Guaranteed	7.4% w/w
Other Associated Resins	11.1%
OTHER INGREDIENTS:	81.5%
TOTAL:	100.0% w/w

ROTENONE ASSAY _____ % ROTENONE

PRENTOX® - Registered Trademark of Prentiss Incorporated

KEEP OUT OF REACH OF CHILDREN

DANGER
POISON

FIRST AID
Have the product container or label with you when calling a poison control center or physician, or going for treatment.

If swallowed	• Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the Poison Control Center or physician. • Do not give anything by mouth to an unconscious or convulsing person.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

SEE INSIDE LEAFLET FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND DIRECTIONS FOR USE

Manufactured by: 5/02

E.P.A. REG. NO. 655-691
E.P.A. EST. NO. 655-GA-1

PRENTISS INCORPORATED
Plant: Kaolin Road, Sandersville, GA 31082
Office: C.B. 2000, Floral Park, NY 11002-2000

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER

Fatal if inhaled or swallowed. Harmful if absorbed through the skin. Causes moderate eye irritation. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Do not breathe dust. Use a dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C), or a NIOSH approved respirator with any N, R, P or HE filter. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash clothing before reuse.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to fish. Fish kills are expected at recommended rates. Consult your State Fish and Game Agency before applying this product to public waters to determine if a permit is needed for such an application. Do not contaminate untreated water when disposing of equipment washwaters.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
STORAGE: Store only in original container, in a dry place inaccessible to children and pets. If spilled, sweep up and dispose of as below.
PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
CONTAINER DISPOSAL: Completely empty bag into application equipment. Then dispose of bag in a sanitary landfill or by incineration, or if allowed by State and local authorities by burning. If burned, stay out of smoke.

DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS:
Use against fish in lakes, ponds, and streams (immediately above lakes and ponds).

Since such factors as pH, temperature, depth, and turbidity will change effectiveness, use this product only at locations, rates, and times authorized and approved by appropriate state and Federal fish and wildlife agencies. Rates must be within the range specified in the labeling.

Properly dispose of dead fish and unused product. Do not use dead fish as food or feed.

Do not use water treated with rotenone to irrigate crops or release within ½mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

Note to User: Adjust pounds of Rotenone according to the actual Rotenone Assay as noted under the Ingredient Statement on this label. For example, if the required amount of 5% rotenone is 21 pounds, and the Rotenone Assay is 7%, use 5/7 of 21 pounds or 15 pounds of this product to yield the proper amount of active rotenone.

APPLICATION DIRECTIONS:

Treatment of Lakes and Ponds

1. **Application Rates and Concentrations of Rotenone**
The actual application rates and concentrations of rotenone needed to control fish will vary widely, depending on the type of use (e.g. selective treatment, normal pond treatment, etc.) and the factors listed above. The table below is a general guide for the proper rates and concentrations.

2. **Total Amount of Product Needed for Treatment**
To determine the total number of pounds needed for treatment, divide the number of acre-feet covered by one pound for a specific type of use (e.g., selective treatment, etc.), as indicated in the table below, into the number of acre-feet in the body of water.

General Guide to the Application Rates and Concentrations of Rotenone Needed to Control Fish in Lakes and Ponds

Type of Use	No. of Acre-Feet Covered by One Pound	Parts Per Million	
		Active Rotenone	5% Product
Selective Treatment	3.7 to 2.8	0.005 - 0.007	0.10 - 1.3
Normal Pond Use	0.74 to 0.37	0.025 - 0.050	0.5 - 1.0
Remove Bullheads or Carp	0.37 to 0.185	0.050 - 0.100	1.02 - 2.0
Remove Bullheads or Carp in Rich Organic Ponds	0.185 to 0.093	0.100 - 0.200	2.0 - 4.0
Pre-impoundment Treatment above Dam	0.123 to 0.074	0.150 - 0.250	3.0 - 5.0

5. **Restocking**
Waters treated with this product detoxify within 2 to 4 weeks after treatment, depending on pH, temperature, water hardness, and depth. To determine if detoxification has occurred, place live boxes containing samples of fish to be stocked in treated waters. More rapid detoxification can be accomplished by adding Potassium Permanganate or chlorine at a 1:1 ratio with the concentration of rotenone applied, plus sufficient additional compound to satisfy the chemical oxidation demand caused by organic matter that may be present in the treated water.

Treatment of Streams Immediately Above Lakes and Ponds
The purpose of treating streams immediately above lakes and ponds is to improve the effectiveness of lake and pond treatments and not to control fish in streams per se. The term "immediately" means the first available site above the lake or pond where treatment is practical.

In order to treat a stream immediately above a lake or pond, you must select a concentration of active rotenone, compute the flow rate of a stream, calculate the application rate, select an exposure time, estimate the amount of product needed, and follow the method of application.

1. **Concentration of Active Rotenone**
Select the "Concentration of Active Rotenone" based on the type of use from those on the table. For example, if you select "Normal Pond Use" you could select a concentration of "0.025 Parts per Million".

2. **Computation of Flow Rate for Stream**
Select a cross section of the stream where the banks and bottom are relatively smooth and free of obstacles. Divide the surface width into 3 equal sections and determine the water depth and surface velocity at the center of each section. In slowly moving streams, determine the velocity by dropping a float attached to 5 feet of loose, monofilament fishing line. Measure the time required for the float to move 5 feet. For fast-moving streams, use a longer distance. Take at least three readings at each point. To calculate the flow rate from the information obtained above, use the following formula:

$$F = \frac{W_s \times D \times L \times C}{T}$$

where F = flow rate (cu. ft./sec.), W_s = surface width (ft.), D = mean depth (ft.), L = mean distance traveled by float (ft.), C = constant (0.8 for rough bottoms and 0.9 for smooth bottoms), and T = mean time for float (sec.).

For example, after using the above formula, you might have computed the stream's flow rate to be "10 cu. ft. per sec."

3. **Calculation of Application Rate**
In order to calculate the application rate (expressed as "pound per sec"), you convert the rate in the table (expressed as "pound per acre-feet"), to "pound per cu. feet" and multiply by the flow rate (expressed as "cu. ft. per sec."). Depending on the size of the stream and the type of equipment, the rate could be expressed in other units, such as "ounces per hr."

The application rate for the stream above is calculated as follows:

$$R_s = R_p \times C \times F$$

where R_s = Application Rate for Stream (lb/sec), R_p = Application Rate for Pond (lb/acre feet), C = 1 acre foot/43560 cu. ft., and F = Flow Rate (cu. ft/sec).

In the example, the Application Rate for Stream would be:
R_s = 1 lb/0.74 acre-foot x 1 acre-foot/43560 cu. ft. x 10 cu. ft./sec.
R_s = .00031 lb/sec or 17.9 oz./hr.

4. **Exposure Time**
The "Exposure Time" would be the period of time (expressed in hours or seconds) during which target fish should **not** enter the lake or pond under treatment. In the example, this period of time could be 4 hours.

5. **Amount of Product**
Calculate the "Amount of Product" for a stream by multiplying the "Application Rate for Stream" by the "Exposure Time". In the example, the "Amount of Product" would be 71.6 oz. (17.9 oz./hr. x 4 hr.) or 4.5 lb.

RE-ENTRY STATEMENT
Do not allow swimming in rotenone-treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to labeling instructions.

[1]Adapted from Kinney, Edward, 1965 Rotenone in Fish Pond Management. USDI Washington, D.C. Leaflet FL-576.

Computation of acre-feet for lake or pond: An acre-foot is a unit of water volume having a surface area of one acre and a depth of one foot. Make a series of transects across the surface, taking depths with a measured pole or weighted line. Add the measurements and divide by the number made to determine the average depth. To compute **total acre-feet**, multiply this average depth by the number of surface acres, which can be determined from an aerial photograph or plat drawn to scale.

3. **Pre-Mixing Method of Application**

Pre-mix one pound of Rotenone with 3 to 10 gallons of water. Uniformly apply over water surface or bubble through underwater lines.

Alternately place undiluted powder in burlap sack and trail behind boat. When treating deep water (20 to 25 feet) weight bag and tow at desired depth.

4. **Removal of Taste and Odor**

Rotenone treated waters do not retain a detectable taste or odor for more than a few days to a maximum of one month. Taste and odor can be removed immediately by treatment with activated charcoal at a rate of 30 ppm. for each 1 ppm. Rotenone remaining (Note: As Rotenone detoxifies, less charcoal is required).

Appendix 7. Rotenone Fish Toxicant Powder Material Safety Data Sheet.

Material Safety Data Sheet
U.S. Department of Labor (OSHA 29 CFR 1910.1200)

Section 1: Product and Company Identification

Product: **655-691** **Prentox® Prenfish™ Fish Toxicant Powder**

Manufacturer's Name: **Prentiss Incorporated**
C. B. 2000
Floral Park, NY 11001
Telephone Number: **(516) 326-1919**

Section II: Composition/Information on Ingredients

Ingredient Name:	OSHA PEL	ACGIH TLV	%
Rotenone (CAS # 83-79-4)	(TWA) 5 mg/M³	(TWA) 5 mg/M³	7.4
Other Cube Resins	None	None	11.1
Other Ingredients	None	None	81.5

Section 3: Hazards Identification:

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Emergency Overview:

A tan powder with a wet chalk or dirt-like odor.

- Fatal if inhaled or swallowed
- Harmful if absorbed through skin
- Causes moderate eye irritation
- May cause allergic skin reactions in some individuals
- This pesticide is extremely toxic to fish

Potential Health Effects:

Primary Route(s) of Entry:
Ingestion, inhalation, and skin contact

Eyes:
Causes moderate eye irritation

Skin:
Harmful if absorbed through the skin. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals.

Ingestion:
Fatal if swallowed

Inhalation:
Fatal if inhaled

Signs and symptoms of acute overexposure:
May cause irritation of the eyes, nose and throat in addition to temporary numbness. Prolonged or repeated exposure can cause nausea, vomiting, abdominal cramps, muscle tremors, poor muscle coordination, seizures, shallow breathing, skin rashes and eye, nose and mouth lesions.

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Section 4: First Aid Measures:

Eyes:
Flush eyes with plenty of water for 15 minutes. Get medical attention if irritation persists

Skin:
Wash with plenty of soap and water. Get medical attention if irritation persists

Ingestion:
Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.

Inhalation:
Remove person to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. Get medical attention

Note to Physician:
If a small amount is ingested (or if treatment is delayed), oral administration of large amounts of activated charcoal and a cathartic is probably sufficient therapy.
Do not administer milk, cream or other substances containing vegetable or animal fats, which enhance the absorption of lipophilic substances.

Section 5: Fire Fighting Measures:

Extinguishing Media:
Carbon dioxide, dry chemical, foam or water

Fire Fighting Instructions:
As in any fire, wear self-contained breathing apparatus, pressure demand, MSHA/NIOSH approved (or equivalent), and full protective gear. Keep upwind. Isolate hazard area. Avoid inhalation of smoke and fumes. Use water or foam to reduce fumes. Do not touch spilled material. If possible, move containers from area. Extinguish only if flow can be stopped. Use flooding amounts of water as a fog. Cool containers with flooding amounts of water from as far a distance as possible. Avoid breathing vapors.

Flammability Classification/Rating:
NFPA/OSHA Class: IIIB
NFPA Rating (Fire): 1

Section 6: Accidental Release Measures:

General and Disposal: Use proper protective equipment to minimize personal exposure (see Section 8). Take all necessary action to prevent and to remedy the adverse effect of the spill. Ensure that the disposal is in compliance with all Federal, State/Provincial, and local regulations (see Section 13 for applicable RCRA number). Refer to Section 15 for applicable Reportable Quantity (RQ) and other regulatory requirements.

Land Spill: Sweep or shovel spilled material into a tightly sealed container. Dispose of with chemical waste.

Section 7: Handling and Storage:

Handling Precautions:

Do not breathe dust. Avoid contact with eyes, skin or clothing.

Storage Precautions:

Do not contaminate water, food or feed by storage. Store in a dry place, away from excessive temperature extremes.

Work/Hygienic Practices:

Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

Section 8: Exposure Controls/Personal Protection:

Manufacturing, formulation and other Non-Agricultural uses.

Engineering controls:

Control airborne concentrations below the appropriate exposure guideline (see Section 2 for applicable OSHA/ACGIH Exposure Limits). Local exhaust ventilation may be necessary.

Eye/Face Protection:

Wear safety glasses, splash goggles or face shield.

Skin Protection:

Wear chemical resistant gloves (Neoprene, Nitrile rubber or PVC) and other protective clothing to avoid skin contact.

Respiratory Protection:

Ensure good ventilation. If not adequate, use a chemical cartridge type respirator approved by the National Institute of Occupational Health and Safety.

General Protection:

Eye wash facility and safety shower should be available. Wear a protective apron, long sleeves and pants to prevent skin contact.

Section 9: Physical and Chemical Properties:

Appearance:

Tan powder

Odor:

Wet chalk or dirt-like odor.

Basic Physical Properties:

Physical State: Solid

Solubility (H_2O): Insoluble

Bulk Density: Fluffed – 0.24 gm/cm^3 (14.7 lb./cu. Ft.). Packed – 0.45 gm/cm^3 (28.1 lb./cu. Ft.)

Section 10: Stability and Reactivity:

Stability: Stable.

Conditions to Avoid (Stability): High temperatures and constant exposure to sunlight

Incompatible Materials: Avoid strong oxidizers and reducing agents

Hazardous Polymerization: Will not occur

Section 11: Toxicological Information:

The following data were developed with rotenone dust containing 5% rotenone.

Eye Effects:

Irritation (Rabbit): Slightly irritating.

Skin Effects:

Irritation (Rabbit): Non-irritating.

Absorption (Rabbit): LD_{50} > 2,020 mg/kg (Slightly Toxic).

Sensitization (Guinea Pig): Sensitizing

Acute Oral Effects:

LD_{50} (Rat, male): 874 mg/kg (Slightly Toxic).

(Rat, female): 99.2 mg/kg (Moderately Toxic).

Acute Inhalation Effects:

4 hour LC_{50} (Rat, Male): 0.087 mg/L (Moderately Toxic).

4 hour LC_{50} (Rat, Female): 0.045 mg/L (Highly Toxic).

4 hour LC_{50} (Rat): 0.056 mg/L (Moderately Toxic).

Note: the severity classifications listed above are those of Prentiss Incorporated, and, particularly for eye irritation, may not always coincide with EPA-mandated Precautionary Statements.

The following data were developed with rotenone, the active ingredient in this product.

Chronic (Cancer) Information:

Rotenone was not carcinogenic when tested in rats and mice.

Carcinogenicity: **NTP:** No **IARC:** No **OSHA:** No

Teratogenicity (Birth Defects):

Rotenone was not teratogenic or fetotoxic when tested in rats and mice.

Reproductive Effects:

Rotenone had no adverse effects on reproduction when tested over two successive generations in rats.

Mutagenicity (Genetic Effects):

Rotenone was not mutagenic nor clastogenic when tested in the Ames test, Yeast test, Mouse Lymphoma test, Mouse Micronucleus test, Chromosome Aberration test and the Mitotic Recombination test in Yeast.

Section 12: Ecological Information:

Other Environmental Information:

This pesticide is extremely toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters, unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA

Section 13: Disposal Considerations:

Do not contaminate water, food or feed by disposal.

Pesticide Disposal:

Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

Container Disposal:

Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of liner in a sanitary landfill or by incineration if allowed by State and local authorities. If drum is contaminated and cannot be reused, dispose of in the same manner.

RCRA Information:

RCRA Hazardous Waste Ingredients: None.

Section 14: Transport Information:

Proper Shipping Name: Pesticide, Solid, Toxic, n.o.s. (Rotenone)
Hazard Class: 6.1, PG I
DOT Identification Number: UN2588
DOT Shipping Label: POISON

Additional Shipping Paper Description: Marine Pollutant

Note: For transport purposes (49 CFR Part 173.132), the calculated 1 hour LC_{50} (Rat) is: 0.224 mg/L (dust)

Section 15: Regulatory Information:

U.S. Federal Regulatory Information:

EPA Reg. No.: 655-691
TSCA Inventory: Registered pesticide, exempt from TSCA.
SARA Title III Notification and Information:

Section 302 (EHS) ingredients: None.
Section 304 (CERCLA & EHS) ingredients (RQ): None.
Section 313 ingredients: None.

SARA Title III Notifications and Information:

SARA Title III Hazard Classes:

Acute Health Hazard: Yes
Chronic Health Hazard: No
Fire Hazard: No
Sudden Release of Pressure Hazard: No
Reactivity Hazard: No

Regulated Ingredients:

Ingredient: Rotenone

CAS Number: 83-79-4

Percent by Weight: 7.4

Regulations:

Illinois Toxic Substance
Massachusetts Hazardous Substance
New Jersey Special Health Hazardous Substance
New Jersey Workplace Hazardous Substance
Pennsylvania Workplace Hazardous Substance

U.S. State Regulatory Information:

California (Proposition 65): This product does not contain any chemical which is known to the State of California to cause cancer or birth defects, or other reproductive harm.

Canadian Regulatory Information:

CPC Number: None
WHMIS Classification for Control Product Regulations (CPR): Registered pesticide under US FIFRA regulations; exempt from CPR classification.
The MSDS contains all CPR required hazard-related information.
WHMIS Hazard Rating: See HMIS rating (Section 16).

Section 16: Other Information:

NFPA Hazard Rating:

Health: 2 – Moderate
Fire: 1 – Slight
Reactivity: 0 – Negligible
Special:

HMIS Hazard Rating:

Health: 2 – Moderate
Fire: 1 – Slight
Reactivity: 0 – Negligible
Protection: J

Date Prepared: August 14, 2000
Supersedes: November 3, 1997
Reason: Revision of sections 3, 5, 6, 7, 8, 9, 11, 13, 14, 15

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

Appendix 8. CFT LegumineTM product label.

RESTRICTED USE PESTICIDE
Due to aquatic toxicity
For retail sale to, and use only by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

CFT Legumine™

Fish Toxicant

For Control of Fish in Lakes, Ponds, Reservoirs, and Streams

ACTIVE INGREDIENTS:

Rotenone	5.0%	w/w
Other Associated Resins	5.0%	
OTHER INGREDIENTS[1]	90.0%	
Total	100.0%	

[1] Contains Petroleum Distillates

CFT Legumine is a trademark of CWE Properties Ltd., LLC

KEEP OUT OF REACH OF CHILDREN

WARNING

FIRST AID

Have product container or label with you when obtaining treatment advice.

If swallowed	• Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Do not give any liquid to the person. · Do not anything to an unconscious person • Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.

Note to Physician: Contains Petroleum Distillates. Vomiting may cause aspiration pneumonia. For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

EPA Reg. No. 655-899

Manufactured for CWE Properties Ltd., LLC, P.O. Box 336277, Greeley CO 80633

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
WARNING

May be fatal if inhaled or swallowed. Causes moderate eye irritation. Harmful if absorbed through skin. Do not breathe spray mist. Do not get in eyes, on skin, or on clothing. Wear goggles or safety glasses.

When handling undiluted product, wear either a respirator with an organic-vapor-removing cartridge with a prefilter approved for pesticides (MSHA/NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix 14G), or a NIOSH approved respirator with an organic vapor (OV) cartridge or canister with any R, P, or HE prefilter.

Wash thoroughly with soap and water after handling and before eating, drinking, or using tobacco. Remove contaminated clothing and wash before reuse. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to fish. Fish kills are expected at recommended rates. Consult your State Fish and Game Agency before applying this product to public waters to determine if a permit is needed for such an application. Do not contaminate untreated water when disposing of equipment washwaters.

CHEMICAL AND PHYSICAL HAZARDS

FLAMMABLE: KEEP AWAY FROM HEAT AND OPEN FLAME. FLASH POINT MINIMUM 45°F (7°C).

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store only in original containers, in a dry place inaccessible to children and pets. This product will not solidify nor show any separation at temperatures down to 40°F and is stable for a minimum of one year when stored in sealed drums at 70°F.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your state pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Triple rinse or equivalent. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

CFT Legumine is registered for use by or under permit from, and after consultation with State and Federal Fish and Wildlife Agencies.

GENERAL INFORMATION

This product is a specially formulated product containing rotenone to be used in fisheries management for the eradication of fish from lakes, ponds, reservoirs and streams.

Since such factors as pH, temperature, depth and turbidity will change effectiveness, use this product only at locations, rates, and times authorized and approved by appropriate State and Federal Fish and Wildlife Agencies. Rates must be within the range specified on the label.
Properly dispose of unused product. Do not use dead fish for food or feed.
Do not use water treated with rotenone to irrigate crops or release within ½ mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

Re-entry Statement: Do not allow swimming in rotenone-treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to labeling instructions.

FOR USE IN PONDS, LAKES, AND RESERVOIRS

The actual application rates and concentrations of rotenone needed to control fish will vary widely, depending on the type of use (e.g., selective treatment, normal pond use, etc.) and the factors listed above. The table below is a general guide for the proper rates and concentrations.
This product disperses readily in water both laterally and vertically, and will penetrate below the thermocline in thermally stratified bodies of water.

Computation of Acre-Feet: An acre-foot is a unit of volume of a body of water having the area of one acre and the depth of one foot. To determine acre-feet in a given body of water, make a series of transects across the body of water taking depths with a measured pole or weighted line. Add the soundings and divide by the number made to determine the average depth. Multiply this average depth by the total surface area in order to determine the acre-feet to be treated. If number of surface acres is unknown, contact your local Soil Conservation Service, which can determine this from aerial photographs.

Amount of CFT Legumine Needed for Specific Uses: To determine the approximate number of gallons needed, find your "Type of Use" in the first column of the table below and then divide the corresponding numbers in the fourth column, "Number of Acre-Feet Covered by One Gallon" into the number of acre-feet in your body of water.

Type of Use	Parts per Million		Number of Acre-Feet Covered by One Gallon
	CFT Legumine	Active Rotenone	
Selective Treatment	0.10 to 0.13	0.005 to 0.007	30 to 24
Normal Pond Use	0.5 to 1.0	0.025 to 0.050	6.0 to 3.0
Remove Bullheads or Carp	1.0 to 2.0	0.050 to 0.100	3.0 to 1.5
Remove Bullheads or Carp in Rich Organic Ponds	2.0 to 4.0	0.100	1.5 to 0.75
Preimpoundment Treatment Above Dam	3.0 to 5.0	0.150 to 0.250	1.0 to 0.60

*Adapted from Kinney, Edward. 1965. Rotenone in Fish Pond Management. USDI Washington, DC Leaflet FL-576

Pre-Mixing and Method of Application: Pre-mix with water at a rate of one gallon of CFT Legumine to 10 gallons of water. Uniformly apply over water surface or bubble through underwater lines.

Detoxification: Water treated with this product will detoxify under natural conditions within one week to one month depending upon temperatures, alkalinity, etc. Rapid detoxification can be accomplished by adding chlorine or potassium permanganate to the water at the same rate as CFT Legumine in parts per million, plus enough additional to meet the chlorine demand of the untreated water.

Removal of Taste and Odor: Waters treated with this product do not retain a detectable taste or odor for more than a few days to a maximum of one month. Taste and odor can be removed immediately by treatment with activated charcoal at a rate of 30 ppm for each 1 ppm of CFT Legumine remaining. (Note: As this product detoxifies, less charcoal is required.)

Restocking After Treatment: Wait 2 to 4 weeks after treatment. Place a sample of fish to be stocked in wire cages in the coolest part of the treated waters. If the fish are not killed within 24 hours, the water may be restocked.

USE IN STREAMS IMMEDIATELY ABOVE LAKES, PONDS, AND RESERVOIRS

The purpose of treating streams immediately above lakes, ponds and reservoirs is to improve the effectiveness of lake, pond and reservoir treatments by preventing target fish from moving into the stream corridors, and not to control fish in streams per se. The term "immediately" means the first available site above the lake, pond or reservoir where treatment is practical, while still creating a sufficient barrier to prevent migration of target fish into the stream corridor.

In order to completely clear a fresh water aquatic habitat of target fish, the entire system above or between fish barriers must be treated. See the use directions for streams and rivers on this label for proper application instructions.

In order to treat a stream immediately above a lake, pond or reservoir you must: (a) Select the concentration of active rotenone, (b) Compute the flow rate of the stream, (c) Calculate the application rate, (d) Select an exposure time, (e) Estimate the amount of product needed, (f) Follow the method of application.

To prevent movement of fish from the pond, lake, or reservoir, the stream treatment should begin before and continue throughout treatment of the pond, lake or reservoir until mixing has occurred.

1. Concentration of Active Rotenone

Select the concentration of active rotenone based on the type of use from those listed on the table. Example: If you select "normal pond use" you could select a concentration of 0.025 parts per million.

2. Computation of Flow Rate for Stream

Select a cross section of the stream where the banks and bottom are relatively smooth and free of obstacles. Divide the surface width into 3 equal sections and determine the water depth and surface velocity at the center of each section. In slowly moving streams, determine the velocity by dropping a float attached to 5 feet of loose monofilament fishing line. Measure the time required for the float to move 5 feet. For fast-moving streams, use a longer distance. Take at least three readings at each point. To calculate the flow rate from the information obtained above, use the following formula:

$$F = \frac{Ws \times D \times L \times C}{T}$$

Where F = flow rate (cubic feet/second), Ws = surface width (feet), D = mean depth (feet), L = mean distance traveled by float (feet), C = constant (0.8 for rough bottoms and 0.9 for smooth bottoms), T = mean time for float (sec.).

3. Calculation of Application Rate

In order to calculate the application rate (expressed as gallons/second), convert the rate in the table (expressed as gallons/acre-feet) to gallons per cubic feet and multiply by the flow rate (expressed as cubic feet/second). Depending on the size of the stream and the type of equipment, the rate could be expressed in other units, such as ounces/hour, or cc/minute.

The application rate for the stream is calculated as follows:

$$R_s = R_p \times C \times F$$

Where R_s = application rate for stream (gallons/second), R_p = application rate for pond (gallons/acre-feet), C = 1 acre-foot/43560 cubic feet and F = flow rate of the stream (cubic feet/second).

4. Exposure Time

The exposure time would be the period of time (expressed in hours or minutes) during which CFT Legumine is applied to the stream in order to prevent target fish from escaping from the pond into the stream corridor.

5. Amount of Product

Calculate the amount of product for a stream by multiplying the application rate for streams by the exposure time.

$$A = R_s \times H$$

Where A = the amount of product for the stream application, R_s = application rate for stream (gallons/second) and H = the exposure time expressed in seconds.

FOR USE IN STREAMS AND RIVERS

Only state or Federal Fish and Wildlife personnel or professional fisheries biologists under the authorization of state or Federal Fish and Wildlife agencies are permitted to make applications of CFT Legumine for control of fish in streams and rivers. Informal consultation with Fish and Wildlife personnel regarding the potential occurrence of endangered species in areas to be treated should take place. Applicators must reference the Stream and River use Monograph before making any application to streams or rivers.

CFT LEGUMINE STREAM AND RIVER USE MONOGRAPH

USE IN STREAMS AND RIVERS

The following use directions are to provide guidance on how to make applications of CFT Legumine to streams and rivers. The unique nature of every application site could require minor adjustments to the method and rate of application. Should these unique conditions require major deviation from the use directions, a Special Local Need 24(c) registration should be obtained from the state.

Before applications of CFT Legumine can be made to streams and rivers, authorization must be obtained from state or federal Fish and Wildlife agencies. Since local environmental conditions will vary, consult with the state Fish and Wildlife agency to ensure the method and rate of application are appropriate for that site.

Contact the local water department to determine if any water intakes are within one mile downstream of the section of stream, river, or canal to be treated. If so, coordinate the application with the water department to make sure the intakes are closed during treatment and detoxification.

Application Rates and Concentration of Rotenone

Slow Moving Rivers: In slow moving rivers and streams with little or no water exchange, use instructions for ponds, lakes and reservoirs.

Flowing Streams and Rivers: Apply rotenone as a drip for 4 to 8 hours to the flowing portion of the stream. Multiple application sites are used along the length of the treated stream, spaced

approximately ½ to 2 miles apart depending on the water flow travel time between sites. Multiple sites are used because rotenone is diluted and detoxified with distance. Application sites are spaced at no more than 2 hours or at no less than 1-hour travel time intervals. This assures that the treated stream remains lethal to fish for a minimum of 2 hours. A non-toxic dye such as Rhodamine-WTR or fluorescein can be used to determine travel times. Cages containing live fish placed immediately upstream of the downstream application sites can be used as sentinels to assure that lethal conditions exist between sites.

Apply rotenone at each application site at a concentration of 0.25 to 1.0 part per million of CFT Legumine. The amount of CFT Legumine needed at each site is dependent on stream flow (see Computation of Flow Rate for Stream).

Application of Undiluted Material

CFT Legumine can drain directly into the center of the stream at a rate 0.85 to 3.4 cc per minute for each cubic foot per second of stream flow. Flow of undiluted CFT Legumine into the stream should be checked at least hourly. This is equivalent to from 0.5 to 2.0 ppm of this product, or from 0.025 to 0.100 ppm rotenone. Backwater, stagnant, and spring areas of streams should be sprayed by hand with a 10% v/v solution of CFT Legumine in water to assure a complete coverage.

Calculation of Application Rate:

$$X = F\ (1.699\ B)$$

X = cc per minute of CFT Legumine applied to the stream, F = the flow rate (cu.ft/sec.) see Computation of Flow Rate for Stream section of the label, B = parts per million desired concentration of CFT Legumine

Total Amount of Product Needed for Treatment: Streams should be treated for 4 to 8 hours in order to clear the treated section of stream of fish. To determine the total amount of CFT Legumine required, use the following equation:

$$Y = X\ (0.0158\ C)$$

Y = gallons of CFT Legumine required for the stream treatment, X = cc per minute of CFT Legumine applied to the stream, C = time in hours of the stream treatment.

Application of Diluted Material

Alternatively, for stream flows up to 25 cubic feet per second, continuous drip of diluted CFT Legumine at 80 cc per minute can be used. Flow of diluted CFT Legumine into the stream should be checked at least hourly. Use a 5 gallon reservoir over a 4 hour period, a 7.5 gallon reservoir over a 6 hour period, or a 10 gallon reservoir over an 8 hour period. The volume of the reservoir can be determined from the equation:

$$R = H \times 1.25$$

Where R = the volume of the reservoir in gallons, H = the duration of the application in hours.

The volume of CFT Legumine diluted with water in the reservoir is determined from the equation:

$$X = Y(102\ F)H$$

Where X = the cc of CFT Legumine diluted in the reservoir, Y = parts per million desired concentration of CFT Legumine, F = the flow rate (cubic feet/second), H = the duration of the application (hours).

For flows over 25 cubic feet per second, additional reservoirs can be used concurrently. Back-water, stagnant and spring areas of streams should be sprayed by hand with a 10% v/v solution of CFT Legumine in water to assure a complete coverage.

Detoxification

To limit effects downstream, detoxification with potassium permanganate can be used at the downstream limit of the tre ated area. Within ½ to 2 miles of the furthest downstream CFT Legumine application site, the rotenone can be detoxified with a potassium permanganate solution at a resultant stream concentration of 2 to 4 parts per million, depending on rotenone concentration and permanganate demand of the water. A 2.5% (10 pounds potassium permanganate to 50 gallons of water) permanganate solution is dripped in at a continuous rate using the equation:

$$X = Y(70\ F)$$

Where X = cc of 2.5% permanganate solution per minute, Y = ppm of desired permanganate concentration, F = cubic feet per second of stream flow.

Flow of permanganate should be checked at least hourly. Live fish in cages placed immediately above the permanganate application site will show signs of stress signaling the need for beginning detoxification. Detoxification can be terminated when replenished fish survive and show no signs of stress for at least four hours.

Detoxification of rotenone by permanganate requires between 15 to 30 minutes contact time (travel time). Cages containing live fish can be placed at these downstream intervals to judge the effectiveness of detoxification. At water temperatures less than 50°F detoxification may be retarded, requiring a longer contact time.

WARRANTY STATEMENT

Our recommendations for the use of this product are based upon tests believed to be reliable. The use of this product being beyond the control of the manufacturer, no guarantee, expressed or implied, is made as to the effects of such or the results to be obtained if not used in accordance with directions or established safe practice. To the extent consistent with applicable law, the buyer must assume all responsibility, including injury or damage, resulting from its misuse as such, or in combination with other materials.

Appendix 9. CFT Legumine™ Material Safety Data Sheet.

CWE Properties Ltd., LLC – P.O. Box 336277 – Greeley, CO 80633

CFT Legumine™ EPA Reg. No. 75338-2

Material Safety Data Sheet

SECTION 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT/CHEMICAL NAME: CFT Legumine™

Emergency Contact: 1-800-858-7378 (National Pesticide Information Center)

Transportation Emergency Contact: 1-800-858-7378 (National Pesticide Information Center

Manufactured for: CWE Properties Ltd., LLC
P.O. Box 336277
Greeley, CO 80633

SECTION 2: HAZARDS IDENTIFICATION SUMMARY

KEEP OUT OF REACH OF CHILDREN –WARNING – May be fatal if inhaled. May be fatal if swallowed. Causes substantial, but temporary, eye injury. Causes skin irritation. Do not breathe spray mist. Do not get in eyes, on skin, or on clothing. Wear goggles or safety glasses. This product is an orange, viscous liquid with slight petroleum odor.

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Ingredients:	Percentage By Weight	CAS No.	TLV (Units)
Rotenone	5.00	83-79-4	5 mg/m3
Other Associated Resins	5.00		
Inert Ingredients, Including N-Methylpyrrolidone	90.00	872-50-4	not listed

SECTION 4: FIRST AID MEASURES

IF SWALLOWED: Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-900-858-7378 immediately for treatment advice. Do not induce vomiting unless told to do so by the Poison Control Center or physician. Do not give any liquid to the person. Do not give anything by mouth to an unconscious or convulsing person.

IF INHALED: Remove victim to fresh air. If not breathing, give artificial respiration, preferably by mouth-to-mouth. Call a physician, Poison Control Center, or the National Pesticide Information

Emergency Telephone Number: 1-800-858-7378

Revision Date: July 12, 2007

Center at 1-800-858-7378 immediately for treatment advice.

IF IN EYES: Hold eyelids open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.

IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin with plenty of water for 15-20 minutes. Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.

Note: Have the product container or label with you when obtaining treatment advice.

SECTION 5: FIRE FIGHTING MEASURES

Flash Point (Method Used): 192°F (89°C) (Closed Cup)

Flammable Limits: LFL: Not established
UFL: Not established

Extinguishing Media: CO_2, foam, dry chemical water spray.

Special Fire Fighting Procedures: Use self-contained breathing apparatus and full protective equipment. Fight fire from upwind from a safe distance and keep non-essential personnel out of area.

SECTION 6: ACCIDENTAL RELEASE MEASURES

SPILL/LEAK PROCEDURES: Wear protective clothing as described in Section 8 (Exposure Controls / Personal Protection) of this MSDS. Absorb liquid with material such as clay, sand, sawdust, or dirt. Sweep up and place in a suitable container for disposal and label the contents. Area can be washed down with a suitable solution of bleach or soda ash and an appropriate alcohol (methanol, ethanol, or isopropanol). Follow this by washing with a strong soap and water solution. Absorb any excess liquid as indicated above, and add to the disposal container. This product is extremely toxic to fish. Fish kills are expected at recommended use rates. Keep spills and cleaning runoff out of municipal sewers and open bodies of water.

SECTION 7: HANDLING AND STORAGE

HANDLING: Avoid inhalation of vapors. Harmful if swallowed, inhaled or absorbed through skin. Avoid contact with skin. Wear clean protective clothing. Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

STORAGE: Store in original containers only. Store in a dry place away from children and domestic animals. Do not store at temperatures below 40 F/4.4^{O}C. This product is stable for a minimum of 1 year when stored in sealed drums at 70^{O}F/21.1 $_{o}$C. Do not contaminate water, food or feed by storage or disposal.

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHS PELs (see section 3).
RESPIRATORY PROTECTION: When working with an undiluted product in a confined space, use a non-powered air purifying respirator equipped with an N–, R-, or P-series filter. For emergency or non-routine operations (cleaning reactor vessels or storage tanks), wear an SCBA"

Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **PROTECTIVE CLOTHING/EQUIPMENT:** Wear chemical-resistant gloves, boots, and aprons to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Viscous liquid
Appearance and Odor: Orange liquid with slight solvent odor.
Specific Gravity: 1.019 g/ml
Bulk Density: 8.506 lbs./gal.

Emergency Telephone Number: 1-800-858-7378

Revision Date: July 12, 2007

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid: None known.
Incompatibility: Strong acids and strong oxidizers.
Hazardous Decomposition Products: Oxides of carbon.
Hazardous Polymerization: Will not occur.

SECTION 11: TOXICOLOGICAL INFORMATION

Acute Oral LD_{50} (rat): 55.3 – 264 mg/kg
Acute Dermal LD_{50} (rabbit): >2020 mg/kg
Inhalation LC_{50} (rat): 0.048 mg/L (4 HR)
Eye Irritation (rabbit): Moderately irritating
Skin Irritation (rabbit): Moderately irritating
Skin Sensitization (guinea pig): Not a sensitizer
Carcinogenic Potential: Not listed by IARC, NTP, or OSHA. ACGIH lists Rotenone as TLV A4: Not classifiable as to human carcinogenicity.

SECTION 12: ECOLOGICAL INFORMATION

This product is extremely toxic to fish. Fish kills are expected at recommended usage rates. Consult local Fish and Game agencies before applying this product to public waters to determine if a permit is needed for such an application.

SECTION 13: DISPOSAL CONSIDERATIONS

Do not reuse empty containers. **Plastic:** Triple rinse (or equivalent), then offer for recycling, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. **Metal:** Triple rinse (or equivalent), then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by other procedures approved by state and local authorities. Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal law and may contaminate groundwater. Do not contaminate water, food or feed by storage or disposal.

SECTION 14: TRANSPORT INFORMATION

U.S DOT Shipping Description: Pesticide, Liquid, Toxic, N.O.S. (Rotenone), 6.1, UN2902, III, Marine Pollutant, ERG Guide 151Emergency Telephone Number: 1-800-858-7378

SECTION 15: REGULATORY INFORMATION

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) HAZARD RATINGS:

Category	Rating
Health	4
Flammability	2
Instability	0

0: Least
1: Slight
2: Moderate
3: High
4: Severe

SARA Hazard Notification/Reporting:
SARA Title III Hazard Category:
Immediate: Yes – Fire: No – Delayed: No – Reactive: No
Reportable Quantity (RQ) U.S. CERCLA: Not listed
SARA Title III, Section 313: N-methylpyrrolidone (CAS: 872-50-4) 10.0%
RCRA Waste Code: Not listed
California Proposition 65: WARNING: This product contains chemicals known to the State of California to cause cancer or birth defects or other reproductive harm.

SECTION 16: OTHER INFORMATION

Prepared by: ERR
Issue Date: July 12, 2007
Revision Notes: July 12, 2007
NOTE: *CFT Legumine is a Restricted Use Pesticide due to Aquatic Toxicity*

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, expressed or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state, and local laws and regulations.

Emergency Telephone Number: 1-800-858-7378

Revision Date: July 12, 2007

Appendix 10. Soldotna Creek drainage water quality data collected in 2006 and 2007.

Lake	Location: lat/long coordinates [a]	Measured parameters	2006 Jul	Aug	Sep	Oct	Nov	Dec	2007 Jan	Feb	Mar	Apr	May	Jun
Derks	60°31′45.6″N 151°01′47.6″W													
		Temperature (°Celsius)	12.95	12.33	10.93	6.25	3.85	3.27	3.30	3.20	3.61	4.23	7.50	11.20
		Specific Conductivity (S/cm)	0.75	0.07	0.06	0.04	0.05	0.06	0.06	0.07	0.07	0.27	0.05	0.06
		Disolved Oxygen (mg/L)	3.32	5.07	4.86	8.60	7.45	5.20	3.77	3.38	2.70	3.16	7.00	5.28
		pH	6.81	6.75	6.44	6.77	6.79	7.96	6.25	6.23	6.72	6.67	7.09	7.02
		Visibility (m)	2.4	2.3	1.5	1.2	1	n/a	1.5	1.6	1.2	1.9	0.9	1.3
		Ice thickness (in)					10.5	20	24	29	31	32		
East Mackey	60°31′84.9″N 151°59′41.4″W													
		Temperature (°Celsius)	17.93	14.86	11.87	5.46	3.96	3.57	3.43	3.33	3.60	4.78	8.43	12.36
		Specific Conductivity (S/cm)	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.07	0.06	0.05	0.05
		Disolved Oxygen (mg/L)	8.13	8.69	8.30	10.66	11.72	10.95	9.19	6.80	6.31	4.97	10.49	7.09
		pH	7.29	6.97	6.88	6.96	7.06	7.34	6.33	5.98	6.74	6.31	6.48	6.99
		Visibility (m)	4	3.3	2.2	2.4	1.5	2.6	2.5	3	3	2.8	1.5	3
		Ice thickness (in)					8.5	20	25	29	32	30		
Sevena	60°33′6.9″N 150°57′55.4″W													
		Temperature (°Celsius)	15.97	15.34	10.09	5.11	3.30	2.32	2.51	2.90	3.30	3.67	6.30	14.17
		Specific Conductivity (S/cm)	0.11	0.03	0.08	0.07	0.09	0.10	0.11	0.15	0.18	0.13	0.12	0.11
		Disolved Oxygen (mg/L)	6.15	7.29	8.39	9.52	9.27	8.56	3.28	2.20	1.55	3.33	8.12	10.60
		pH	7.60	7.79	7.47	7.53	7.67	7.48	7.99	7.50	8.87	7.71	7.23	8.23
		Visibility (m)	1.3	1.35	1.3	1.2	1	1.8	2	2	1.5	1.9	0.9	0.8
		Ice thickness (in)					12	20	23	26	32	32		
Union	60°31′25.1″N 151°58′04.1″W													
		Temperature (°Celsius)	16.86	12.70	10.44	5.05	4.03	3.22	3.18	3.58	3.44	4.58	7.73	11.64
		Specific Conductivity (S/cm)	0.03	0.00	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.08	0.04	0.04
		Disolved Oxygen (mg/L)	8.14	7.20	7.30	10.80	11.92	11.64	10.52	8.78	7.81	3.87	7.64	6.81
		pH	6.91	7.82	6.60	6.77	7.17	7.23	6.68	6.18	6.49	6.26	6.63	7.26
		Visibility (m)	3.3	3.2	2	2.3	2	1.75	2.4	2.3	2	2.4	1.5	n/a
		Ice thickness (in)					11.5	20	24	28	33	26		
West Mackey	60°31′89.1″N 151°00′52.6″W													
		Temperature (°Celsius)	18.92	14.53	11.52	5.01	3.90	3.18	3.36	3.15	3.50	4.72	9.00	14.45
		Specific Conductivity (S/cm)	0.09	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.64	0.06	0.03	0.03
		Disolved Oxygen (mg/L)	8.46	9.63	8.78	10.60	11.68	10.83	9.13	7.67	5.33	4.49	10.03	9.41
		pH	7.24	6.89	7.24	6.76	7.22	6.85	7.11	6.58	7.29	5.92	6.60	7.26
		Visibility (m)	2.8	2.4	2.5	2.4	1.5	ND	2.6	2.5	2.3	2.5	1.6	2.6
		Ice thickness (in)						20	24	27	30	32		

Appendix 11. Potassium permanganate material data safety sheet.

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MATERIAL SAFETY DATA SHEET

Potassium Permanganate

Section 01 - Chemical And Product And Company Information

Product Identifier ..... Potassium Permanganate, all grades

Product Use ..... Oxidizing & bleaching, disinifectant, deodorizer, remove iron & manganese from water, tanning, algicide, dye ingredient.

Supplier Name..... ClearTech Industries Inc.
2302 Hanselman Avenue
Saskatoon, SK. Canada
S7L 5Z3

Prepared By..... ClearTech Industries Inc. Technical Department
Phone: (306)664-2522

Preparation Date..... April 1, 2010

24-Hour Emergency Phone..... 306-664-2522

Section 02 - Composition / Information on Ingredients

Hazardous Ingredients.....	Potassium permanganate	97-100%
CAS Number.....	Potassium permanganate	7722-64-7

Synonym (s)..... Permanganic acid, potassium permanganate free flow NSF, potassium permanganate BP crystals NSF, potassium permanganate BP crystals, potassium permanganate free flow, Condy's crystals, permanganate of potash.

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Section 03 - Hazard Identification

Inhalation..... Excessive inhalation is irritating to the nose, throat, and upper espiratory tract. It may cause central nervous system depression, spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of over-exposure include burning, coughing, laryngitis, shortness of breathe, headache, nausea, and vomiting.

Skin Contact / Absorption..... Severe irritation or burns.

Eye Contact..... Severe irritation or burns. Usually where the chemical touches the eye a hardened, ulcer-like dark-brown injury develops. Swelling of the eyelid and conjunctiva as well as bleeding can occur. Permanent eye eye damage is possible.

Ingestion..... Ingestion causes burns to the mouth and throat and severe gastro-intestinal distress. Symptoms include nausea, vomiting, abdominal pain, a slowing of the pulse, and shock with a fall in blood pressure. Generally ingestion of concentrations up to 1% cause burning of the throat, nausea, vomiting, and abdominal pain. Ingestion of concentrations from 1% to 3% cause anemia and swelling of the throat with possible suffocation. Ingestion of concentration from 3% to 5% may cause kidney damage.

Exposure Limits..... OSHA/PEL= 5mg/m^3

Section 04 - First Aid Measures

Inhalation..... Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.

Skin Contact / Absorption..... Remove contaminated clothing. Wash affected area with soap and water. Seek medical attention if irritation occurs or persists.

Eye Contact..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention

Ingestion..... Call physician. If swallowed do not induce vomiting. If conscious give large amounts of water. Follow with diluted vinegar, fruit juice or whites of eggs beaten with water.

Additional Information..... Not available

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Section 05 - Fire Fighting

Conditions of Flammability..... Non-flammable. However, the product is a strong oxidizer and will give off oxygen when heated.

Means of Extinction..... Use water spray to blanket fire, cool fire exposed containers, and to flush nonignited spills or vapors away from fire. Suffocating type extinguishers are not as effective as water. Do not allow water runoff to enter sewers or waterways.

Flash Point..... Not applicable

Auto-ignition Temperature..... Not applicable

Upper Flammable Limit ..... Not applicable

Lower Flammable Limit..... Not applicable

Hazardous Combustible Products... Thermal decomposition yields oxygen and toxic fumes of manganese oxides.

Special Fire Fighting Procedures..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing. Potassium permanganate is a NFPA Class 2 Oxidizer, it will increase the burning rate or cause spontaneous ignition of combustible material with which in comes into contact.

Explosion Hazards..... Strong oxidants may explode when shocked, or if exposed to heat, flame, or friction. Also may act as initiation source for dust or vapor explosions. Contact with oxidizable substances may cause extremely violent combustion. Sealed containers may rupture when heated. Sensitive to mechanical impact.

Section 06 - Accidental Release Measures

Leak / Spill..... Wear appropriate personal protective equipment. Ventilate area. Stop or reduce leak if safe to do so. Prevent material from entering sewers. Soak up spill with absorbent material which does not react with spilled chemical. Put material in suitable, covered, labelled containers. Flush area with water. Shovel spilled solid into clean, dry, labelled containers and cover. Flush area with water.

Deactivating Materials..... Neutralize with dilute solutions of sodium sulphite, sodium metabisulphite, sodium bisulphite, or sodium thiosulphate.

Section 07 - Handling and Storage

Handling Procedures..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.

Storage Requirements..... Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage and moisture. Isolate from any source of heat or ignition. Avoid storage on wood floors. Separate from incompatibles, combustibles, organic or other readily oxidizable materials. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

Section 08 - Personal Protection and Exposure Controls

Protective Equipment

Eyes..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.

Respiratory..... None required where adequate ventilation exists. If airborne concentration exceeds the TLV by up to 10 times a half face particulate respirator is required. For airborne concentrations up to 50 times the TLV, a full face NIOSH approved dust/mist respirator is required. For higher levels or where the concentration is unknown a self contained breathing apparatus is recommended.

Gloves..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Clothing..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Footwear..... Impervious boots of chemically resistant material should be worn.

Engineering Controls

Ventilation Requirements..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure and control of process conditions should be provided. Supply sufficient replacement air to make up for air removed by exhaust systems.

Other..... Emergency shower and eyewash should be in close proximity.

Section 09 - Physical and Chemical Properties

Physical State	Solid
Odor and Appearance	Odourless dark purple to bronze crystals
Odor Threshold	Not applicable
Specific Gravity (Water=1)	2.70
Vapor Pressure (mm Hg, 20C)	Not available
Vapor Density (Air=1)	Not available
Evaporation Rate	Not available
Boiling Point	Not available
Freeze/Melting Point	Decomposes at approximately 240°C
pH	Not available
Water/Oil Distribution Coefficient	Not available
Bulk Density	166.8 lb/ft^3
% Volatiles by Volume	0% at 21°C
Solubility in Water	65g/L @ 20°C
Molecular Formula	$KMnO_4$
Molecular Weight	158.04

Section 10 - Stability and Reactivity

Stability	Stable under ordinary conditions of use and storage.
Incompatibility	Organic materials, combustible materials, reducing agents, strong acids, peroxides, alcohols, ammonium nitrate, ammonium perchlorate, dichloromethylsilane, antimony, arsenic, phosphorous, sulphur, titanium, carbon, iron salts, mercury salts, hypophosphites, hyposulphites, sulphites, oxalates, halides, hydrides, arsenites, and heat.

Hazardous Products of Decomposition.. Contact with hydrochloric acid liberates chlorine. Explodes when in contact with sulphuric acid, peroxides, nitric acid, alcohols, arsenic, phosphorous, sulphur, titanium, and anhydrides. Contact with other incompatibles results in ignition and rapid burning.

Polymerization..... Will not occur.

Section 11 - Toxicological Information

Irritancy..... Strong irritant or corrosive

Sensitization..... Repeated contact may cause sensitization in some individuals.

Chronic/Acute Effects..... Repeated intake of manganese compounds by ingestion & inhalation can result in chronic manganese poisoning characterized by impairment of the central nervous system. Early symptoms include sluggishness, sleepiness, and weakness of the legs. Advances cases show uncontrollable laughter, spastic gait, emotional disturbances, fixed facial expressions, and falling down while walking. A higher incidence of pneumonia has been found in workers exposed to some airborne managanese compounds. Men exposed to manganese dusts showed a decrease in fertility. Target organs: respiratory system, central nervous system, blood, and kidneys.

Synergistic Materials..... Not available

Animal Toxicity Data..... LD_{50}(oral,rat): 1090mg/kg

Carcinogenicity..... Not considered to be carcinogenic by IARC or ACGIH

Reproductive Toxicity..... May have adverse reproductive effects.

Teratogenicity..... Not considered a teratogen in "Dangerous Properties of Industrial Materials" 7th edition.

Mutagenicity..... Potassium permanganate caused mutations in several short-term tests involving bacteria and mouse cells.

Section 12 - Ecological Information

Fish Toxicity..... Not available

Biodegradability..... Not available

Environmental Effects..... Not available

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Section 13 - Disposal Consideration

Waste Disposal.....Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transportation Information

TDG Classification

Class..... 5.1

Group..... II

PIN Number..... UN 1490

Other..... Secure containers (full and/or empty) with suitable hold down devises during shipment.

Section 15 - Regulatory Information

WHMIS Classification.....C, E

NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.

NSF Certification.....Product is certified under NSF/ANSI Standard 60 for disinfection and oxidation at a maximum dosage of 50mg/L (note: only free flow and BP crystals that are labeled as NSF are certified).

Section 16 - Other Information

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

Attention: Receiver of the chemical goods / MSDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Material Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

If you have any questions or concerns please call our customer service or technical service department.

CLEARTECH

ClearTech Industries Inc. - Locations

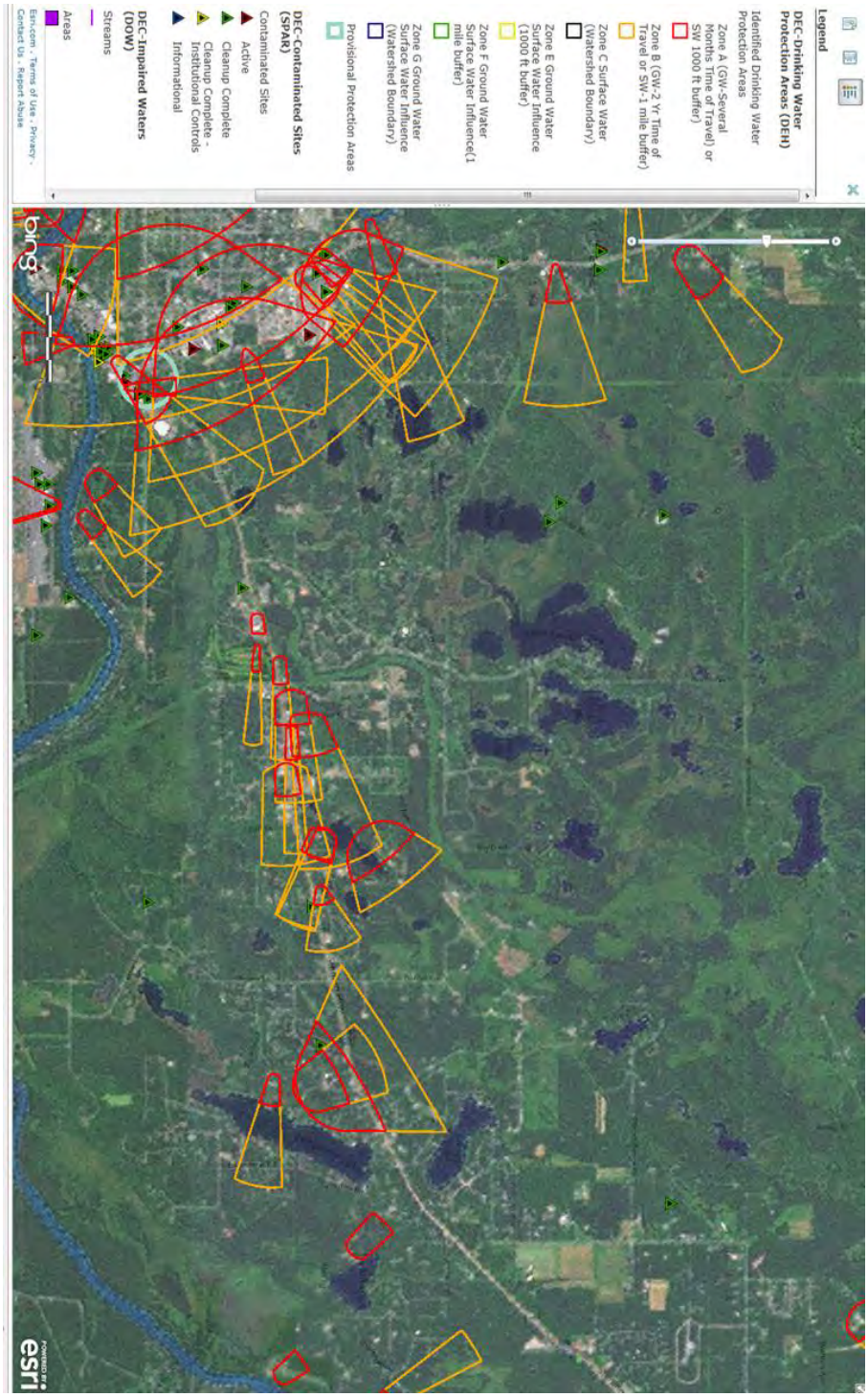
Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3
Phone: 306-664-2522
Fax: 306-665-6216

www.ClearTech.ca

Location	Address	Postal Code	Phone Number	Fax Number
Richmond, B.C.	12431 Horseshoe Way	V7A 4X6	604-272-4000	604-272-4596
Calgary, AB.	5516E - 40th St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton, AB.	11750 - 180th Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon, SK.	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282
Regina, SK.	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg, MB.	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga, ON.	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

24 Hour Emergency Number - All Locations - 306-664-2522

Appendix 12. Map of Department of Environmental Conservation (DEC) protected public drinking water sources near the Soldotna Creek drainage.



Appendix 13. Memo on groundwater risk for the Soldotna Creek drainage area.
Alaska DNR hydrologist summary for the Soldotna Creek drainage. Provided by Roy Ireland by email on Oct, 13, 2010.

I have reviewed the water rights for the Soldotna Creek area and have made copies of well logs for the same area. Both the list of water rights and the stack of well logs probably include some areas not pertinent to the study but, in all likelihood, they are not fully inclusive either. There are no water well drillers in the area who are in compliance with the state water well log requirements, so there are certainly many more wells in the area than the stack I was able to accumulate.

The area involved is substantially larger than that of the Denise Lake review - a simple scan of the sections covered shows it is at least 10 square miles and likely a third larger than that. There is quite a range in topography too, with some significant elevational changes as one moves through and across the basin. Given the range in elevations and a general lack of precision on the location of wells, it is difficult to fix any specific aquifers as the major producers for the area. A basic assumption is that the sediments are horizontal and area-wide in distribution; however, extensive glaciation and subsequent erosion has caused a degree of complexity.

There are numerous shallow wells (less than thirty feet); while a few may be active water wells, most are water quality monitoring piezometers. About 41% of the remaining wells are between 30 feet and 80 ft deep in depth and the next 41% takes it to about 140 ft deep. The final 20% of the wells are deeper than 140 ft, with only three over three hundred feet in depth. Elevational differences undoubtedly account for the differences in well depth and some features seen at depth in some logs appear to be much shallower in other logs.

As in the smaller, included, basin of Denise Lake, there are layers of mixed sands and gravels with some clay to a depth of 30 ft. These upper layers are followed by a series of clays, which change from yellow to grey in color, to about 45 ft: it appears that these clays act as a lower confining layer to the water table (the unconfined aquifer).

At about 45 feet, a series of cemented gravels is followed by multiple layers of sands and silts, reaching to a depth of about 160 ft. These layers are wet and constitute the upper confined aquifer in many areas. A substantial layer of blue clay at about 160 feet to 170 feet forms the lower confining layer for this sequence.

Another series of wet sands and gravels, some with silt, follows below the blue clay and forms a second confined aquifer. Increasing cementation appears to occur with greater depth - some well logs refer to a "sandstone". The lower confining layer for the aquifer is not well defined but may be another blue clay series at a depth of over 200 feet.

Some wells show a tendency flow from the top of the casing, i.e. "free flowing artesian wells". This demonstrates the positive head in both of the aquifers, as is further evidenced by the static water levels being well above the confining layers as shown on the well logs. Several natural springs are known to exist in the area, but it is unclear if they represent either the confined or the unconfined aquifers.

The source of recharge to the confined aquifers is probably quite remote and any local recharge to the unconfined water table most likely eventually drains into the lakes and creeks rather than infiltrating through the clays and deeper down to the confined aquifers. The existence of unknown faults and/or other geologic features could allow for intermingling of the various waters, but, normally, evidence would appear to reveal any such features.

It is possible that during the dryer periods, there could be losing reaches within the stream and the lake system that could discharge water to the water table; however, this determination would require extensive stream monitoring. Of similar concern, underwater springs that may lie on the lake beds could, under certain conditions, allow water to flow into the aquifers. Lakes should be monitored for the occurrence of springs (usually most visible as weak spots in the surface ice in winter); deeper lakes could be in connection with the confined aquifers, but I have no evidence of this.

This is a rather general review of the hydrology - any greater detail would require intensive study using tools (and software) I do not have access to. I believe that there is sufficient detail to show that the confined aquifers would be protected from surface effects of lake treatment. I would suggest that water testing be done prior to treatment, during the process and for a brief period after the treatment.

Other Issues:
1) There may be several regulated water utility services in the area. I suggest that DEC be contacted to see if they have any concerns regarding lake treatment.

2) There are no Water Rights issues because no water will be removed or redistributed.

3) Coastal Zone issues may arise, though I am not familiar with their procedures

4) Soldotna creek may not be a very large spawning creek, but it certainly provides substantial rearing habitat. Any overflow or outflow from a treated lake into the creek could have negative impacts and should be guarded against. I would suggest that any treatment be closely timed so as to avoid any breakup runoff or precipitation generated events.

This email has not undergone any peer review; a full hydrologic review would be both time and money intensive and is beyond our means at this time. For a more intensive investigation I would suggest that you either contact the USGS or a private hydrologic consultant.

Appendix 14. Estimated maximum rotenone concentration potential in the Kenai River resulting from Soldotna Creek discharge.

Minimum monthly mean Kenai River discharge estimaed from May through July, 2000-2012[a]	Estimated maximum Soldotna Creek discharge from May 15th through October, 2006[b,c]	Estimated rotenone concentration in the Kenai River after mixing with rotenone treated creek discharge
2561 cfs [d]	44.1 cfs	0.96ppb [d,e]

a Data source: http://waterdata.usgs.gov/ak/nwis/uv/?site_no=15266300&PARAmeter_cd=00065,00; downloaded on 8/9/13.

b Source: Massengill, R. L. 2011(b). Control efforts for invasive northern pike Esox lucius on the Kenai Peninsula, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 11-10, Anchorage. http://www.adfg.alaska.gov/FedAidpdfs/Fds11-10.pdf

c cfs= cubic feet per second

d ppb = parts per billion

e Calculation to derive estimate is from Finlayson et al. 2010

Appendix 15. Summary of the Best Management Practices (BMP's) to be utilized for alternative #4.

The following BMP's are practices that reduce contamination of water resources, mitigate non-target impacts and guide the use and handling of chemicals.

Treatment Timing

Timing the rotenone treatment for Area One to occur during October (cold water conditions) and shortly before ice-up will accomplish several things. First, cold water will slow the natural degradation of rotenone ensuring the pike population is exposed to the rotenone for the maximum amount of time and reduce the likelihood of failure and subsequent retreatment. This timing will coincide when water recreation is minimal and when waterfowl use in Area One has decreased significantly. A fall treatment should avoid killing adult wood frogs as opposed to a warm weather treatment when larval woods frogs are present which are far less tolerant to rotenone exposure.

The Area two treatments are scheduled for late spring early summer when, historically, water levels are at their lowest so less rotenone and potassium permanganate (KMNO4) is needed. Warm water temperatures should greatly accelerate the natural deactivation of rotenone and shorten the duration rotenone is present in the drainage. The early summer treatment will occur when most salmon smolt emigration is done and before adult salmon return to the drainage thus reducing the number of salmon exposed to rotenone.

Treatment Stages

Separating the rotenone treatments into distinct areas (Area One and Two) and not treating both areas in the same year will allow non-target organisms (invertebrates, amphibians, etc.) present in an untreated area to persist and serve as a source for recolonization in the treated areas.

Fish Rescue

A massive effort will begin in the spring of 2015 and will continue into 2016 to collect and relocate native fish from in Area Two (mainstem of Soldotna Creek, Sevena Lake and Tree Lake) to Area One to both restore lost native fish populations in Area One and avoid the complete loss of native fish present in Area Two.

Treatment Evaluation

Gillnetting conducted to verify the success of the rotenone treatments will be done under the ice to prevent the incidental take of birds. ADFG has invested much effort into evaluating the use of eDNA detection methods and plans to use this non-lethal technology to help assess the treatment success and reduce the dependency on gillnetting efforts.

Rotenone Deactivation

Rotenone is only required to be chemically deactivated if it leaves the treatment area in excess of 2.0 ppb. The Area One rotenone treatment is not expected to result in discharge of treated water outside of the treatment area in excess of 2.0ppm rotenone due to the effects of dilution and natural degradation. Regardless, ADFG will have a deactivation

station installed at the outlet of Area One (Derks Lake) so that $KMNO_4$ can be used to chemically deactivate the rotenone if needed. In addition, water will be impounded at Derks Lake for days or weeks following the Area One rotenone treatment. Impounding the water will allow the rotenone to significantly degrade from natural processes before leaving Area One.

A pair of deactivation stations will be installed near the terminus of Area Two (Soldotna Creek mouth) to deactivate rotenone before it can enter the Kenai River.. In addition, the effect of dilution, once Soldotna Creek mixes with the Kenai River, will render the rotenone below 2.0ppb, the level requiring chemical deactivation. Therefore the chemical deactivation stations provide an additional level of protection beyond what is required.

Aerial Application Guidelines

Aerial applications of rotenone to Area Two will adhere to EPA aerial application guidelines and ADEC pesticide application permit requirements. These guidelines and requirements include precautions that will be taken to minimize pesticide drift and increase safety as follows: not allowing the spray boom width to exceed 90% of the rotor blade diameter, spray release height will be at the lowest consistent with flight safety, swath path adjustments will compensate for crosswinds and no aerial applications will occur if wind is >12 mph and the use of low drift spray nozzles that apply a course spray and avoid fewer driftable fines. Finally, the helicopter pilot will be an ADEC- certified aerial pesticide applicator working from an enclosed cockpit using a GPS guidance system to aid in targeting and tracking of the application swaths.

Human Safety

Applicators and handlers working with undiluted rotenone and $KMNO_4$ are most at risk to chemical exposure. All applicators and handlers will undergo a half day safety training course provided by the project supervisor who is an ADEC certified pesticide applicator. PPE will always be worn by all applicators and handlers. The majority of the rotenone will be applied with boats equipped with semi-closed pump systems so direct handling of the rotenone is not needed. Signage will close public entry to waters being treated and signage will advise the public to avoid contact with treated water posttreatment until the rotenone is fully deactivated. First aid and spill response supplies will be onsite during the applications and emergency contact information readily available to all workers.

Spill Prevention

All offsite and onsite rotenone storage will utilize a spill containment system capable of containing all the product being stored. All overnight rotenone and $KMNO_4$ storage will be in an enclosed and locked area with appropriate signage posted. Mixing and/or transferring of all rotenone products will be done within a spill container. Spill response equipment and supplies will be close at hand during all rotenone applications. Applicators and handlers will be trained on spill and emergency response plans. All rotenone containers will be securely fastened during transport to avoid movement or tipping.

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