UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232

Refer to NMFS No: WCR-2018-9246

August 2, 2018

Mary D'aVersa, District Manager
Bureau of Land Management
Idaho Falls District
1405 Hollipark Drive
Idaho Falls, Idaho 83401

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Bureau of Land Management Salmon and Challis Field Offices 2018–2033 Integrated Weed Control Program; 17060204 - Lemhi River; 17060202 - Pahsimeroi River; 17060203 - Middle Salmon River/Panther Creek; 17060201 - Upper Salmon River; Custer and Lemhi Counties, Idaho

Dear Ms. D'aVersa:

Thank you for your letter of March 9, 2018, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for Salmon and Challis Field Offices 2018–2033 Integrated Weed Control Program. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

In this biological opinion (Opinion), NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of Snake River spring/summer Chinook salmon, Snake River sockeye salmon, and Snake River Basin steelhead. NMFS also determined the action will not destroy or adversely modify designated critical habitat for Snake River spring/summer Chinook salmon, Snake River sockeye salmon, and Snake River Basin steelhead. Rationale for our conclusions is provided in the attached Opinion.

As required by section 7 of the ESA, NMFS provides an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPM) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the Bureau of Land Management (BLM), and any permittee who performs any portion of the action must comply with to carry out the RPM. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

Helicopter applications of herbicides are covered under this Opinion. Aerial applications of herbicide formulations from fixed-wing aircraft were not included in the effects analysis, ITS, and conclusions for listed species and critical habitat in this Opinion; and, as such, are not exempt from ESA section 9 actions. If the BLM wishes to employ fixed wing aircraft for dispersing herbicides, additional information in the form of an aerial application plan detailing the herbicide formulations and quantities, type of aircraft, areas to be sprayed, spraying dates, and conservation measures designed to reduce spraying drift, prevent inadvertent contamination of riparian and aquatic ecosystems, and to monitor incidental take levels should be submitted to NMFS for additional consultation.

This document also includes the results of our analysis of the action's effects on EFH pursuant to section 305(b) of the MSA, and includes 10 Conservation Recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These Conservation Recommendations are a non-identical set of the ESA Terms and Conditions. Section 305(b)(4)(B) of the MSA requires federal agencies provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH Conservation Recommendations, the BLM must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many Conservation Recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, NMFS asks that you clearly identify the number of Conservation Recommendations accepted.

Please contact Kimberly Murphy, consulting biologist, in the Southern Snake Branch of the Snake Basin Office at (208) 756-5180, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

for Barry A. Thom
Regional Administrator

Enclosure

cc: L. Price – BLM
T. Kuck – BLM
S. Fisher – USFWS

bcc: SBAO – File copy; Read File; K. Murphy, B. Lind

Murphy:Lind:SCBLMWeedsBO:am:20180731:WCR-2018-9246

cc Addresses

Linda Price
Bureau of Land Management
Salmon Field Office Manager
lrprice@blm.gov

Todd Kuck
Bureau of Land Management
Challis Field Office Manager
tkuck@blm.gov

Sandi Fisher
U.S. Fish and Wildlife Service
sandi_fisher@fws.gov

Endangered Species Act Section 7(a)(2) Programmatic Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

Bureau of Land Management Salmon and Challis Field Offices 2018-2033 Integrated Weed Control Program; 17060204 - Lemhi River; 17060202 - Pahsimeroi River; 17060203 - Middle Salmon River/Panther Creek; 17060201 - Upper Salmon River; Custer and Lemhi Counties, Idaho (One Project)

NMFS Consultation Number: WCR-2018-9246

Action Agency: Bureau of Land Management, Salmon and Challis Field Offices

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Snake River Basin steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	No
Snake River spring/summer Chinook (*O. tshawytscha*)	Threatened	Yes	No	No
Snake River Sockeye Salmon (*O. nerka*)	Endangered	Yes	No	No

Fishery Management Plan that Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Issued By:

Michael Tehan (signature)
for Barry A. Thom
Regional Administrator

Date: August 2, 2018

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

ACRONYMS

a.e.	acid equivalent
a.i.	active ingredients
APHIS	Animal and Plant Health Inspection Service
ATV	All-Terrain Vehicle
BA	Biological Assessment
BLM	Bureau of Land Management
BMPs	Best Management Practices
CFO	Challis Field Office
CWA	Clean Water Act
CWMA	Cooperative Weed Management Area
DPS	Distinct Population Segment
DQA	Data Quality Act
EEC	Estimated Environmental Concentration
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
EUP	End Use Product
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GIS	Geographic Information System
GLEAMS	Groundwater Loading Effects of Agricultural Management Systems
GPS	Global Positioning System
HQ	Hazard Quotient
HUC	Hydrologic Unit Codes
ITS	Incidental Take Statement
IWM	Integrated Weed Management
lb/ac	pounds per acre
lb/gal	pounds per gallon
mg a.e./L	milligrams acid equivalent per Liter
mg/L	milligrams per Liter
MPG	Major Population Group
MIST	Minimum Impact Suppression Tactics
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSO	Methylated Seed Oil

MUP	Manufacturing Use Products
NA	Not Applicable
NISMS	National Invasive Species Management Systems
NMFS	National Marine Fisheries Service
NLAA	Not Likely to Adversely Affect
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observed Adverse Effect Levels
NOEC	No Observed Effect Concentrations
NEPA	National Environmental Policy Act
O.	*Oncorhynchus*
OHV	Off-Highway-Vehicle
OHWM	Ordinary High Water Mark
Opinion	Biological Opinion
PBF	Physical or Biological Features
PCE	Primary Constituent Element
POEA	Polyoxyethyleneamine
ppb	parts per billion
PUR	Pesticide Use Report
RPM	Reasonable and Prudent Measures
SERA	Syracuse Environmental Research Associates, Inc.
SFO	Salmon Field Office
SDS	Safety Data Sheet
TEA	triethylamine salt
TGAI	technical grade active ingredient
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Population
Washington State	Washington State Department of Ecology and Agriculture
WCR	Water Contamination Rates

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System [https://pcts.nmfs.noaa.gov]. A complete record of this consultation is on file at the Snake Basin Office, Boise, Idaho.

1.2 Consultation History

On March 14, 2018, NMFS received a letter from the Bureau of Land Management (BLM) requesting ESA consultation on the effects of the proposed 2018 to 2033 Integrated Weed Control Program. The biological assessment (BA) accompanying the BLM's consultation initiation letter and a June 26, 2018, email described the environmental baseline as well as weed management activities proposed for a 15-year period (2018 through 2033). The BA analyzed the potential effects of those activities on Snake River Basin steelhead, Snake River spring/summer Chinook salmon, Snake River sockeye salmon, and designated critical habitat for these species. The BLM determined the proposed action would be not likely to adversely affect (NLAA) these species and designated critical habitats. The BA also addressed effects to EFH for Snake River spring/summer Chinook salmon; determining the action may adversely affect EFH.

During pre-consultation discussions NMFS informed the BLM that NMFS could not concur with the NLAA determinations due to uncertainties regarding potential sublethal effects of herbicide active ingredients, unknown inert ingredients, and potential synergistic effects. After review of the consultation initiation package NMFS confirmed, by a March 28, 2018, letter, that adverse effects were likely to occur and notified the BLM that NMFS would be drafting an Opinion on the proposed action.

This Opinion is based on information provided in the BLM's February 2018, BA (BLM 2018) and other sources of information (e.g., meetings, emails, telephone calls, other NMFS consultation documents, end-use-product (EUP) labels, readily available literature, published environmental risk assessments, BLM National Environmental Policy Act (NEPA) decisions, etc.). A complete record of this consultation is on file at NMFS' Snake Basin Office in Boise, Idaho.

The BLM and NMFS, through the Salmon-Challis Level 1 Team process, have discussed the proposed action and four draft BAs since approximately August 10, 2017, when the first draft BA was received by NMFS. The following bullets provide a history of the consultation.

- NMFS received the first draft BA on August 10, 2017, and provided the BLM comments on August 19, 2017. Comments were discussed at the August 23, 2017, Salmon-Challis Level 1 Team meeting.

- A second draft BA was received on December 12, 2017. The BA format and content changed between drafts and no tracking of changes was provided. NMFS responded with comments on January 3, 2018.

- NMFS received the third version of the BA on January 25, 2018. NMFS again reviewed the draft and provided comments to BLM by email on February 6, 2018. The BLM changed their effects determination from a Likely to Adversely Affect to NLAA. NMFS indicated we were unlikely to concur that the action would be NLAA ESA-listed species or critical habitats and noted inconsistencies between the proposed action's scope and the effects analysis.

- A fourth and final draft BA, addressing all previous comments, was received by NMFS on February 12, 2018. NMFS provided minor comments to the BLM on February 15, 2018, and verbally indicated that the BA was ready to be submitted for consultation, recognizing that NMFS would not concur with the BLM's NLAA determinations and that all comments from NMFS needed to be addressed.

- The Salmon-Challis Level 1 Team discussed these comments and the BLM's weed monitoring and reporting plan with a follow-up meeting on February 23, 2018.

- The final BA and request for consultation was received March 14, 2018, and ESA consultation was initiated at that time.

- NMFS provided the BLM a 30-day review letter on March 28, 2018, formally documenting our inability to concur with the BLM's NLAA determinations and notifying the BLM that the Opinion would be complete prior to July 27, 2018.

- The BLM submitted supplemental information for the proposed action on June 26, 2018. In order to give NMFS time to incorporate this new information into this Opinion, NMFS and the BLM mutually agreed to extend NMFS' completion time for the Opinion by 1-week, to August 2, 2018.

The BLM's proposed Integrated Weed Control Program will likely affect tribal trust resources. As a result, NMFS contacted the Shoshone-Bannock Tribes pursuant to the Secretarial Order

(June 5, 1997). A copy of the draft proposed action, terms and conditions, and recommended conservation measures were sent to the Shoshone-Bannock Tribes on July 10, 2018, with a request for comments. NMFS did not receive any response.

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (50 CFR 402.02). Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). There are no interrelated or interdependent actions associated with this action.

This Opinion addresses the BLMs' proposal to authorize, fund, implement, and permit others to implement the Integrated Weed Management (IWM) program on public lands administered by the Challis Field Office (CFO) and the Salmon Field Office (SFO) to control noxious and invasive species. The BLM proposes a strategy that may include chemical, manual, mechanical, prescribed fire, and biological methods. The action also includes rehabilitation and restoration of treated sites and the addition of a research and demonstration component (if necessary). The CFO administers approximately 799,000 acres in Custer and Lemhi Counties, Idaho. The SFO administers approximately 493,000 acres in Lemhi County, Idaho. The consultation addresses weed control actions for the 2018 through 2033 field seasons.

The federal action agency is the BLM. The BLM is proposing the action according to its authority under the Federal Noxious Weed Act of 1974, as amended by section 15 of the Farm Bill, which requires that federal agencies establish integrated management systems to control undesirable plant species. The BLM is also implementing the proposed action in accordance with Executive Order 13112 regarding Invasive Species (February 3, 1999), which directs federal agencies to "detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner."

The proposed action described in the BA tiers to Section 7 Watershed BAs previously prepared for listed fish (including project addendums) as shown in Figure 1 (USFS 1999a-c, 2000; BLM 1993a-b, 1998, and 1999a-h); the Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement, 2007 (2007 PEIS; USDI-BLM 2007a, and corresponding NMFS 2007 (Opinion)); the Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report (PER; BLM 2007b), the Final Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on BLM Lands in 17 Western States Programmatic Environmental Impact Statement (BLM 2016; NMFS FPR-2015-9121), and BA for Vegetation Treatments using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States (BLM 2016). In addition, analysis in the Challis-Salmon Integrated Weed Control Program Environmental Assessment is incorporated herein by reference (2009 Challis-Salmon Weed EA; BLM 2009 and 2014 BLM Biological Assessment of 2014–2024 Riparian Noxious Weed Control Program for Federally Listed Fish Species; BLM 2014).

In addition to the BLM actions, point source discharges from pesticide applications to "waters of the United States," whether intentional or inadvertent, are required to have permit coverage under the U.S. Environmental Protection Agency's (EPA) Clean Water Act (CWA) National Pollutant Discharge Elimination System. Issuance of Pesticide General Permits by EPA are separate federal actions that have already been addressed under a programmatic section 7 consultation issued October 17, 2016 (NMFS tracking # FPR 2016/9154). Therefore, EPA's issuance of pesticide general permits related to the proposed action will not be discussed further in this Opinion.

The number of acres treated under the proposed action would vary from year to year, and more or fewer acres might be treated, depending on funding, inventories, and the variability in weed invasion dynamics. The total amount of acreage treated by herbicides annually would not exceed 20,000 acres for the two field offices combined; of this amount, no more than 10,000 acres would be treated aerially and no more than 5,000 acres of riparian[1] weed control would occur exclusively by using ground-based tactics. Further, no more than 25 percent of the acreage contained in each 6th field hydrologic unit code (HUC) would be treated annually. There could be up to a total of 400 acres/year of manual/mechanical treatment and up to 1,000 acres/year of biological control treatment within the two field offices (Table 1). Revegetation could occur on areas up to 50 acres.

The BA states that for the purposes of this analysis, treated acres represent the perimeter of the invasive species infestation area that had a treatment while applied acres are the actual amount of herbicide application. Broadcast methods of application have greater coverage of herbicide than do the more targeted method of spot spraying. A mix of broadcast and spot spraying would be assumed to have up to 40 percent of applied herbicide to the treated area. The assumption used in calculating applied acres is that broadcast methods would result in treated acres equaling applied acres and that spot spray methods could be as low as 10 percent applied acres. Therefore, the treated acres recorded each year will be an overestimate due to the multiple accounting for acres that are treated with more than one herbicide or for the acres in which spot or mixed broadcast/spot methods are used. Aerial herbicide applications will be accomplished with the use of small, highly maneuverable helicopters that can fly within less than 45 feet of the ground to deliver herbicide from a boom system. Application rates will be ultra-low volume (~2 gallons/acre). The helicopters will utilize real time, light bar positioning Global Positioning System (GPS) technology that is capable of targeting weed infestations with a high degree of accuracy and a low risk of drift to non-target plant species, and map treatment areas. Onboard technology can be used to check drift potential.

[1] The BLM's BA defined riparian areas in slightly different ways throughout the BA. NMFS completed the analysis using a combination of the definitions used in the BA to ensure completeness. For this consultation, NMFS interprets the term *riparian areas* as: Areas within 50 feet of live water or in annual floodplains where soil permeability is high (e.g., silt/loam and sandy soils); areas with soils over shallow water tables (e.g., supersaturated soils); and hydrologically connected wet ditches.

Table 1. Maximum Acres to be Treated Annually by Treatment Method.

Treatment Method	Treated Acres[1]
Biological Control	1,000 acres
Mechanical Control	400 acres
Herbicide Control	20,000 acres (total)
Ground Application	10,000 acres
Aerial Application	10,000 acres

[1]Total acres are treated polygons, not chemically treated acres. Totals are applicable to entire CFO and SFO.

1.3.1 Biological Control

Biological control will include the use of insects, pathogens, or other disease vectors of the target plant. Biological methods of vegetation treatment use living organisms to selectively suppress, inhibit, or control herbaceous and woody vegetation. Biological weed control activities include the release of insect agents which are parasitic and "host specific" to target noxious weeds. Biological control is not used to eradicate a weed species. Since this is a predator/prey relationship the goal is to reduce the target organism to a level considered manageable.

Commonly used biological agents used by the BLM include those for Dalmatian toadflax (*Linaria dalmatica*), leafy spurge (*Euphorbia esula*), rush skeletonweed (*Chondrilla juncea*), spotted knapweed (*Centaurea stoebe*), and Canada thistle (*Cirsium arvense*). As agents become approved for release against additional weed species, they will be considered for use as part of their integrated pest management program. This approval process is well regulated and includes specific input by U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS); USDA, Agricultural Research Service; U.S. Fish and Wildlife Service (USFWS); and other agencies. Before being approved for release, potential biological control agents are well studied and tested to ensure they are host specific and will not move to off-target plant species.

1.3.1.1 Biological Treatment Design Criteria

- The BLM shall obtain an APHIS Permit to Move Live Plant Pests, Noxious Weeds, or Soil for biological agents when they are being transported across state lines.
- The BLM shall only use APHIS and State of Idaho/Utah-approved biological control agents.
- To the extent practicable, the BLM will collect biological control agents locally or from areas with similar climatic and weather conditions, land and soil types, and cover types to maximize successful establishment.
- Biological control agents will be distributed at the optimal season and life-cycle stage for successful short-term establishment. Quantities sufficient to optimize successful short-term establishment will be distributed.

- For those agents that self-disperse poorly, their distribution will be actively assisted throughout target infestations by redistribution (i.e., collecting and moving the agent to new locations).

1.3.2 Manual and Mechanical Control

The term “manual” defines treatments such as hand pulling or using hand tools, such as hand clippers, hoes, rakes, shovels, etc., to remove plants or cut off seed heads. The term “mechanical” refers to the use of equipment and power tools, including actions like mowing, torching (using a propane burner to kill invasive plants with heat), and weed whipping. Mechanical and manual treatments are used to physically destroy, disrupt growth, or interfere with the reproduction of noxious and invasive non-native weeds. This component of the noxious weed control program includes the use of hand-operated power and hand tools in the manual control of noxious weeds. Treatments can be accomplished by hand, hand tool, or power tool; and may include pulling, grubbing, digging, hoeing, tilling, cutting, mowing, and mulching of weeds. In manual treatments, workers primarily cut plants off above the ground level and may also pull, grub, or dig out plant root systems. Mechanical treatment also could include burning weeds with a propane torch. The BLM does not currently use or propose to use chaining or disking as a method to control non-native invasive plant species.

Mechanical treatments will be used on a limited basis, primarily to control individual plants or very small, isolated infestations of weeds. Larger infestations of weeds are very difficult to control with mechanical treatment. Furthermore, steep slopes and rocky soils prohibit or limit the use of many mechanical treatment activities.

1.3.2.1 Best Management Practices for Manual and Mechanical Treatment Methods

- Minimize soil disturbance as much as possible to minimize germination of invasive plant seeds and bare soil.

- Avoid non-target species damage to the extent practicable. Select mechanical methods to effectively control the target species (e.g., grubbing/hoeing is inappropriate for rhizomatous species and may increase the density of the invasive plant population as root fragments sprout and become new plants).

- Apply mechanical treatments at the proper stage of plant growth when treatment will be most effective at controlling the target invasive plant.

- Thoroughly inspect and clean all equipment and clothing to remove invasive plant seeds or vegetative propagules to prevent the movement of the invasive plant to another site.

- To the extent practicable, conduct clipping and removal of seed stalks prior to seed maturity to reduce inputs to the seed bank or when seeds are easily picked up and transported by vectors such as wind, humans or animals.

- Specific to aquatic invasive plants, hand-pulling and/or smothering may be used when an infestation is very limited in extent and occurs close to the shoreline of a waterbody, but has not yet infested deeper waters.

- Mechanical treatments should not occur on any slopes where excessive erosion to waterbodies (e.g., slope fall lines to lakes, streams, etc.) and resource damage will occur. Proper erosion control techniques will be utilized on steep slopes to prevent excessive erosion and resource damage from occurring.

- When working in watersheds with ESA-listed species, mechanical ground disturbing activities will not be conducted adjacent to or within riparian areas during the spawning season.

- A 25-foot vegetative buffer will be maintained next to live water to leave ground cover intact and prevent erosion into streams or adjacent waterbodies.

- Limit mechanical treatments to power tools that do not disturb the ground when working within 25 feet of streambanks, or floodprone areas along lakes, ponds, springs, and seeps.

1.3.3 Herbicide Application

Chemical herbicides and associated adjuvants are applied to target plants under this method. The BLM proposes using ground-based or aerial application of herbicides, depending on: (1) Treatment objective and priority of the target invasive plant species; (2) accessibility, topography, and size of the treatment area; (3) the expected efficiency and effectiveness of the method selected; (4) the risk for spread or invasion into other locations; and (5) the potential to harm priority habitats and vegetation complexes such as those associated with threatened, endangered, or sensitive species. Herbicides are extensively screened and tested before they are approved and registered for use by the EPA.

Herbicide labels contain information on the proper administration of each herbicide, including the following: (1) A list of the ingredients; (2) an EPA registration number; (3) precautionary statements (hazards to humans and domestic animals, personal protective equipment, user safety recommendations, first aid, and environmental hazards); (4) directions for use, storage, and disposal; (5) mixing and application rates; (6) approved uses and inherent risks of use; (7) limitations of remedies; and (8) general information.

Proposed herbicide application methods include:

- **Spot spraying –** This method targets individual plants and the immediate area around them. Most spot spraying is usually done with a backpack sprayer. However, spot spraying may also be applied using a hose from a truck-mounted or off-highway vehicle (OHV) mounted tank, or tanks mounted on pack animals. This is the most common herbicide application method.

- **Broadcast –** Herbicide is applied to cover an area of ground rather than individual plants. This method may employ a spray system mounted on a truck or OHV. Broadcast applications are used in areas where invasive plants occupy a large percentage of plant cover on the site, making spot spraying impractical.

- **Wicking/Wiping/Injecting** – This method will be used when targeting invasive species such as Russian Olive (*Elaeagnus angustifolia*) trees. Most wicking/wiping/injecting would take place on stumps after trees were cut to prevent trees from re-sprouting.

- **Aerial application -** This method will be used in areas where physical features, such as topography, restricted access, size and/or rate of infestation spread, personnel safety, or other factors (such as prohibitive cost of ground application) occur. Only helicopter applications are proposed.

Herbicide formulations and mixtures could contain one or more of the 15 active ingredients displayed in Table 2. The range of application rates for each chemical is derived from Human Health and Ecological Risk Assessments and from the herbicide label. Additional herbicides may be added in the future at either the Land Use Plan Level or project level, through appropriate risk analysis, NEPA procedures, and ESA consultation (discussed in BLM 2018 BA). Table 3 provides specific buffers for individual active ingredients, environmental conditions, and types of waterbodies potentially encountered within the action area during ground-based applications. These buffers and plans are critical measures to minimizing potential exposure of ESA-listed fish and their habitats.

The BLM CFO and SFO propose to use only Washington State aquatic-certified adjuvants in riparian areas or in aerial applications in watersheds with ESA-listed fish. Table 4 lists currently approved additives and adjuvants (i.e., ingredients that improve herbicide effectiveness) available for use on BLM-administered lands in Idaho that have met this aquatic certification. The intent of Table 4 is not to limit the BLM's use to only the product names displayed. Review of new formulations/EUPs by the Salmon-Challis Level 1 Team will only be required where the active ingredients and maximum application rates are inconsistent with those already described in this proposed action.

Table 2. Proposed herbicides and application settings for use on BLM-administered land within the Challis and Salmon field offices.

Herbicide	Commonly Used Brand Names[a]	Maximum Application Rate (a.i. or acid equivalent [a.e.]/acre)	Typical Application Rate (pounds [lbs] a.i. or a.e. acre)	General Location		
				Vegetation - Away From water (>50 feet)	Vegetation - Near Water (<50 feet)	Aerial Delivery
2,4-D amine	Amine 4, Weedar® 64	2.0 lb a.e./acre/app 4.0 lb/ae/acre/year	1.0–2.0 lb a.e./ac	X	X	X
Aminopyralid	Milestone®	0.11 lb a.e./acre/year	0.078–0.11 lb a.e./ac	X	X	X

Herbicide	Commonly Used Brand Names[a]	Maximum Application Rate (a.i. or acid equivalent [a.e.]/acre)	Typical Application Rate (pounds [lbs] a.i. or a.e. acre)	General Location		
				Vegetation - Away From water (>50 feet)	Vegetation - Near Water (<50 feet)	Aerial Delivery
Chlorsulfuron	Telar®	0.02 product/acre/year (0.12. lb a.i./acre/year)	0.01–0.02 lb a.i./ac	X		
Clopyralid	Transline®	0.5 lb a.e./acre/year	0.1–0.5 lb a.e./ac	X	X	
Dicamba	Banvel®	1.0 lb a.i./acre/app 2.0 lb a.i./acre/year	0.5–2.0 lb a.i./ac	X		
Fluroxypyr	Vista® XRT®, Starane®, Spotlight®	0.5 lb a.e./acre/year	0.25 lb a.e./ac	X		
Glyphosate[b]	Rodeo®, Roundup®, Accord®	1.7 lb a.e./acre/app 4.0 lb a.e./acre/year	0.5–3.0 lb a.e./ac	X	X	X
Imazapic	Plateau®	0.1875 lb a.i./acre/year	0.09–0.16 lb a.i./ac	X		X
Imazapyr	TVC Total, Habitat, Vegetation Control®, Assault®, Chopper®, Arsenal®	1.5 lb a.e./acre/year	1.0 lb a.e./ac	X	X	
Metsulfuron-methyl	Escort®	0.15 lb a.i./acre/year	0.01–0.02 lb a.i./ac	X		
Picloram	Tordon™	1.0 lb a.i./acre/year	0.25–1.0 lb a.i./ac	X		
Rimsulfuron	Matrix®	0.0625 a.i./acre/year	0.0469-0.0625 a.i./ac	X		X
Sulfometuron methyl	Oust Weed Killer® DPX 5648	0.03–0.281 lb a.i./acre/app 0.03–0.38 lb a.i./acre/year	0.09–0.38 lb a.i./ac	X		
Triclopyr TEA: triethylamine salt	Element 3A®, Garlon 3A®	2.0 lb a.e./acre/year	1–2.0 lb a.e./ac	X	X	

[a] List represents brands most commonly used, although brands other than those listed may also be used.
[b] Formulations containing the Polyoxyethyleneamine (POEA) surfactant (i.e., Roundup® and similar products) are not proposed <100 feet from water.

Table 3. Herbicide application buffer widths near water for ground based applications (Perennial Streams and Wetlands, and Intermittent Streams, Roadside Ditches with flowing or standing water present) in feet from ordinary high water mark (OHWM) by application methods.

Herbicide	Broadcast Spraying	Focused Spot Spraying[b]	Hand Selective[c]	Comments
Labeled for Aquatic Use				
Aquatic Glyphosate	>50	OHWM	OHWM	Aqua Neat, Aquamaster, Glyphos Aquatic, Rodeo with no surfactants
Aquatic Imazapyr	>50	OHWM	OHWM	
Aquatic Triclopyr-	>50	OHWM	OHWM	
Aquatic 2,4-D	>50	OHWM	OHWM	
Low Risk to Aquatic Organisms				
Aminopyralid	>50	OHWM	OHWM	
Dicamba	>50	>50	>50	Using 1 pound per gallon (lb/gal) application rate with appropriate label restrictions
Fluroxypyr	>50	>50	>50	
Imazapic	>50	>50	>50	
Clopyralid	>50	>50	>50	
Metsulfuron-methyl	>50	>50	>50	
Rimsulfuron	>50	>50	>50	
Moderate Risk to Aquatic Organisms				
Dicamba	>50	>50	>50	Using 4 lb/gal application rate with appropriate label restrictions such as Banvel
Sulfometuron-Methyl	>50	>50	>50	
Chlorsulfuron	>50	>50	>50	
High Risk to Aquatic Organisms				
Glyphosate	>100	>100	>100	Roundup or other formulations with POEA
Picloram	>50	>50	>50	

[a] Riparian ecosystems are transitional areas between terrestrial and aquatic ecosystems adjacent to streams, lakes, wetlands, springs and reservoirs. These areas exhibit vegetation, soils or physical characteristics reflective of free water at or near the surface. The riparian areas are defined as those portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. The riparian areas include traditional riparian corridors, wetlands, intermittent headwater streams, and other areas where proper ecological functioning is crucial to maintenance of the stream's water, sediment, woody debris, and nutrient delivery systems (USFS and BLM 1995).

[b] Focused Spot spraying – hand held nozzles attached to back pack tanks or vehicles and hand pumped sprayers to apply herbicide directly onto small patches or individual plants.

[c] Hand Selective – wicking, wiping, basal bark, hack & squirt, stem injections – all on individual plants.

Table 4. Approved Additives and Adjuvants.

Type	Product Name	Company	EPA Registration Number
Surfactant			
Non-Ionic	*LI-700	Loveland Products Inc.	CA Reg. No. 34704-50035 WA Reg. No. AW36208-70004
	*Spreader 90	Loveland Products Inc.	WA Reg. No. 34704-05002-AA
Spreader/Sticker	*Bond	Loveland Products Inc.	CA Reg. No. 36208-50005
	*Tactic	Loveland Products Inc.	CA Reg. No. 34704-50041-AA
Silicone Based	*Dyne-Amic	Helena	CA Reg. No. 5095-50071-AA
	*Kinetic	Setre (Helena)	CA Reg. No. 5905-50087-AA
Oil-based			
Crop Oil Concentrate	*Agri-Dex	Helena	CA Reg. No. 5905-50094-AA
Methylated Seed Oil (MSO)	*MSO Concentrate	Loveland Products Inc.	CA Reg. No. 34704-50029-AA
Vegetable Oil	*Competitor	Wilbur-Ellis	CA Reg. No. 2935-50173
Fertilizer-based			
Nitrogen Based	*Bronc Max	Wilbur-Ellis	NA
	*Bronc Plus Dry	Wilbur-Ellis	WA Reg. No.2935-03002
Special Purpose or Utility			
Colerants	Hi-Light	Becker-Underwood	NA
	Hi-Light WSP	Becker-Underwood	NA
	Marker Dye	Loveland Products Inc.	NA
	BullsEye	Milliken Chemical	NA
	Signal	Precision	NA
Deposition Aid	*Cygnet Plus	Brewer International	CA Reg. No. 1051114-50001
	*Liberate	Loveland Products Inc.	CA Reg. No. 34704-50030-AA
Water Conditioner	*Cut-Rate	Wilbur-Ellis	WA Reg. No. 2935-06001

*Indicates Washington State Department of Ecology and Agriculture (Washington State) approved aquatic surfactant.

1.3.3.1 Design Criteria for Herbicide Application

The proposed design criteria described here and in the consultation initiation package as parts of the proposed action are intended to reduce or avoid potential adverse effects on aquatic ESA-listed species and their habitats. NMFS regards the following Best Management Practices (BMP) (including Table 5) as integral components of the proposed action and expects that all proposed project activities will be completed consistent with these practices. We have completed our effects analysis accordingly. Any deviation from these practices will be beyond the scope of this consultation and further consultation will be required to determine what effect a modified action may have on ESA-listed species or designated critical habitats. Chemical control methods pose the greatest risk to aquatic ESA-listed resources and receive more attention in the BMP than the other treatment methods. A complete list of BMP can be found in the BA.

- The BLM will follow established guidelines and BMPs as stated in: (1) BLM Manual 9011, Chemical Pest Control; (2) BLM Manual Handbook H-9011-1; (3) Final Environmental Impact Statement, Vegetation Treatment on BLM Land in Thirteen Western States, May 1991; (4) BLM Challis Salmon Integrated Weed Control Program Programmatic EA, 2008; (5) Final Vegetation Treatments Using Herbicides on Bureau of

Land Management Lands in 17 Western States Programmatic Environmental Impact Statement, 2007 (2007 PEIS; USDI-BLM 2007a, and corresponding NMFS Opinion); (6) Bureau of Land Management Vegetation Treatments using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States 2015 Consultation; and (7) 2018 BA of Challis-Salmon Integrated Weed Control Program.

- Typical application rates are most commonly used within the action area and are on average significantly less than maximum rates.

- Applicators will be required to review, understand, and conform to the "Environmental Hazards" section on the herbicide label. This section warns of known pesticide risks to the environment and provides practical ways to avoid harm to organisms or to the environment.

- Applicators will avoid accidental direct spray and spill conditions to reduce the largest potential impacts.

- A certified/licensed pesticide applicator will be oversee all spray projects onsite.

- A spill cleanup kit will be available whenever pesticides (herbicides) are transported or stored. The typical application rate will be used rather than the maximum application rate to reduce potential risk to most species for most herbicides.

- Herbicide will be applied to the smallest area possible to achieve control of the target species.

- All approved herbicides will be handled and applied in strict accordance with all label restrictions and precautions, as well as applicable BLM Policy. In instances where herbicide labels, federal, or state stipulations overlap, the more restrictive criteria will be adhered to. Selection of an herbicide for site-specific weed control will depend on its effectiveness on a particular weed species, success in previous similar applications, habitat types, soil types, and nearness of water and private property.

- A spill contingency plan will be developed prior to all herbicide applications. Individuals involved in herbicide handling or application will be instructed on the spill contingency plan and spill control, containment, and cleanup procedures.

- During application, weather conditions will be monitored by trained personnel at spray sites (i.e., wind speed, temperature, and relative humidity). Additional weather and application monitoring will occur whenever a weather change may impact safe placement of the herbicide on the target area.

- All pesticide labels will be strictly enforced.

- A combination of herbicides may be used when it is determined that this is the most effective way to control multiple weed species, or when mixing of herbicides are more effective on weed species. All herbicide combinations will conform to label guidelines for mixing.

- Table 5 will be referred to for maximum wind speed restrictions by herbicide application method.

- Do not spray if precipitation is occurring or is imminent (within 24 hours).

- Do not spray if air turbulence is sufficient to affect the normal spray pattern.

- Do not spray if snow or ice covers the target foliage.

- Do not broadcast spray within 100 feet of open water when wind velocity exceeds 5 miles per hour (mph).

- No carrier other than water will be used.

- Annual Operating Plans for noxious weed control on public lands will integrate PACFISH/INFISH Riparian Management Objectives, standards and guidelines; RA-3, RA-4, RA-5, WR-2, WR-3, WR-4, FW-l.

- A 150-foot buffer from live waters, riparian areas (i.e., possessing vegetation consistent with hydric soils), or soils over shallow water tables (i.e., supersaturated soils) is required for use of any upland herbicide with a soil half-life greater than 365 days. Expiration of the soil half-life is required prior to repeated treatment of the area with the same upland herbicide.

- Sampling of aerial spray projects may be accomplished through the use of spray cards, dye or other type of indicator. The purpose of this monitoring will be to validate buffer effectiveness for riparian areas and water edges. Findings from these indicators will be included with the annual monitoring results.

- Aerial spray units (and perennial seeps, ponds, springs, and wetlands in proposed aerial units) will be identified prior to spraying to ensure only appropriate portions of the unit are aerially treated. A GPS will be used in spray helicopters and each treatment unit will be mapped before the flight to ensure that only areas marked for treatment are treated. Drift monitoring cards may be placed within 300 feet from and perpendicular to perennial streams to monitor levels of herbicide drift.

- Aerial application equipment will be designed to deliver a median droplet diameter of 300 to 800 microns. This droplet size is large enough to avoid excessive drift while providing adequate coverage of target vegetation.

- A maximum of 20,000 acres will be treated annually not to exceed 10,000 acres aerially and no more than 5,000 acres treated within riparian habitats utilizing ground based methods.

- No more than 25 percent of total acreage within each 6th field HUC will be treated annually, with no more than 1000 acres treated in riparian areas.

- In order to prevent herbicide and adjuvants from entering water: (1) Local weather conditions will be checked daily; (2) site-specific conditions will be monitored during herbicide application; (3) the most suitable herbicide and adjuvant (as appropriate) combinations for the setting will be selected and applied at the lowest effective use rates; (4) spot-spraying techniques will be employed in riparian areas; (5) herbicides will be applied at low pressure; (6) the largest appropriate nozzle size and other appropriate equipment will be used; (7) drift control agents will be added where necessary; and (8) directional application techniques will be used to direct herbicide away from water.

- Only Washington State aquatic-certified adjuvants will be used in riparian areas.

- Only Washington State aquatic-certified adjuvants will be used in aerial applications in watersheds with ESA listed fish (Table 4).

- All colorants used will be non-toxic, water-soluble, liquid formulations.

- Within 300 feet of wetlands or riparian areas, do not fuel/refuel aerial equipment, store fuel, or perform equipment maintenance (locate all fueling and fuel storage areas, as well as service landings outside of protected riparian areas).

- Equipment used for transportation, storage, or application of chemicals shall be maintained in a leak proof condition.

- Dye (non-toxic, water-soluble liquid formulations) will be used in all riparian spray treatments.

- No herbicide mixing will be authorized within 100 feet of any live waters. Mixing and loading operations must take place in an area where an accidental spill will not contaminate a stream or body of water before it can be contained.

- Within 25 feet of live waters or areas with shallow water tables, only approved riparian herbicides (Table 5) will be used; appropriate methods of control include backpack sprayer, hand pump sprayer, wicking, wiping, dripping, painting, or injecting.

- Only ground based spot/selective applications of herbicides rated as having a low or moderate risk level for aquatic species (Table 5) will be authorized for use 25 to 50 feet from live waters. Authorized spray equipment will include vehicle mounted spray rigs (hand-held sprayer only), backpack sprayer, hand pump sprayer, and wicking (e.g., also includes wiping, dipping, painting, or injecting target species).

- Herbicide applications will be implemented in a manner to avoid off site movement of herbicides either through the air, through soil, or along the soil surface. Project site terrain, soil type, and vegetation would be taken into consideration when selecting herbicide type, application method, and application timing.

- All applicators will comply with safety requirements, including personal protective equipment, spray equipment, herbicide labels and rates, and environmental concerns. All contractors and county agreement applicators are responsible for the cleanup of hazardous materials released on public lands, if they are at fault. All weed control efforts done by BLM personnel or their authorized agents will be done in accordance with the applicable Safety Plan and the Storage, Transportation and Spill Contingency Plans. Emergency response kits and trained personnel will be available and onsite whenever herbicides are transported or stored.

- Aerial herbicide application will not occur over areas with >30 percent live tree canopy cover.

- Make helicopter applications at a target airspeed of 40 to 50 mph and less than 45 feet above ground.

- Manual control (e.g., hand pulling, grubbing, cutting, etc.) is authorized in all areas, and may be used in sensitive areas to avoid adverse effects to non-target species or water quality. All noxious weed disposals will be in accord with proper disposal methods.

- Hydrologically connected roadside ditches, which occur within the 50-foot riparian buffer, will only be treated with approved riparian herbicides (Table 5). If a hydrologically connected ditch is wet it will be treated as a riparian area and only approved riparian herbicides can be used for treatments; hydrologically connected roadside ditches will not be sprayed for at least 24 hours before a predicted rain event (high probability from current forecast).

- Disking, plowing, or blading will not occur within appropriate buffer zones surrounding riparian areas as decided by an Interdisciplinary Team. Distances identified for PACFISH/INFISH will be followed when determining buffer zone width.

- Soils that are fully saturated will not be disturbed or only minimally disturbed.

- In locations adjacent to streams where sediment has been identified, through the Total Maximum Daily Load process, as an instream pollutant, an Interdisciplinary Team will determine whether additional BMP for erosion control will be required.

- No spraying of picloram will be authorized within 50 feet of any live waters or in areas with shallow water tables.

- Drafting equipment will be equipped with back siphoning prevention devices.

- If it is necessary to use boats to reach a treatment area, the only mixed herbicides to be transported over water will be those that do not contain picloram. Picloram will only be transported in an appropriately sealed and labeled container, and will be mixed >100 feet from live or seasonal waterways. Extreme caution will be used while loading and unloading herbicides and spray equipment to minimize the potential for contamination of the water. Herbicides will be transported in water-tight, floatable containers. When possible, the boat will be grounded before loading or unloading at the destination.

- Aquatic formulations of 2,4-D amine, glyphosate, aminopyralid, imazapyr, and triclopyr TEA shall be used within 50 feet of live water.

- No aerial application will take place within the following buffers:

    - 300 feet – threatened and endangered fish streams,

    - 300 feet – fish bearing waters,

    - 300 feet – perennial, non-fish bearing waters,

    - 300 feet – intermittent stream channels with live water, and,

    - 300 feet – ponds, lakes, springs, wetlands.

1.3.3.2 Additional Conservation Recommendations

The following recommendations originated from a previous NMFS' consultation with the BLM (NMFS No. 2008/01894) and were presented in the BA as measures BLM staff should do during implementations. How often these measures will be employed is unknown. For that reason, we assume these measures will not be implemented in all applications despite the intent being to do so as often as possible.

1. The BLM shall use herbicides with the least toxicity to ESA-listed fish and other non-target organisms whenever possible.

2. The BLM shall investigate the utility of alternative forms of weed control that do not involve the use of chemicals toxic to aquatic organisms.

3. The applicator should only use surfactants or adjuvants in riparian areas where the effects of the ingredients have been tested on salmonids and have been found to be of low toxicity and the products do not contain any ingredients on the EPA's List 1 or 2.

4. The BLM shall use added precaution when applying herbicides near streams or along roadside ditches within riparian areas. Herbicides containing glyphosate without surfactants or toxic additives, such as Rodeo®, shall be the product of choice under appropriate site conditions. Where glyphosate is not appropriate, 2,4-D amine salt may be used near streams and ditches.

Table 5. Buffers, maximum wind speed, application methods, and herbicide restriction associated with aquatic habitats, riparian areas, and wetland resources.

Buffer	Max. Wind Speed	Application Method	Herbicides Authorized
<25 feet from live water	5 mph	Backpack sprayer, hand pump sprayer, wicking, wiping, dipping, painting, injecting	Aquatic Formulation of: 2,4-D Amine Glyphosate Triclopyr Imazapyr Safe to the Water's Edge: Aminopyralid Only Washington State approved aquatic adjuvants/surfactants as identified in Table 4 Dye is required
25-50 feet from live water	8 mph	Ground based spot spraying (all-terrain vehicle (ATV)/OHV, backpack, hand sprayer)	Aquatic Formulation of: 2,4-D Amine Glyphosate Clopyralid Imazapyr Triclopyr Aminopyralid Only Washington State approved aquatic adjuvants/surfactants as identified in Table 4 Dye is required
>50 feet from live water	10 mph	Ground based spot spraying (ATV/ OHV, backpack, hand sprayer)	BLM approved herbicides identified in Table 2* and adjuvants identified in the BA Appendix A, Table A-1.
>50 feet from live water	5 mph	Ground based broadcast boom spraying (ATV/ OHV, truck)	BLM approved herbicides identified in Table 2* of this Opinion and adjuvants identified in Appendix A, Table A-1.
>100 feet from live water	10 mph	Ground based broadcast boom spraying (ATV/ OHV, truck)	BLM approved herbicides identified in Table 2 and adjuvants identified in Appendix A, Table A-1.
>300 feet from intermittent stream channels and hydrologically connected ditches	5 mph	Aerial application	2,4-D amine Aminopyralid Glyphosate Imazapic Rimsulfuron Only Washington State approved aquatic adjuvants/surfactants as identified in Table 4

Buffer	Max. Wind Speed	Application Method	Herbicides Authorized
>300 feet from ponds, lakes, reservoirs, springs and wetlands	5 mph	Aerial application	2,4-D amine Aminopyralid Glyphosate Imazapic Rimsulfuron Only Washington State approved aquatic adjuvants/surfactants identified in Table 4
>300 feet from perennial non-fish bearing waters	5 mph	Aerial application	2,4-D amine Aminopyralid Glyphosate Imazapic Rimsulfuron Only Washington State approved aquatic adjuvants/surfactants as identified in Table 4
>300 feet from fish bearing waters	5 mph	Aerial application	2,4-D amine Aminopyralid Glyphosate Imazapic Rimsulfuron Only Washington State approved aquatic adjuvants/surfactants as identified in Table 4
>300 feet from T&E fish bearing streams	5 mph	Aerial application	2,4-D amine Aminopyralid Glyphosate Imazapic Rimsulfuron Only Washington State approved aquatic adjuvants/surfactants as identified in Table 4

* Formulations containing the POEA surfactant (i.e., Roundup® and similar products) will not be used <100 feet from water for ground application and <300 feet for aerial.

1.3.3.3 Prescribed Fire

Prescribed fire will be used in a limited capacity in conjunction with herbicide spraying and restoration activities to remove surface litter and prepare the soil surface for reseeding in areas of cheatgrass (*Bromus tectorum*) infestation where the thatch layer is such that seed, chemicals, etc. cannot reach the soil. Prescribed fire will only be used in restoration activities, so all design criteria specific to restoration activities will also apply to prescribed fire. No ignition or fire line will occur within riparian areas. Prescribed fires will only be ignited in spring or fall. All fire line will be constructed with hand tools and all fire lines will be rehabilitated using the Minimum Impact Suppression Tactics (MIST) guidelines. A site-specific burn plan will be developed prior to any prescribed fire actions.

1.3.4 Research and Demonstration

The Research and Demonstration component will be used in areas to demonstrate current and emerging technologies and evaluate the efficacy of treatment applications. Nationally, the BLM allows for limited and controlled use of new herbicides on demonstration plots up to 5 acres in size, with a maximum of 15 acres per field office. The Research and Demonstration plots are included in the 10,000 acres of ground-based herbicide application. Herbicides proposed for research will have EPA registration and approved label for use on the site proposed (e.g., rangeland, pasture, non-cropland, aquatic habitat). Proposals will receive BLM Washington Office approval prior to use. As stated in the 2007 Programmatic for Vegetation Treatments on Bureau of Land Management Lands in 17 Western States, local bureau offices must go through separate, site-specific consultation with the Service to evaluate the effects to listed species of all new herbicides. Therefore, the effects of this portion of the proposed action will not be analyzed further.

1.3.5 Monitoring

The BLM will monitor the effectiveness of its riparian noxious weed program at site and landscape levels. Site level monitoring will involve assessing the effectiveness of the treatment agent or control method. Follow-up treatments will occur as staffing and funding allow. Treatment with biological controls will be monitored through a coordinated effort with the USDA, Idaho Department of Agriculture, Lemhi and Custer Counties, and BLM employees; the timeframe may involve multiple years to determine effectiveness. Monitoring of physical, cultural, and chemical control methods will be conducted on randomly selected sites through visual observation of target species' relative abundance/site dominance compared to pre-treatment conditions. Sequential monitoring of these sites will occur in subsequent years.

Landscape level effectiveness monitoring will be accomplished by tracking noxious weed occurrence through Geographic Information System (GIS) mapping across the two field offices. As noxious weed patches are inventoried, they will be mapped and tracked through GIS to monitor the amount of land base with noxious weeds and evaluate treatment effectiveness. Landscape level inventory and monitoring is expected to reveal new populations of noxious weeds, which will be mapped and evaluated for control or eradication.

Weed treatments and the effects of such treatments will be documented with the use of pesticide application records, as well as photo points and GIS data that document where a sprayer travels to treat weeds and how much chemical is applied. The overall levels of herbicide application on most large infestations have been reduced due to the success in treatment with either chemicals, biological applications, or both. The funding, size, and efficiency of the BLM's current weed treatment workforce has allowed a greater level of inventory and treatment resulting in the location and treatment of many new weed infestations. With the location and treatment of new weed infestations each year it may appear that the overall levels of herbicide application are increasing and the numbers of weed infestations are not being reduced. In actuality, the success of the program can be demonstrated by the fact that many large infestations, especially of new invaders like rush skeletonweed, have been dramatically reduced, along with the chemical application needed to treat such infestation on a yearly basis.

1.3.6 Adaptive Management

The noxious weed control program is a long-term endeavor to control weeds where/when practicable. However, because there are areas of scientific and management uncertainty, management actions will need to be refined over time to meet noxious weed reduction objectives while maintaining aquatic ecosystem health. Annual site-specific monitoring will assess the effectiveness of specific control measures on weed species relative to application rate/method and area. Management actions may require refinement or change over time as data from specific effectiveness monitoring is analyzed.

1.3.7 Reporting

The BLM field offices annually submit a Pesticide Use Report (PUR) to the EPA. The PUR details herbicides used, rate of application, and amount used either singularly or in a tank mix. Acreage and amount of herbicide applied is identified for ground treatments. Presently, PURs are sent to the BLM Idaho State Office, then to the BLM Washington Office, where they are reviewed and submitted to the EPA. A new database, National Invasive Species Management Systems (NISMS), is in the process of being implemented which will nationalize weed treatments and inventory. All treatments, monitoring, and tracking will be incorporated into the methodology of field inventory and treatment on the ground. This data will be collected at the time of treatment and will automatically go into the NISMS database.

A final report summarizing past year weed control activities will be submitted to NMFS and USFWS prior to starting next year's weed control activities. The summary report will primarily consist of a table summarizing treatments that occurred within 50 feet of surface water and will be identified by the 6^{th} field HUC. The table will summarize the following: mechanical/manual treatments; biological control releases; herbicide application information including; acres treated; application methods; herbicides used; and adjuvants included in the tank mix. Additionally, all aerial applications with be reported and identified by the 6^{th} field HUC.

1.3.8 Rehabilitation and Restoration

Rehabilitation and restoration are vital components of an adaptive IWM program. Rehabilitation is defined as short-term mitigation to ensure minimum site stability and functionality. Many desired plant communities are able to successfully reestablish without intervention after control efforts. However, sites that are severely damaged or at which few desirable species remain may not be able to recover without help. This may include site preparation and seeding of desirable non-native vegetation. Restoration is a long-term objective and involves returning sites to natural functions and native species.

Natural revegetation is the preferred option whenever possible. Invasive plant-infested sites or areas of disturbance (e.g., wildfire) will be assessed to determine if the area is capable of natural recovery after weed control treatments. A determination will be made as to what mix of desirable or native grass and forb plants still occur on the site and if they are numerous and vigorous enough to be capable of spreading vegetatively or via seed production.

The objective is to reestablish a desired plant community and a return to conditions that foster the recovery of natural ecosystem processes. Equipment that could be used during reseeding activities includes, but is not limited to, hand tools such as rakes or larger equipment such OHV-drawn harrows and aerial delivery.

1.3.8.1 Best Management Practices for Rehabilitation and Restoration

- Natural revegetation is the preferred option whenever possible. Invasive plant-infested sites or areas of disturbance (e.g., wildfire) will be assessed to determine if the area is capable of natural recovery after invasive plant treatments.

- Disking, plowing, or blading will not occur within appropriate buffer zones surrounding riparian areas as decided by an Interdisciplinary Team. Distances identified for PACFISH/INFISH will be followed when determining buffer zone width.

- Rehabilitation and Restoration practices are limited to invasive plant infestation areas with a maximum 50 acres per location.

- Native or sterile seed/seedlings will be used when possible.

- If it is determined that non-native species are the best choice for interim or permanent revegetation, select species that do not behave invasively under conditions similar to those at the site to be revegetated.

- Conduct rehabilitation and restoration activities only in areas with low or moderate land type erosion hazard ratings.

- Equipment will be pressure washed prior to and following implementation to avoid introduction and/or spread of invasive plants.

- The BLM will evaluate options, including closure from livestock or human disturbance, until seeding is established successfully.

- Prescribed fire will only be used for revegetation when the thatch layer of annual grasses was too copious for seed/chemical/etc. for good soil contact and will conform to all other standard operating procedures for revegetation.

- A site-specific burn plan will be developed prior to any prescribed fire actions.

- When working in watersheds with ESA-listed species, mechanical ground disturbing activities will not be conducted adjacent to or within riparian areas during the spawning season.

- A 25-foot vegetative buffer will be maintained next to live water to leave ground cover intact and prevent erosion into streams or adjacent waterbodies.

- Mechanical treatments will be limited to power tools that do not disturb the ground when working within 25 feet of streambanks, or floodprone areas along lakes, ponds, springs, and seeps.

1.3.9 Cooperative Partnerships

Cooperative Weed Management Areas (CWMAs) provide an opportunity for coordinating weed control efforts within a specific project area and provide a more efficient method of control, restoration, and monitoring. Locally, the BLM is involved in three CWMAs (Lemhi County, Custer County, and Lost River). The cooperative partnerships undertaken through these CWMAs make individual and cooperative efforts more effective. Partners include federal, state, county, private organizations, and private landowners. The BLM involvement in a CWMA does not constitute a federal nexus for actions on non-federal land. However, it does provide the BLM an opportunity to identify potential ESA concerns on private land. It is also an opportunity for BLM to share recommendations and BMPs, which reduce risks to listed species and their habitats. Noxious weed control efforts on non-federal lands may proceed without BLM approval or funding.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an Opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This Opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of" a listed species, which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This Opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features” (81 FR 7214).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.

- Describe the environmental baseline in the action area.

- Analyze the effects of the proposed action on both species and their habitat using an “exposure-response-risk” approach.

- Describe any cumulative effects in the action area.

- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.

- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.

- If necessary, suggest a reasonable and prudent alternatives to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This Opinion examines the status of each species that would be adversely affected by the proposed action (Table 6). The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species’ likelihood of both survival and recovery. The species status section also helps to inform the description of the species’ current “reproduction, numbers, or distribution” as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds that make up the designated area, and discusses the current function of the essential PBF that help to form that conservation value.

Table 6. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register decision notices for ESA-listed species considered in this Opinion.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon ***(Oncorhynchus tshawytscha)***			
Snake River spring/summer-run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall-run	T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Sockeye salmon *(O. nerka)*			
Snake River	E 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead (*O. mykiss*)			
Snake River Basin	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

Note: Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered.

2.2.1 Status of the Species

This Opinion considers the status of three species: Snake River spring/summer Chinook salmon, Snake River Basin steelhead, and Snake River sockeye salmon. Each of these evolutionarily significant units (ESU) or distinct population segments (DPS) is composed of multiple populations which spawn and rear in different watersheds across the Snake or Salmon River basins. Having multiple viable populations makes an ESU or DPS less likely to become extinct from a single catastrophic event (ICTRT 2007). NMFS expresses the status of an ESU or DPS in terms of the status and extinction risk of its individual populations, relying on McElhaney et al.'s (2000) description of a viable salmonid population (VSP). The four parameters of a VSP are abundance, productivity, spatial structure, and diversity. Final recovery plans for each species (NMFS 2015; NMFS 2017) describe these four parameters in detail and the parameter values needed for persistence of individual populations and for recovery of the ESU or DPS.

We summarize the status and available information on each species based on the detailed information on the status of individual populations and the species as a whole provided by the *ESA Recovery Plan for Snake River Spring/Summer Chinook Salmon & Snake River Basin Steelhead* (NMFS 2017), and *Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest* (NWFSC 2015) (Table 7). We also identify the major threats or limiting factors for the ESUs/DPS. These three documents are incorporated by reference here. For all three species, many individual populations are not meeting recovery plan abundance and productivity targets, such that each species remains threatened with extinction. For Snake River spring/summer Chinook salmon, the Salmon/Challis BLM Field Offices overlap with the Upper Salmon River Lower Mainstem; Lemhi; Pahsimeroi; and East Fork extant populations in the Upper Salmon River major population group (MPG). These four populations in the Upper Salmon River MPG are currently at high risk of extinction due to population abundance and productivity values below minimum viability targets (NWFSC 2015).

Table 7. Listing classification and date, status summary (including recovery plan reference and most recent status review), and limiting factors for species considered in this Opinion.

Species	Listing Classification and Date	Status Summary	Limiting Factors
Snake River Basin steelhead	Threatened 1/5/06	This DPS comprises 24 populations organized into five MPGs. Currently, five populations are tentatively rated at high risk of extinction, 17 populations are rated as maintained (moderate risk of extinction), one population is viable, and one population is highly viable. Although abundance has increased since the time of listing, four out of the five MPGs are not meeting the population viability goals laid out in the recovery plan (NMFS 2017). In order for the species to recover, more populations will need to reach viable status through increases in abundance and productivity. Additionally, the relative proportion of hatchery fish spawning in natural spawning areas near major hatchery release sites remains uncertain and may need to be reduced (NWFSC 2015).	• Adverse effects related to the mainstem Columbia and Snake River hydropower system and modifications to the species' migration corridor. • Genetic diversity effects from out-of-population hatchery releases. Potential effects from high proportion of hatchery fish on natural spawning grounds. • Degraded freshwater habitat. • Harvest-related effects, particularly for B-run steelhead. • Predation in the migration corridor.
Snake River spring/summer Chinook salmon	Threatened 6/28/05	This ESU comprises 28 extant and four extirpated populations, organized into five MPGs, none of which are meeting the viability goals laid out in the recovery plan (NMFS 2017). All except one extant population (Chamberlin Creek) are at high risk of extinction (NWFSC 2015). Most populations will need to see increases in abundance and productivity in order for the ESU to recover. Several populations have a high proportion of hatchery-origin spawners—particularly in the Grande Ronde, Lower Snake, and South Fork Salmon MPGs—and diversity risk will also need to be lowered in multiple populations in order for the ESU to recover (ICBTRT 2007; ICTRT 2010; NWFSC 2015).	• Adverse effects related to the mainstem Columbia and Snake River hydropower system and modifications to the species' migration corridor. • Degraded freshwater habitat, including altered streamflows and degraded water quality. • Harvest-related effects. • Predation in the migration corridor. • Potential effects from high proportion of hatchery fish on natural spawning grounds.
Snake River sockeye salmon	Endangered 6/28/05	This ESU comprises all anadromous and residual sockeye salmon from the Snake River Basin in Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive propagation program. Currently, the Snake River sockeye salmon run is highly dependent on a captive broodstock program operated at the Sawtooth Hatchery and Eagle Hatchery. Although the captive brood program rescued the ESU from the brink of extinction, diversity risk remains high without sustainable natural production (Ford 2011, NWFSC 2015).	• Degraded freshwater habitat, including altered streamflows and degraded water quality. • Mainstem Columbia River hydropower-related impacts • active eradication of sockeye from some lakes in the 1950s and 1960s. • Harvest-related effects. • Effects of predation, competition, and disease.

The Salmon/Challis BLM Field Offices overlap with three of the 12 Snake River Basin steelhead populations (i.e., East Fork Salmon River, Lemhi, and Pahsimeroi) in the Salmon River MPG. Currently, the Salmon River MPG is not viable (Ford 2011). The Salmon/Challis BLM Field Offices also overlap with the Snake River sockeye salmon ESU. The ESU is almost entirely supported by adults produced through the captive propagation program at the present time. The

Snake River sockeye salmon ESU does not meet the ESU-level viability criteria (i.e., a non-negligible risk of extinction over 100-year time period) based on current abundance and productivity information.

Attributes associated with a VSP are: (1) Abundance (number of adult spawners in natural production areas); (2) productivity (adult progeny per parent); (3) spatial structure; and (4) diversity. A VSP needs sufficient levels of these four population attributes in order to: safeguard the genetic diversity of the listed ESU or DPS; enhance its capacity to adapt to various environmental conditions; and allow it to become self-sustaining in the natural environment (ICTRT 2007). These viability attributes are influenced by survival, behavior, and experiences throughout the entire salmonid life cycle, characteristics that are influenced in turn by habitat and other environmental and anthropogenic conditions. The present risk faced by the ESU/DPS informs NMFS' determination of whether additional risk will appreciably reduce the likelihood that the ESU/DPS will survive or recover in the wild.

2.2.2 Status of Critical Habitat

In evaluating the condition of designated critical habitat, NMFS examines the condition and trends of PBFs which are essential to the conservation of the ESA-listed species because they support one or more life stages of the species. Proper function of these PBFs is necessary to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and the growth and development of juvenile fish. Modification of PBFs may affect freshwater spawning, rearing or migration in the action area. Generally speaking, sites required to support one or more life stages of the ESA-listed species (i.e., sites for spawning, rearing, migration, and foraging) contain PBF essential to the conservation of the listed species (e.g., spawning gravels, water quality and quantity, side channels, or food) (Table 8).

Table 8. Types of sites, essential physical and biological features, and the species life stage each physical and biological feature supports.

Site	Essential Physical and Biological Features	Species Life Stage
Snake River Basin Steelhead[a]		
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity & floodplain connectivity to form and maintain physical habitat conditions	Juvenile growth and mobility
	Water quality and forage[b]	Juvenile development
	Natural cover[c]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[c]	Juvenile and adult mobility and survival
Snake River Spring/Summer Chinook Salmon, Fall Chinook, & Sockeye Salmon		
Spawning & Juvenile Rearing	Spawning gravel, water quality and quantity, cover/shelter (Chinook only), food, riparian vegetation, space (Chinook only), water temperature and access (sockeye only)	Juvenile and adult

Site	Essential Physical and Biological Features	Species Life Stage
Migration	Substrate, water quality and quantity, water temperature, water velocity, cover/shelter, food[d], riparian vegetation, space, safe passage	Juvenile and adult

[a] Additional PBFs pertaining to estuarine, nearshore, and offshore marine areas have also been described for Snake River steelhead and Middle Columbia steelhead. These PBFs will not be affected by the proposed action and have therefore not been described in this Opinion.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.
[c] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[d] Food applies to juvenile migration only.

Table 9 summarizes designated critical habitat for each species, based on the detailed information on the status of critical habitat throughout the designation area provided in the recovery plans for the species (NMFS 2017; NMFS 2015), which are incorporated by reference here. Across the designation, the current ability of PBFs to support the species varies from excellent in wilderness areas to poor in areas of intensive human land use.

Critical habitat includes the stream channel and water column with the lateral extent defined by the ordinary high-water line, or the bankfull elevation where the ordinary high-water line is not defined. In addition, critical habitat for Chinook salmon includes the adjacent riparian zone, which is defined as the area within 300 feet of the line of high water of a stream channel or from the shoreline of standing body of water (58 FR 68543). The riparian zone is critical because it provides shade, streambank stability, organic matter input, and regulation of sediment, nutrients, and chemicals.

Table 9. Geographical extent of designated critical habitat within the Snake River for ESA-listed salmon and steelhead.

ESU/DPS	Designation	Geographical Extent of Critical Habitat
Snake River sockeye salmon	58 FR 68543; December 28, 1993	Snake and Salmon Rivers; Alturas Lake Creek; Valley Creek, Stanley Lake, Redfish Lake, Yellowbelly Lake, Pettit Lake, Alturas Lake; all inlet/outlet creeks to those lakes
Snake River spring/summer Chinook salmon	58 FR 68543; December 28, 1993. 64 FR 57399; October 25, 1999.	All Snake River reaches upstream to Hells Canyon Dam; all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Salmon River basin; and all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Hells Canyon, Imnaha, Lower Grande Ronde, Upper Grande Ronde, Lower Snake-Asotin, Lower Snake-Tucannon, and Wallowa subbasins.
Snake River Basin steelhead	70 FR 52630; September 2, 2005	Specific stream reaches are designated within the Lower Snake, Salmon, and Clearwater River basins. Table 21 in the Federal Register details habitat areas within the DPS's geographical range that are excluded from critical habitat designation.

2.2.3 Climate Change Implications for ESA-listed Species and their Critical Habitat

One factor affecting the status of the species and their critical habitat considered in this Opinion is climate change. Likely changes in temperature, precipitation, wind patterns, and sea-level height have implications for survival of all three species in both their freshwater and marine habitats. During the next century average temperatures in the Pacific Northwest are projected to increase 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014). Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events) in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014). In general, these changes in air temperatures, river temperatures, and river flows are expected to cause changes in salmon and steelhead distribution, behavior, growth, and survival, although the magnitude of these changes remains unclear.

Climate change could affect Snake River spring/summer Chinook salmon, Snake River Basin steelhead, and Snake River sockeye salmon in the following ways: (a) Winter flooding in transient and rainfall-dominated watersheds may scour redds, reducing egg survival, and may reduce overwintering habitat for juveniles; (b) reduced summer and fall flows may reduce the quality and quantity of juvenile rearing habitat, strand fish, or make fish more susceptible to predation and disease; (c) higher temperatures while adults are holding in tributaries and migrating to spawning grounds may lead to increased pre-spawning mortality or reduced spawning success; and (d) lethal water temperatures may occur in the mainstem migration corridor or in holding tributaries, resulting in higher mortality rates (NMFS 2017). Both freshwater and marine productivity tend to be lower in warmer years for Snake River Basin steelhead and Snake River spring/summer Chinook salmon populations, and likely for Snake River sockeye salmon. Climate factors will likely make it more challenging to increase abundance and recover the species by reducing the suitable rearing areas and leading to a more limited run-timing under the warmer future conditions. This possibility reinforces the importance of achieving survival improvements throughout each species' entire life cycle, and across different populations since neighboring populations with different habitat may respond differently to climate change. Existing well-connected, high-elevation habitats on public lands will be important to supporting salmon survival and recovery as the climate continues to warm (Martin and Glick 2008).

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The CFO administers approximately 799,000 acres in Custer and Lemhi Counties, Idaho. The SFO administers approximately 493,000 acres in Lemhi County, Idaho

Non-BLM managed lands and waterbodies are excluded from the action area since the BLM does not authorize, fund, or conduct weed treatment activities there and effects from treatments on BLM-managed lands are not anticipated to be meaningfully detected across property boundaries. The action area includes land and streams distributed across seven subbasins (i.e., Lemhi River; Pahsimeroi River; Middle Salmon River/Panther Creek; Upper Salmon River, Big Lost River, Little Lost River, and Birch Creek). However, the Little Lost River, Big Lost, and Birch Creek subbasins do not have ESA-listed anadromous fish species or habitats and will not be analyzed in this Opinion. The action area occurs in Custer and Lemhi counties (Figure 1).

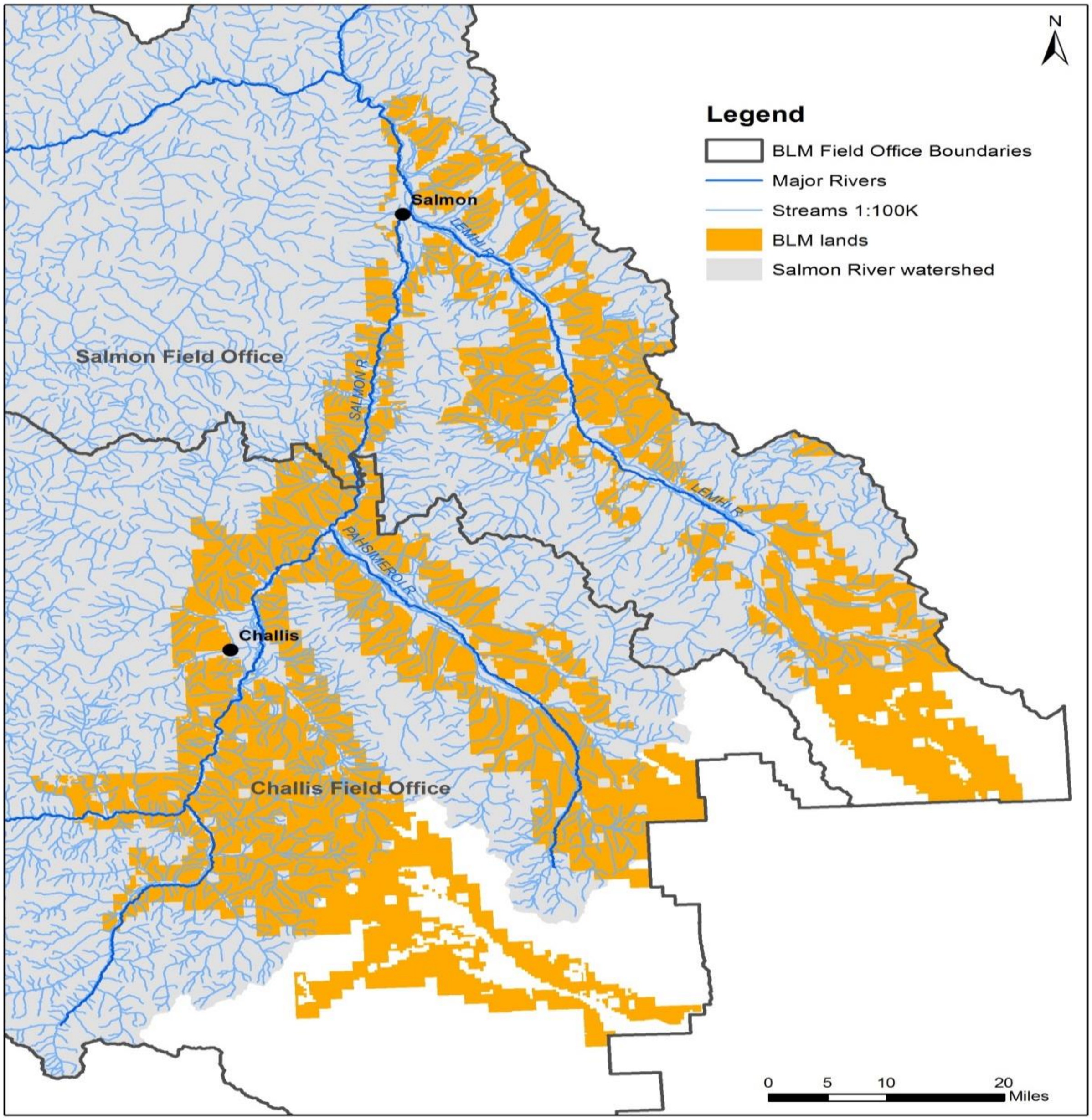

Figure 1. Action area map for the BLM's proposed Programmatic IWM Program action; all streams and riparian areas on BLM-managed lands within the Salmon River Basin are included in the action area.

2.4 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

An environmental baseline that does not meet the biological requirements of a listed species may increase the likelihood that adverse effects of the proposed action will result in jeopardy to a listed species or in destruction or adverse modification of a designated critical habitat.

NMFS describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support all life stages of each listed species within the action area. Each listed species considered in this Opinion resides in or migrates through the action area. Thus, for this action, the biological requirements for salmon and steelhead are the habitat characteristics that support successful completion of spring/summer Chinook salmon and steelhead spawning, rearing, and freshwater migration, and successful freshwater migration for sockeye salmon.

The Salmon River is the largest subbasin (14,000 square miles) in the Columbia River drainage, excluding the Snake River, and has the most stream miles of habitat available to anadromous fish. Major tributaries include the Little Salmon River, South Fork Salmon River, Middle Fork Salmon River, Panther Creek, Lemhi River, Pahsimeroi River, and East Fork Salmon River. The action area includes BLM-managed riparian areas and adjacent streams within the Lemhi, Pahsimeroi, East Fork Salmon River, and Middle-Salmon/Panther Creek subbasins. Because the proposed weed treatments, and the action area, are highly fragmented and spread across a wide geographic area, the following baseline discussion is general.

Additional baseline information is available in BLM watershed BAs (and amendments) which were previously presented to NMFS as part of ongoing ESA consultations (USFS 1999a-c and 2000; BLM 1993 a-g; and 1999a-e). Each BA provides specific information describing: (1) Description of listed aquatic species and their distribution; (2) physical characteristics; (3) riparian vegetation characteristics; (4) upland vegetation characteristics; (5) human-caused characteristics; and (6) specific stream and river characteristics. In addition, recent Salmon Field Office BAs for the Canyon to Big Timber and Salmon River Corridor Watershed Environmental Assessments, the 2010 Lemhi River BA, and the Challis Field Office BAs for the Pahsimeroi, East Fork, and Upper Salmon section 7 watershed grazing activities provide additional characterization of baseline conditions including specific descriptions of: (1) Substrate; (2) greenline vegetation; (3) greenline to greenline width; (4) stream temperature; and (5) streambank stability for the streams analyzed.

Public lands account for approximately 91 percent of the Salmon River basin, with most of this being in federal ownership and managed by seven national forests or the BLM. Public lands within the basin are managed to produce wood products, forage for domestic livestock, mineral commodities, and to provide recreation, wilderness, and terrestrial and aquatic habitats. Approximately 9 percent of the basin's land area is privately owned.

Primary private land use is agricultural cultivation, which is concentrated in valley bottom areas within the upper and lower portions of the basin. Other land management practices within the basin vary among landowners. The greatest proportion of national forest lands are federally-designated wilderness area or are areas with low resource commodity suitability. One-third of the national forest lands in the basin are managed intensively for forest, mineral, or range resource commodity production. The BLM lands in the basin are managed to provide domestic livestock rangeland and habitats for native species. State of Idaho endowment lands within the basin are managed for forest, mineral, or range resource commodity production.

Since the State Stream Channel Protection Act became law in 1971, the Idaho Department of Water Resources has issued a total of 1,763 stream alteration permits within the Salmon River basin (IDWR 2001 as cited in Ecovista 2004). It is unclear to what degree channel modifying activities completed without permits may have had on the observed pattern. Stream channels in the basin are also altered, albeit on a smaller scale, by recreational dredging activities (Ecovista 2004).

Water quality in many areas of the basin is affected to varying degrees by land uses that include livestock grazing, road construction, logging and mining (Ecovista 2004). Eighty-nine waterbodies in the Salmon River basin are classified as impaired under the guidelines of section 303(d) of the CWA. The primary parameters of concern are sediment (88 cases), nutrients (17 cases), flow alteration, irregular temperatures, and habitat alteration. Five to 10 percent of the waters in the Pahsimeroi, Middle Salmon-Panther, and Lemhi watersheds are listed as impaired by the EPA. In the Upper Salmon less than 5 percent are listed as impaired (Ecovista 2004). No waterbodies are impaired for chemical contaminants (IDEQ 2010).

In the Lemhi, East Fork Salmon, Pahsimeroi, and Middle Salmon-Panther subbasins, fewer than 20 percent of the larger streams meet all designated uses (i.e., specific uses identified for each water body through state and tribal cooperation, such as support of salmonid fishes, drinking water supplies, maintenance of aquatic life, consumption of fish, recreational contact with water, and agriculture) (Ecovista 2004). Partial and seasonal barriers have been created on many of these streams. In addition to the 75 percent to 90 percent of Forest Service and BLM road culverts that are barriers to some life stage (USFS 2005), partial to complete barriers to anadromous fish exist on the Lemhi, Pahsimeroi and Upper Salmon Rivers at irrigation diversions. Twenty minor tributaries contain dams that are used for numerous purposes such as irrigation, recreation, and fish propagation.

Agricultural diversions within the Salmon River basin have a major impact near developed areas, particularly the Lemhi, Pahsimeroi, the mainstem Salmon River, and several Salmon River tributaries. Although the majority of diversions accessible to ESA-listed species are screened, several need repair and upgrading. A major problem is localized stream dewatering due to over allocation. In addition to water diversions, numerous small pumping operations for private use occur throughout the subbasin. Impacts of water withdrawal on fish production are greatest during the summer month when streamflows are critically low (Ecovista 2004). Water diversion results in reduced or blocked habitat access, less space, higher water temperatures, and less food; all of which influence anadromous fish survival and reproductive success.

Grazing on private lands continues to impact aquatic and riparian habitat. Within the action area, grazing impacts are particularly noticeable on the mainstem Lemhi River and the lower reaches of most of the tributaries, the Pahsimeroi subbasin, and the East Fork Salmon River. Generally, private land grazing contributes to elevated water temperatures, increased sediment delivery, and reduced habitat complexity (via riparian vegetation and channel morphology impacts).

Mining, though no longer as active as it was historically, is still prevalent in parts of the Salmon River basin. Impacts from mining include severe alterations of substrate composition, channel displacement, bank and riparian destruction, and loss of instream cover and pool forming structures. Within the action area, Kirtly and Bohannon Creeks (Lemhi River tributaries), Patterson Creek (Pahsimeroi River tributary), and Kinnikinic and Bayhorse Creeks (Salmon River tributaries) have all had documented spawning and rearing habitat destroyed by mining activities.

The Salmon River basin is somewhat unique, in that large sections of riparian and floodplain habitats have retained their composition, structure and function due to wilderness designations or protective management. Outside of wilderness areas, land management activities such as road construction, timber harvest, grazing, diversions, other riparian development or other conversions within the 50- and 100-year floodplains have altered riparian functions. In the Pahsimeroi River alone, approximately 61 percent of the riparian areas have been anthropogenically altered. These alterations have resulted in increased rates of erosion, sediment delivery, and increased stream temperatures (Ecovista 2004). Some restorative work has been completed, including 146 miles of riparian fencing protecting 39 river miles and 239 miles of road modifications that reduce riparian encroachment. The Salmon River Basin Assessment (Ecovista 2004) identified riparian protection and restoration as activities most likely to yield the greatest gains for fish with the least cost. In general terms, floodplain access within the basin is functioning at an acceptable level. However mining, road encroachment, channelization, and agricultural land use have resulted in some areas (e.g., 12-mile section of Main Salmon River and Lemhi River) having impaired floodplain access (Ecovista 2004). Loss of floodplain access alters hydrology by preventing energy dissipation of high flows and reduces organic matter input from riparian interaction affecting primary productivity.

Under the current environmental baseline, the biological needs of salmon and steelhead are generally not being met in the action area. Historic and ongoing habitat impacts reduce the habitat's ability to consistently provide high quality spawning, rearing, and migratory habitats. Although much of the action area still supports anadromous ESA-listed species, existing habitat conditions do not currently allow the affected species to meet abundance/productivity or spatial structure/diversity necessary for viable populations. The purpose of the proposed action is to improve degraded vegetation conditions both in upland and riparian locations and maintain native vegetation assemblages where weeds are not currently found. In the following effects section, the analysis is based on the assumption that the various activities will occur in areas with degraded salmonid habitats.

2.5 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

2.5.1 Effects of the Action on ESA-listed Species

The proposed action involves all noxious weed treatment activities authorized, funded or carried out by the BLM during the 2018 through the 2033 treatment seasons. In general, there are three treatment types with potential to affect ESA-listed species: (1) Biological treatments; (2) mechanical and manual treatments ; and (3) chemical treatments. More detailed descriptions of these activities are included in Section 1.3 above. The proposed action included extensive BMPs to avoid and/or minimize adverse effects to ESA-listed species during noxious weed management and the following assessment assumes those measures will be implemented as described for all treatments.

The following discussion focuses on the effects of chemical treatments. However, even given the low risk mechanical and biological treatments pose for the species, a summary of the effects of non-chemical treatment's effects is also presented.

2.5.1.1 Effects of Non-Chemical Treatments

Biological Control. The number of biological releases will vary with insect availability and BLM funding levels. Biological release agents receive intensive evaluation by the USDA's APHIS prior to approval for release. This process is intended to ensure release agents do not have unintended ecological consequences. Only APHIS-approved biological controls will be used on the BLM and releases will comply with all APHIS requirements.

The described approval process should ensure release agents only feed on target species. As a result, native vegetation has a low likelihood of being affected and target noxious weed infestations will be better controlled. Control of noxious weed infestations will enable native vegetation to recolonize the affected areas, promoting proper ecological function within the treated areas. A reduction of noxious weeds in riparian areas, and along streambanks, will benefit native plant species and improve riparian function. This should decrease erosion and potentially benefit sediment levels in action area streams. Although site-scale improvements in riparian condition are expected from biological control agent use, biological control is not expected to meaningfully affect water temperature, suspended sediment, deposited sediment, or water contamination because of the small size of treatment areas. Therefore, direct effects to ESA-listed species are unlikely.

Mechanical and Manual Treatments. There could be up to a total of 400 acres/year of manual/mechanical treatment between the two field offices. However, based on past monitoring reports, approximately 7 to 15 acres of mechanical weed treatments occur annually across BLM-managed riparian areas. This limited amount of treatment will likely cause effects to listed species and habitat that will be so small that they cannot be measured. Mechanical treatments typically involve hand labor and tools to physically remove individual noxious weed plants from infested sites. Only minor amounts of ground disturbance occur at individual sites. Further, mechanically treated sites are typically small, resulting in limited surface disturbance. Treatments will only remove invasive species. The small amount of acreage treated and the proposed BMPs will result in only minor effects to species and their habitats.

Rehabilitation and Restoration. The BLM's objective is to reestablish a desired plant community and return to conditions that foster the recovery of natural ecosystem processes. Natural revegetation is the preferred option whenever possible, but on occasion reseeding will be needed. Equipment that could be used during reseeding activities includes, but is not limited to, hand tools such as rakes or larger equipment such OHV-drawn harrows and aerial delivery. These actions would typically take place in areas that have been converted from native plant communities, either by cultivation or dense infestation. Examples of these types of areas include: recreation sites; cultivated land acquisitions; and high disturbance areas now dominated by invasive plants (e.g., abandoned landfills, pipelines, relinquished right-of-way sites, decommissioned mineral material sites, and abandoned mine lands).

Direct disturbance of spawning ESA-listed fish could potentially occur if rehabilitation work occurred directly adjacent to spawning habitat and while fish were spawning. The BLM eliminated this potential exposure pathway by requiring all ground disturbing activities be conducted outside of riparian areas during spawning season. This results in very low risk for potential direct disturbance of spawning fish or embryos.

A reduction of noxious and invasive weeds and the establishment of desirable vegetation will reduce potential for future noxious weed encroachment into riparian areas. No adverse effects attributed to rehabilitation and/or use of mechanical equipment will occur to water temperature, suspended sediment, deposited sediment, or from water contamination. Increased erosion/sediment is unlikely to occur and would be undetectable in live waters should it occur. Long term benefits from reduced erosion/sediment will occur from establishment of desirable vegetation.

Additionally, BMPs limit treatment slopes to land type erosion hazard ratings of low or moderate risk and this would likely prevent large-scale erosion from occurring during and after these treatments. The small amount of acreage treated at any given time, combined with the anticipated effectiveness of proposed BMP (e.g., Minimize ground disturbing activities to the extent possible during reseeding efforts. Conduct rehabilitation and restoration activities only in areas with low or moderate land type erosion hazard ratings. A 25-foot vegetative buffer will be maintained next to live water), is expected to ensure that effects related to these types of activities reduce the potential for sediment introductions to a very low potential.

Prescribed Fire. Prescribed fire will be used in a limited capacity in conjunction with herbicide spraying and restoration activities to remove surface litter and prepare the soil surface for reseeding in areas of cheatgrass infestation where the thatch layer is such that seed, chemicals, etc. cannot reach the soil. Prescribed fire will only be used in restoration activities, so all design criteria specific to restoration activities will also apply to prescribed fire. No ignition will occur within riparian areas.

Prescribed fires ignited during the spring and fall periods generally burn in a scattered pattern, leaving a mosaic of burned and unburned areas. Pockets of mineral soil exposed by fire consumption of ground litter are typically surrounded by unburned or lightly burned areas that are too moist to burn through the duff layers. The resulting patchwork of burned and unburned areas help hold soil particles on slopes and out of stream and river channels. For these reasons, invertebrate forage production and interstitial winter cover for juvenile fish are unlikely to be impacted by significant sediment deposition within stream substrate. Elevated total suspended solids are also unlikely to reach levels that could cause physiological stress to salmon and steelhead, reduce growth of juveniles, and adversely affect fish survival. Juvenile salmon and steelhead, which may occupy aquatic habitats within action area streams, are unlikely to be exposed to increased turbidity and harmful sediment pulses resulting from the proposed action. Considering proposed BMPs, both the amount of sediment introduced into action area streams, and any resulting turbidity associated with those deliveries, will result in very low risk for potential direct disturbance of fish or embryos.

Removal of the riparian shade canopy through prescribed fire is unlikely to increase the amount of solar radiation reaching action area streams and result in increased stream temperatures because streamside fuels are normally too moist to burn (particularly during spring, fall, and winter). Prescribed fire ignitions will not occur in riparian areas, and fire spread into riparian areas from adjacent slopes is usually inhibited, if not extinguished, by higher humidity and higher fuel moistures alongside streams and rivers. While individual streamside trees and shrubs may “torch out” (be consumed by fire) and no longer provide riparian shade after prescribed fire treatments, the vast majority of riparian vegetation will remain intact through implementation of the proposed action. Because effects to riparian vegetation are expected to be minimal, the effects on riparian vegetation and ultimately ESA-listed species occupying that habitat will be very minor.

Loss of live vegetation through prescribed fire sufficient to increase water yield to watersheds is not expected because of the patchy nature of prescribed fire fuel consumption. Prescribed fires are not designed to denude entire slopes of live vegetation. As described previously, prescribed fire results in a mosaic of burn intensities and fuel consumption. Understory trees and shrubs may be killed by fire while overstory trees (most often adapted to fire) survive. Thus, overall water loss to evapotranspiration will not likely change appreciably from current conditions. Therefore, the effect of increased water yields on ESA-listed fish species is expected to be minor.

The Project may also involve the construction of some fire line to help keep the prescribed fires within desired areas. All fire line will be constructed with hand tools and all fire lines will be rehabilitated using the MIST guidelines. A site-specific burn plan will be developed prior to any prescribed fire actions. No fire line construction is planned within riparian areas. However, there is a low likelihood that streamside fire line construction may become necessary during implementation of this proposal. If fire line construction becomes necessary, then all fire lines will be constructed with hand tools and all fire lines will be rehabilitated using MIST guidelines to limit sediment transport into streams. Considering proposed BMPs, both the amount of sediment introduced into action area streams, and any resulting turbidity associated with those deliveries, will be minor.

2.5.1.2 Effects of Herbicide Treatments

The analysis of the effects of herbicides on salmonids is evaluated in this Opinion by: (1) Assessing the likelihood that listed fish and other aquatic organisms will be exposed to the herbicides; (2) reviewing the toxicological effects of the herbicides, inert ingredients, and adjuvants on listed fish and other aquatic organisms; and (3) assessing the ecological risk qualitatively based on the exposure risk and toxicity. The analysis considers the:

- Life history stages (and any associated vulnerabilities) of the ESA-listed species present in the action area;
- Known or suspected mechanisms of toxicity for the active ingredients, end-use products, inert ingredients, or known adjuvants;
- The BMPs, chemical application rates, amount of chemical use, location, application methods, and other factors that determine the likelihood of chemicals reaching the water; and,
- Possibility for antagonistic, additive, or synergistic interactions between active ingredients within formulations and with other chemicals that may enter surface waters as a result of parallel or upstream land use activities.

Under the proposed action, the risks to salmon and steelhead from herbicides are likely to occur primarily through the direct toxicological effects of the herbicides and adjuvants on the fish, rather than physical changes in fish habitat or effects on aquatic vegetation or prey species. However, both types of effects may occur and are considered in this Opinion. Unfortunately, the toxicological effects and ecological risks to aquatic species, including ESA-listed fish, are not fully known for all proposed herbicides, end-use products, and adjuvants in the proposed action.

Due to concerns about the uncertainty of effects of pesticides on ESA-listed fish, the EPA was directed by the 9th District Court (Washington Toxics Coalition v. EPA) to consult with NMFS on the effects of 55 pesticides used in the states of Washington, Oregon, and California. On August 1, 2008, NMFS entered into a settlement agreement to complete consultations on 37 active ingredients. To date, NMFS has completed eight biological opinions, covering 31 active ingredients. NMFS will not review two ingredients—lindane and molinate—because they have been prohibited since August 2009. NMFS plans to review the four remaining ingredients—1,3-D; racemic metolachlor; bromoxynil; and prometryn—by December 31, 2019. NMFS pesticide consultations can be found at https://www.fisheries.noaa.gov/national/consultations/pesticide-consultations. Of those active ingredients, two (2,4-D and triclopyr) are proposed for use by the BLM[2]. Results of the national consultation on the registration of 2,4-D and triclopyr are incorporated in this Opinion.

New formulations, or EUPs, containing the proposed active ingredients are frequently brought to market and many of the proposed EUPs are produced by many companies under different names. Table 2 identifies some of the EUPs available for the active ingredients but is likely incomplete, and more EUPs are likely to become available during the 15-year consultation timeframe. Based on the active ingredients and other ingredients they contain, the effects of these products are often similar or identical. The intent of Table 2 is not to limit the BLM's use to only the product names displayed. Review of new formulations/EUPs by the Salmon-Challis Level 1 Team will only be required where the active ingredients and maximum application rates are inconsistent with those already described in this proposed action.

Additional ESA and MSA consultation will be required prior to the use of new active ingredients. In order to add additional EUPs containing active ingredients included in this Opinion, the BLM will need to present documentation (e.g., typical and maximum application rates, toxicity information, ingredient information, and registration information) to the Salmon-Challis Level 1 Team demonstrating that the potential effects of using the EUP are similar to those considered in this Opinion.

Chemical Exposure Pathways and Mitigating Measures. Water can be contaminated by direct spray, drift, windblown soils, spills and leakage, or through leaching and runoff. The following analysis will discuss the potential for each to occur in detail.

Water Contamination by Direct Spray. Accidental spraying of herbicides into water is expected to occur infrequently and likely only when a ground applicator inadvertently directs the nozzle toward the water to spray weeds located near the water's edge and a portion of the spray stream misses the target plant. Direct spraying of water is likely only if the applicator is not paying attention to where the spray is going, or when weeds are sprayed near water and the nozzle is not adjusted properly. This type of contamination is unlikely to involve large amounts of chemicals. Marker dyes will be used to monitor where sprays are landing; consequently, operators will be capable of quickly adjust their aim away from the water if they observe the spray stream hitting the water or streambank. However, Berg (2004) noted that direct spray or drift of herbicide onto water sources was the most commonly noted BMP failure.

Aerial spraying near water and riparian zones may represent the greatest potential for water contamination either through direct application or wind drift. The aerial spray drift cannot be completely eliminated; however, with proper management, drift levels can be minimized. The amount of contamination from over-spraying should be reduced by proposed BMPs that:

1. Require a certified herbicide applicator oversee all spray projects;

2. Restrict herbicide application near water to spot-spraying with a single nozzle by hand;

[2] Triclopyr BEE formulation was also evaluated, but the BLM proposes to use the TEA formulation of triclopyr, which was not analyzed by the registration opinion; therefore, the registration opinion is not applicable to the triclopyr formulations proposed in this consultation.

3. Require that no broadcast application methods be used in riparian areas (the transition area between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water);

4. Require daily checks of local weather conditions, and monitoring site-specific conditions during herbicide application for wind thresholds;

5. Require that herbicide and adjuvants are prevented from entering water, by: (a) Checking local weather conditions daily; (b) monitoring site-specific conditions during herbicide application; (c) selecting the most suitable herbicide and adjuvant (as appropriate) combinations for the setting and applying the lowest effective use rates; (d) employing spot spraying techniques in riparian areas; (e) applying herbicides at low pressure; (f) using the largest appropriate nozzle size and other appropriate equipment; (g) adding drift control agents where necessary; and (h) utilizing directional application techniques to direct herbicide away from water;

6. Require that only Washington State aquatic-certified adjuvants (e.g., deposition aid, surfactant, dye) are used in riparian areas (see Table 4);

7. Require that herbicides are not applied if wind conditions exceed 5 mph in riparian areas or in any wind conditions exceeding product label directions;

8. Require 300-foot no spray buffer from all surface waters for all helicopter applications.

When applied consistently and correctly, these measures are expected to limit direct spray of herbicides into surface waters to infrequent occurrences. Additionally, aerial treatment units will be mapped pre-flight and GPS on the helicopter will allow precise compliance with the mapped unit boundary, as well as in-flight monitoring of actual treatment areas. Post-flight implementation monitoring will also be improved by the on-board mapping capability. When applying herbicide, helicopters fly at very low elevations and under tight weather tolerances. These conditions afford pilots excellent ground visibility during applications, including the ability to spot live water that may have inadvertently gone unmapped. Pilots are certified pesticide applicators and are required by law to follow label directions for herbicides applied, including avoidance of direct delivery to water. Pilots will avoid herbicide applications to water using the prescribed buffer distances and through visual identification of surface water while in flight. With routine compliance with the described BMP, direct delivery of herbicide to action area surface waters is expected to be rare, of low intensity when/if it occurs, and isolated to individual project sites that are geographically scattered. As a result, in-water herbicide concentrations should be minor.

Water Contamination by Wind Drift. Rates of contamination by wind drift are largely dependent on droplet size, elevation of the spray nozzle, wind speed, and weather conditions (heat and humidity) that can cause the water droplets to evaporate, leaving the chemicals suspended in the air (Rashin and Graber 1993). During periods when there is virtually no wind, little vertical air mixing occurs, and drift can travel long distances. The complete absence of winds can cause herbicide particles to remain suspended in air for hours. This circumstance is likely to occur infrequently in mountainous regions, due to daily convective cycles. Convective winds occur daily, except under heavy cloud cover; consequently, periods without any wind are rare during the summer weed spraying season, but they may occur occasionally on cloudy days.

Wind speeds less than 2 mph may be approaching temperature inversion conditions. Temperature inversion occurs when warm air traps cooler air below it. Temperature inversions make it easy for spray drops to remain suspended in the air and move slowly downwind. Because of this risk, the 2,4-D and triclopyr registration Opinion (NMFS Tracking #2004/02673) contains a term and condition specific to broadcast spraying under specific wind conditions. That term and condition requires the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) labels of all pesticide products containing 2,4-D and triclopyr to have the following statement: "Do not broadcast spray when wind speeds are below 2 mph or exceed 10 mph, except when winds in excess of 10 mph will carry drift away from salmonid-bearing waters." Since label adherence is required under the action, these measures are expected to be applied by the BLM and will reduce wind drift of those chemicals. Other active ingredients have not all undergone EPA registration consultations and thus do not contain the same label restrictions. Thus, drift of some herbicides could occur if broadcast spraying is performed under the described wind conditions if other BMP do not otherwise eliminate the risk.

Aerial spraying near water and riparian zones may represent the greatest potential for exposure of aquatic organisms to contaminants through wind drift. Risk of contamination during the ground-based application of herbicides may be less than during aerial application because application occurs more slowly, applicators are working at ground level, using marker dyes, and are able to quickly adjust their application techniques. Helicopter pilots are flying low, at low speed and the elevated position affords a great deal of visibility. These factors, combined with the downward orientation of the spray nozzles appear effective in eliminating most drift. For example, the Lolo National Forest reported no herbicide detections in Mormon Creek after Picloram was sprayed with a helicopter using similar project design criteria and application rates proposed by the BLM (Techline 1998). The Lolo and Bitterroot National Forests have continued to make similar applications since that initial treatment and they have not yet detected herbicide reaching buffered streams (Stockmann 2015). However, it was noted that many of those applications utilized a drift control agent. Drift control agents were proposed for use by the BLM where necessary. Where buffers are used to prevent herbicide delivery to streams, drift control agents should likely be utilized. Regardless, water contamination from spray drift is not likely to be completely eliminated.

Unfavorable weather conditions can cause high wind drift rates and are likely to be encountered occasionally during periods with low relative humidity and high temperatures, which are common from July through September. During hot and dry conditions, herbicides can quickly volatize when the carrier (i.e., water) evaporates. Even under the most extreme heat and low humidity, volatilization is unlikely to be a significant cause of wind drift, since there is little opportunity for the spray to evaporate because it will be applied by hand with the nozzle close to the target or by low level helicopter applications. The proposed action does not include specifications for controlling droplet size during hot and dry conditions, but droplet size is not likely to be a significant factor affecting wind drift when herbicides are applied by hand and with a single nozzle. Drift control agents can also be used where necessary, along with utilizing directional application techniques to direct herbicide away from water. Aerial broadcast operation criteria recommends the use of low pressure and larger droplet sizes to the extent possible with applications occurring at 5 mph or less outside the 300-foot buffers to minimize the potential for wind drift. If droplets are small enough to become volatilized, they are likely to become suspended and dispersed as they travel. If a small volume of an herbicide is dispersed over a wide area, the likelihood of settling directly into water is low since water comprises only a small percentage of the surface area.

Occasional wind drift may occur when herbicides are applied near streams. Spray streams typically include a range of droplet sizes, and a fraction of the droplets are small enough to be blown off-target and into the water. The majority of the material in a spray stream delivered by hand with a marker dye typically hits the target, leaving only a fraction of the chemicals subject to drift. In addition, all live water (perennial streams, flowing intermittent streams, lakes, ponds, springs, and wetlands) will have a 300-foot no application buffer for aerial treatments. This buffer distance is expected to avoid drift of aerially applied herbicides into surface waters.

Multiple studies support the effectiveness of the 300-foot buffer in preventing drift to surface waters. The Oregon Department of Forestry (Dent and Robben 2000) evaluated 26 stream sample sites adjacent to aerial treatment units for presence of herbicide up to 72 hours post-treatment. Units received either a 60-foot of 300-foot buffer depending on channel type. Sample detection limits were 1 part per billion (ppb) for all samples with a subset having detection limits of 0.5 ppb. They detected no herbicide in any samples tested at 1 ppb detection limits. For the seven sites with 0.5 ppb detection limits, two herbicides (hexazinone and 2,4-D ester) were detected in five samples. This study suggests the proposed buffers will prevent environmentally relevant concentrations of aerially applied herbicide from reaching water. Felsot (2001) reported that over 90 percent of spray droplets land on aerially targeted treatment areas, and about 10 percent or less move off-target. Of the droplets that moved off-target, less than 1 percent drift beyond 300 feet when helicopter delivery was 25 feet high, even less drifted off target when applied from 10 feet. For boom spray ground applications at 4 feet high, over 99.9 percent of applied herbicide was deposited within 100 feet downwind of treatment units. Drift card monitoring on the Lolo National Forest also supports the effectiveness of the proposed buffer distances (Lolo National Forest 2005). They monitored 12 projects implemented between 2002 and 2005, and monitoring of 36 drift card lines, established perpendicular to buffered streams, detected just one instance of drift reaching the stream (1 percent detection). For all the sites, the average distance herbicide drifted into the prescribed buffer (100 or 300 feet, depending on waterbody) was just 74 feet (applying zero feet for non-detections). The Bitterroot National Forest O'Brien Creek Drift Monitoring Report (Kulla 2002) indicated three of five drift cards placed perpendicular to two streams detected small levels of herbicide, but none closer than 270 feet from the stream, consistent with the Lolo's findings. These results suggest the 300-foot proposed buffer is likely to be effective in preventing drift to streams.

The monitoring data suggest that failure to buffer dry intermittent channels is likely to result in either direct overspray of those channels or drift onto them. In the event a rain event occurs shortly after application, there is potential for some herbicide to be picked up in surface water, dependent on product solubility and soil binding properties. This is discussed further in the *Water Contamination from Leaching and Runoff* section below.

Based on proposed BMPs water contamination from wind drift will be further reduced by: (1) Ensuring a certified herbicide applicator oversees all spray projects; (2) restricting herbicide application near water to spot-spraying with a single nozzle by hand; (3) following buffer restrictions as outlined in Table 3; (4) no herbicide shall be applied in sustained wind conditions exceeding 5 mph in riparian areas or in any wind conditions exceeding product label directions; (5) applicators obtaining a weather forecast prior to initiating spraying to ensure no precipitation or wind events could occur during or immediately after (at least 24 hours) spraying that could allow drift into surface waters; (6) applicators using a marker dye to provide the operator the ability to accurately see the locations where herbicides are applied; (7) all live water (perennial streams, flowing intermittent streams, lakes, ponds, springs, and wetlands) will have a 300-foot no application aerial herbicide buffer; (8) drift monitoring cards may be placed out to 300 feet from and perpendicular to perennial streams to monitor herbicide presence on some of the application sites to ensure that BMPs is effective at prevent drift; (9) aerial herbicide application will not occur when sustained wind speeds exceed 5 mph or label recommendations, whichever is less; (10) aerial herbicide applications will not occur during inversions, or below minimum relative humidity or above maximum temperature, as stated on label; (11) aerial spray units (and perennial seeps, ponds, springs, and wetlands in proposed aerial units) will be identified prior to spraying to ensure only appropriate portions of the unit are aerially treated; (12) a GPS will be used in spray helicopters and each treatment unit mapped before the flight to ensure that only areas marked for treatment are treated; and (13) aerial herbicide application will not occur over areas with more than 30% live tree canopy cover.

Water Contamination by Wind-Blown Soils. Certain herbicides may readily bind to mineral or organic particles in soils, and the contaminated soils can subsequently be blown into streams. Wind-blown soil particles can be a significant source of water contamination in agricultural settings, where large contiguous blocks of land are tilled to bare soils and exposed to winds. Bare soil areas are typically small in the action area and interspersed with abundant vegetative cover which blocks wind and filters dust. These conditions make the contamination risk from wind-blown soils low. In addition, only a small fraction of herbicide contaminants reside on the soil surface, and contaminated soils may not be subjected to winds before herbicides become immobilized through absorption by plants or downward movement into the soils.

The sites most susceptible to generate contamination from wind-blown soils are recently burned areas, unsurfaced parking or storage areas, roadside drainage ditches, and undeveloped recreation sites next to streams. When treated with herbicides, these types of locations can produce small amounts of herbicide-laden dust that could be blown into streams. However, the amount of contamination from this pathway is likely to be immeasurable unless extensive burned areas are sprayed in the same year in which the fire occurred. Historically, the BLM has not treated extensive burned areas with herbicide. In general, a reseeding strategy is implemented to treat burned areas. Considering these factors, the risk of contaminating surface waters from wind-blown soil contamination is minimal for this action.

Water Contamination by Spills and Leakage. Most of the herbicides in the proposed action will be applied in a liquid solution, which requires transferring liquids from one container to another and occasional field mixing of chemicals. Liquids are prone to spills through leaky spray equipment or containers and when mixing or transferring chemicals from one container to another. In general, minor amounts of herbicide leakage are likely to occur throughout the spray season from dripping while using spray equipment, but this type of leakage would occur at concentrations far below the target application rate, and it would not cause any meaningful increase in water contamination over the amount expected based on the target rate.

Chemical contamination of water involving larger amounts of herbicides from spilled or leaking containers is likely to be an uncommon event because a significant leak or spill must occur and the spilled chemicals must reach the water. The likelihood of a significant spill is difficult to predict, but is constrained by BMPs that limit the amounts of chemicals that are transported at any given time (i.e., transport only the quantity of herbicide and adjuvants needed for a project; secure containers being transported in such a way to prevent the likelihood of spills; make periodic checks en route to help avoid spillage; carry herbicides and adjuvants in watertight, floatable containers when supplies need to be carried over water by boat, raft or other watercraft.). Spilled chemicals reaching water will be restricted by limiting storage and mixing of chemicals to locations where a spill would be too distant from water to reach it before it could be cleaned up (i.e., wherever possible, chemicals will be mixed and loaded at a distance greater than 100 feet from water and where spilled materials will not flow into groundwater, wetlands or streams; and material safety data sheets, safety plan, spill prevention plan and cleanup kits will be available to applicators). Consequently, spills and leakage from handling are not expected, but if they occur are not likely to be more than a minimal potential for water contamination. However, a larger spill from a transporting accident could occur.

There is no practical way to transport chemicals in the field without crossing bridges or using roads or trails in close proximity to streams; consequently, transportation-related spills cannot be ruled out. Although the likelihood of accidents is unknown, the risks from any spill that occurs is limited by several factors: all chemicals must be transported in approved herbicide containers, which are likely to withstand minor accidents without spillage; the amount of chemicals handled at any given time are limited by provisions of the proposed action; the applicator being familiar with and carrying a spill cleanup kit whenever herbicides are transported; and mixing and chemical transfers must take place in a location where the chemicals can be contained before they can directly enter the water. These precautions considered, spills during transportation are unlikely to occur resulting in direct water contamination. Because the effects of a spill resulting from transportation would vary depending upon what was spilled, how much was spilled, and in what proximity to ESA-listed fish, large, transportation-related spills would be outside the scope of this consultation and the BLM will need to complete emergency consultation on any spill response measures.

Water Contamination from Leaching and Runoff. Post-application rain events can potentially mobilize herbicides deposited on plant tissues or soils through leaching and runoff. The highest herbicide contamination from surface runoff typically occurs in brief pulses during and shortly after storm events; especially when applied close to streams or to drainage ditches that flow directly into stream channels. Runoff from intense rainfall events is believed to be the primary mechanism allowing herbicides to reach streams in the action area. A large percentage of an applied herbicide could be moved off site if intense rainfall occurs shortly after herbicides are applied. These storms tend to be isolated and high intensity events should affect only a fraction of the action area at any given time. Weed infestations are widely scattered across the action area.

If the BLM applied herbicides to the annual maximum 20,000 acres, a limited application compared to the approximately 1.29 million acres of the Salmon and Challis BLM (799,000 CFO acres and 493,000 SFO acres), less than 1.5 percent of BLM-managed lands in the basin would receive herbicide applications annually. Not all of the 20,000 treatments acres will occur near water; and individual treatments in any given year will be spread out over a large geographical area. The BLM proposes 5,000 acres of riparian herbicide treatment annually. However, this acreage is an overestimate of the actual acres that will be contacted by applied chemicals. Spot spray methods, used to treat riparian acres, will result in 10 to 25 percent of each riparian acre actually being chemically treated (Personal Communication, Josh Gibbs, BLM GIS Specialist, July 3, 2018), meaning that equivalent fully treated chemicals acres is more likely to range from 500 to 1,250 acres (i.e., 0.09 percent or less of the BLM-managed lands in the basin) annually.

Physical properties of the herbicides (i.e., movement in groundwater, soil half-life, water solubility, etc.) and environmental conditions (i.e., soil type, precipitation rates, wind, etc.) are the primary variables influencing herbicide movement from runoff. Some of these variables and estimated environmental concentration (EEC), which are a product of water contamination rates (WCRs) multiplied by application rate, are shown in Table 9. Herbicides with a low sorption coefficient and a long half-life, such as chlorsulfuron, dicamba, metsulfuron-methyl, and picloram have the greatest ability to leach through soils and reach groundwater or surface water, with picloram possessing the greatest risk.

Contaminants are filtered out of the water to varying degrees by sorption onto plants, debris, and soils encountered in the flow path. In general, the amount of filtering increases with the distance surface runoff travels before reaching a stream and with increasing dispersal of the flow. Herbicides can be completely removed from surface runoff that trickles a long distance though vegetation and organic debris, while little or no filtering might occur in runoff that is quickly concentrated into a channel or ditch. Due to the effects of filtering and greater residence time, vegetative buffers are generally effective in controlling water contamination (Berg 2004).

Herbicides mobilized by subsurface flows can enter a nearby stream by contaminating the hyporheic aquifer that mixes with surface flows in a stream, or they can contaminate more distant streams if the runoff reaches deeper aquifers and then emerge as springs. Contamination by subsurface flows through the hyporheic zone occurs more gradually over an extended period of time following a storm, with timeframes highly variable, typically ranging from hours to weeks, depending on the soil type, physical properties of the aquifer, and distance from the point of contamination to the stream.

As herbicides move through groundwater, some of the herbicides are lost to chemical breakdown and metabolism by plants and other organisms. Contaminants may also be filtered out of subsurface runoff as the runoff percolates through the soil. Soils with large fractions of fine particles and organic materials have a large filtering capacity and coarse soils that lack organic material have little or no filtering capacity. At some point, distance from water also becomes the dominant influence on the amount of water soluble chemicals that reach a stream, and in general, the greater the distance between treated areas and the water table or nearest stream channel, the smaller the potential for water contamination. Stream buffers and/or spot spraying in riparian areas are used in the proposed action to take advantage of the filtering capacity provided by plants, debris and soils.

A portion of the herbicides applied to the action area will be affected by the processes described above and will likely contaminate water in concentrations high enough to cause adverse effects to ESA-listed fish or other aquatic organisms. However, water contamination will be minimized by: (1) Applicators obtaining a weather forecast prior to initiating spraying to ensure no precipitation or wind events could occur during or immediately after spraying that could allow runoff or drift into surface waters; (2) limiting the application of certain chemicals (i.e., picloram, chlorsulfuron, clopyralid, imazapic, etc.), both in distance from streams and number of applications, to minimize the potential of water contamination and applying no-spray buffer zones along all streams and ponded waterbodies for those herbicides not labeled for aquatic or streamside application; (3) not using broadcast application methods in riparian areas (4) using spot spraying techniques in riparian areas, applying herbicide at low pressure, using the largest appropriate nozzle size and other appropriate equipment, adding drift control agents where necessary, and utilizing directional application techniques to direct herbicide away from water; (5) selecting the most suitable herbicide and adjuvant combinations (as appropriate) for the setting and applying the lowest effective use rates; and (6) not storing, mixing, or cleaning herbicides within 100 feet of any live waters or over shallow groundwater areas. Considering application of these BMP, we believe that any effects to ESA-listed fish from surface runoff or leaching will be of short duration, small in magnitude, not lethal, and infrequent.

Surface runoff is most likely to occur where persistent chemicals are applied to bare ground and where direct transport to surface or groundwater can occur during subsequent storm events. Hydrologically connected roadside ditches are such locations. BMP require avoidance of wet ditches as well as strict weather forecasting to reduce the opportunity for these events to occur. However, much of the existing invasive plant infestations occur along road corridors and unexpected summer rainstorms occur frequently. These conditions present at least some opportunity for runoff to occur from the action. These events should still occur infrequently, be of low magnitude, and be spatially widespread.

Reduction of Exposure Risks. In addition to the BMPs mentioned in the previous sections, the BLM proposed several additional measures as part of their general weed management program to minimize the potential for contaminating action area waterbodies. Key BMPs include the following:

Only low risk application methods will be used near water. This approach substantially eliminates the risk of directly spraying chemicals into water or dry stream channels. Applicators are required to use more risk-averse application methods in sites that are close to stream channels. Because of reduced risk with increasing distance from water, fewer safeguards are required as distance from waterbodies increase. Key provisions include using the least toxic chemicals near water, and more precise herbicide application methods in stream side areas, such as wicking, wiping, or hand spraying with a single nozzle.

Dyes will be used to more accurately control the application rate. Dyes also reduce the likelihood of spraying chemicals directly into water by showing the applicator exactly where the herbicide is being sprayed and limits over application by identifying treated areas.

Collectively, the entire suite of BMPs addresses the mechanisms that enable chemicals to reach stream channels (i.e., drift, spillage, direct overspray, leaching, and runoff). Water quality monitoring conducted by the U.S. Forest Service for similar weed treatments suggest that BMPs similar to the proposed actions successfully minimize the occurrence of water contamination and minimize the concentration of chemicals when water contamination does occur (Berg 2004). For this reason, the BLM is likely to keep herbicides from reaching water in appreciable amounts in the vast majority of circumstances. However, the efficacy of the BMPs is not documented to the extent that risks can be absolutely eliminated or specifically quantified. For example, some criteria logically prevent water contamination (i.e., in field mixing provisions), while others are assumed to be reliable precautions, but less than 100 percent effective under all possible circumstances. Consequently, the precautionary measures in the proposed action are likely to eliminate routine risks under the vast majority of application circumstances, but they do not completely eliminate the risk of chemical contamination. For these reasons the following sections discuss potential exposure and biological response scenarios for the proposed herbicides formulations and adjuvants.

2.5.1.3 Exposure to Herbicide

Weed treatments typically occur sometime between the start of emergence (about April) and can extend until dormancy (until November at some elevations). During this period, all life stages of Chinook salmon, and steelhead could potentially be exposed to herbicides, including incubating eggs, rearing juveniles, and migrating/holding adults. Migrating juvenile and adult sockeye salmon could be exposed at treatment sites along the Salmon River.

As previously described, the BLM has proposed multiple measures to minimize or avoid water contamination from herbicides, with measures directed at all potential exposure pathways. In addition, the proposed action estimates no more than 20,000 acres of BLM-managed lands will be treated with herbicides annually (approximately 1,250 riparian and 15,000 applied upland acres). If the BLM applied herbicides to the maximum 16,250 acres, across the approximate 1.29 million acres of BLM-administered land, less than 1.25 percent of BLM managed lands in the basin would receive herbicide applications annually.

Available data on water quality monitoring by the BLM for past weed treatments are limited, but suggest that BMPs similar to those in the proposed action successfully minimize the occurrence of water contamination and the concentration of chemicals in the water when contamination occurs (Berg 2004). However, even with implementation of the numerous BMPs and limiting the size of the treatment area, there is uncertainty in the complete elimination of the potential for herbicides to reach surface water. Even with the various buffer widths included in the action, there is potential for herbicides to reach streams, although that potential diminishes as the distance from the herbicide application to surface water increases and application methods change. Water contamination (and subsequent fish exposure to herbicides) is most likely to occur under the proposed action in occasional circumstances: (1) Where chemicals are applied close to water, in dry channels, or on coarse alluvial soils; (2) when operator errors occur, such as spilling chemicals during transportation, or accidentally spraying herbicides into water; or (3) when unexpected weather conditions occur during or shortly after spraying. Beyond these occasional circumstances, chemical contamination of water from the proposed action is unlikely to occur given the properties of the herbicides, the small amounts of chemicals used, the short persistence in soil and lack of soil mobility for most active ingredients, implementation of design criteria that minimize or avoid water contamination (such as use of hand application and wind speed criteria), and limited acreage treated within the action area.

ESA-listed fish and critical habitat could be absent from a treatment area, but still occur a short distance downstream from potential treatment areas. The effects analyses in this Opinion are based upon the assumption that all of the protective measures listed in proposed action and this Opinion will be implemented without exception wherever the action affects ESA-listed fish or critical habitat. To most effectively avoid/minimize potential effects to listed fish or designated critical habitat, all BMPs designed to reduce the likelihood of surface runoff or groundwater contamination need to be applied in or immediately upstream from watersheds currently occupied by ESA-listed fish species or designated as critical habitat.

Site-specific estimates of fish exposure are not known since the exact treatment locations, the amount and type of chemicals that will be applied, water volume of contaminated streams, and weather conditions are not known ahead of time. Thus, a quantitative estimate of fish exposure to individual proposed herbicides was evaluated for a generalized "worst-case" scenario.

Worst-case scenarios include development of the EECs for each active ingredient. The EECs are a product of the WCRs found in the most recent Forest Service Risk Assessments prepared by the Syracuse Environmental Research Associates, Inc. (SERA) and/or BLM risk assessments and the maximum label application rates. Although a variety of models can be used to estimate contamination rates of surface water after pesticide applications, SERA relies heavily upon the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model. The GLEAMS model is a root zone model that can be used to examine the fate of chemicals in various types of soils under different meteorological and hydrogeological conditions. The WCRs extrapolated from SERA were generally GLEAMS model results; however, some WCRs selected for this Opinion came from field studies. A discussion about how the EEC was derived for each of the active ingredients, is included in Appendix A. SERA Herbicide WCRs and EECs are summarized in Table 10 (excluding rimsulfuron), along with their persistence/mobility in soils, and some general physical property information.

Although there is no current SERA report with a WCR or EEC listed for rimsulfuron, BLM completed a similar risk assessment for this chemical in 2014 (AECOM 2014). Rimsulfuron is classified as practically nontoxic to freshwater fish on an acute basis (EPA 2012). In contrast, vascular plants are extremely sensitive to rimsulfuron. However, it is not registered for use as an aquatic herbicide (EPA 2012), so products containing it will be used only to control invasive plants away from surface waters. During early coordination with NMFS staff, concerns were expressed about the indirect effects of the use of rimsulfuron in riparian areas because it is toxic to vascular plants. Harming vegetation in riparian zones could have indirect effects on ESA-listed species and designated critical habitat. However, by applying the recommended buffer distances, the likelihood of a response from indirect effects of exposure will be diminished. This, along with rimsulfuron's low toxicity to fish, makes the potential for adverse impacts on anadromous fish from its use extremely low to nonexistent.

NMFS' approach is conservative, and likely overstates EEC and potentially inflates the potential risk to species exposed during the action for most applications. However, given the current baseline condition for the affected species, and unknowns regarding site-specific environmental conditions at application sites, we elected to present the worst-case scenario in this Opinion. This is consistent with recent consultations on similar actions NMFS has completed (NMFS 2012; NMFS 2013; NMFS 2014; NMFS 2016a; NMFS 2016b and ensures consideration of maximum potential exposure of ESA-listed species considered in the analysis. Inclusion of both the worst-case and typical scenarios allows easy comparison of each potential situation. Overall conclusions regarding effects of the action do not meaningfully differ between our analysis and the BLMs'.

2.5.1.4 Toxicological Effects of Herbicides

Herbicides (including the active ingredient, inert ingredients, and adjuvants) can potentially harm[3] fish directly or indirectly. Herbicides can directly affect fish by killing them outright or causing sublethal changes in behavior or physiology. Herbicides indirectly affect fish by altering their environment (Scholz et al. 2005). Environmental alterations may include changes in cover, shade, runoff, and availability of prey species.

Direct Effects. Herbicide exposure may directly result in one or more of the toxicological endpoints identified below. These endpoints are generally considered to be important for the fitness of salmonids and other fish species. They include:

- Direct mortality at any life history stage;
- An increase or decrease in growth;
- Changes in reproductive behavior;
- A reduction in the number of eggs produced, fertilized, or hatched;
- Developmental abnormalities, including behavioral deficits or physical deformities;
- Reduced ability to osmoregulate or adapt to salinity gradients;
- Reduced ability to tolerate shifts in other environmental variables (e.g., temperature or increased stress);

[3] NMFS defines harm as "an act which actually kills or injures fish or wildlife." Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR 222.102).

- An increased susceptibility to disease;
- An increased susceptibility to predation; and,
- Changes in migratory behavior.

The ecological significance of sublethal toxicological effects to individual fish depends on the degree to which essential behavior patterns are impaired, and the number of individuals exposed to harmful effects. Sublethal effects could compromise the viability and genetic integrity of wild populations if the effects are widespread across an entire DPS or ESU, or if localized exposures result in the concentrated loss of fish in a geographic area occupied by a local population with unique genetic traits. Scholz et al. (2000) and Moore and Waring (1996) indicated that environmentally relevant exposures to diazinon can disrupt olfactory capacity in the context of survival and reproductive success of Chinook salmon, both of which are key management considerations under the ESA (Scholz et al. 2000). The likelihood of population effects from sublethal effects of the chemicals in the proposed action are largely undocumented, but appreciable population effects can be ruled out if the potential exposure to harmful effects is limited to small numbers of fish and a spatial pattern that is not likely to cause the loss of a unique genetic stock.

Weis et al. (2001) reviewed published literature on consequences of changes in behavior of fish from exposure to contaminants and noted studies reporting impaired growth and population declines from altered feeding behavior and impaired predator avoidance. Potential sublethal effects, such as those leading to a shortened lifespan, reduced reproductive output, or other deleterious biological outcomes are a potential threat to ESA-listed species from the proposed action. Anadromous fish in the Snake River are exposed to multiple physiological sublethal stressors with apparent cumulative effects (e.g., Ebel et al. 1975; Matthews et al. 1986; Coutant 1999). Cumulative exposure to multiple sublethal stressors associated with the Snake River hydropower system has been attributed to delayed mortality in Snake River salmon (Budy et al. 2002). Mortality resulting from a history of multiple physiologically sublethal stressors is referred to as “ecological death” (Kruzynski et al. 1994; Kruzynski and Birtwell 1994). Cumulative effects of multiple stressors are thought to be the cause of declines in some fish populations, even though the effects of any single stressor appeared to be insignificant (Korman et al. 1994). Although exposure to pesticides is not a reported factor in delayed mortality of fish, one can reasonably assume that physiological stress created from sublethal exposure to herbicides, or potential impacts to primary production, could contribute to reduced growth of juveniles. Baldwin et al. (2009) found evidence that juvenile growth reductions caused by exposure to popular pesticides (organophosphate and carbamate classes), led to modeled reductions in population productivity. The proposed action does not include the same class of pesticides, and herbicide exposure is likely to be of lower duration and less chronic than evaluated by Baldwin et al. (2009), suggesting the proposed action will not lead to widespread growth reductions and decreased productivity.

Table 10. Physical properties, application rates, and EECs for herbicides proposed for use.

Active Ingredient	Persistence in Soil (days)[1]	Mobile in Soil	Typical Application Rate (lb a.e./Acre)[2]	Max Label Application Rate (lb a.e./Acre)	WCRs (mg a.e./L)[3]	EEC (mg a.e./L)[4]
2,4-D amine	10 Low	Yes, but degrades quickly	0.5-2.0	4.0	0.44	1.76
Clopyralid	40 Moderate	No	0.1-0.5	0.5	0.07	0.035
Aminopyralid	103 Days (High)	Yes	0.03 – 0.11	0.11	0.6	0.066
Chlorsulfuron	40 (28–42) Low-Mod	No	0.01-0.02	0.12	0.2	0.024
Dicamba[5]	7-42 Low-Mod	Yes	0.5-2	2	0.01	0.02
Glyphosate	47 Moderate	No	0.5 -3.0	4	0.083	0.66
Imazapic	7-150 Low-High	No	0.1-0.16	0.19	0.01	0.002
Imazapyr	2,150 (313–2,972) High	Yes	1.0	1.5	0.009	0.013
Rimsulfuron	21–24 Low	No	0.0469-0.0625	0.0625	NA	NA
Metsulfuron-methyl	30 (7–28) Low	No	0.01-0.02	0.15	0.01	0.002
Picloram[6]	90 (20–300) Mod-High	Yes	0.25-1.0	1.0	0.18	0.18
Sulfometuron-methyl	20–28 Low	No	0.09-0.38	0.38	0.02	0.008
Triclopyr triethylamine salt (TEA) (Garlon 3A)	30 Low	Yes	1-1.5	2.08	Acid: 0.24 TCP: 0.02	Acid: 2.16 TCP: 0.18
Fluroxypyr (Vista XRT)	36 Moderate	Yes	0.012-0.5	0.5	0.08	0.04

[1] Soil half-life values for herbicides are from Herbicide Handbook (Ahrens 1994) and BLM Ecological Risk Assessment (BLM ERA 2014). Pesticides considered non-persistent are those with a half-life of less than 30 days; moderately persistent herbicides are those with a half-life of 30 to 100 days; pesticides with a half-life of more than 100 days are considered persistent.

[2] Typical application rates are those used by the BLM; maximum application rates are those on the product labels unless otherwise noted.

[3] The WCRs were obtained from the most recent SERA risk assessments Pesticide-Use Risk Assessments and Worksheets https://www.fs.fed.us/foresthealth/pesticide/risk.shtml

[4] The EECs were derived by multiplying the maximum label application rate by the WCR.

[5] Dicamba application rates on the BLM are 1 pound per acre (lb/ac) for broadcast applications and no more than 2 lb/ac per year on a treatment area, per label requirements for rangeland uses.

[6] Maximum application rate for picloram is 1 lb a.e./acre; rates may be higher for smaller portions of the acre, but the total use on the acre cannot exceed 1 lb a.e./acre/year.

[NA] Not Applicable. Although there is no current SERA report with a WCR or EEC listed for rimsulfuron, BLM completed a similar risk assessment for this chemical in 2014 (AECOM 2014).

Comparing EECs to LC_{50} values (Table 10 and 11) indicates that peak herbicide EECs should be a small fraction of lethal concentrations. Peak EECs of all but one herbicide are less than 1 percent of the lowest reported LC_{50}. The only exception is the original formulation of glyphosate (i.e., Roundup), which has a peak EEC equivalent to approximately 4.4 percent of the reported LC_{50} – still far below expected lethal exposure levels. In addition, both EEC estimations provided (using upper bounds and representative estimates) are presumed to represent conditions that will generally not be encountered – given the anticipated effectiveness of the described BMP in preventing delivery of herbicide to water and thus further minimizing potential for lethal conditions to occur.

Because exposures causing fifty percent mortality (i.e., LC_{50}) are a poor measure to ensure protection of threatened and endangered fish, particularly from sub-lethal effects, NMFS used reported no observed adverse effect levels (NOAEL), or no observed effect concentrations (NOEC) to evaluate potential sublethal effects to fish from upper bound EECs. Dividing the EEC by the NOEC or NOAEL produces a ratio dubbed the Hazard Quotient (HQ). When NOEC or NOAEL values were not available, NMFS used the lowest available LC_{50} for freshwater fish and applied an uncertainty factor of 20 to approximate an NOAEL (SERA 2014). In all cases, a HQ less than 1.0 (termed a level of concern), suggests potential exposure is has low risk to cause an adverse effect. When HQs are greater than 1.0, higher risk exists and adverse effects are more likely.

Upper bound and representative or central sublethal HQs, which were calculated to infer the risk of adverse effects, (Table 11) are all below 1, with most being several orders of magnitude lower. This suggests that under even worst-case WCR conditions and max-label application rates, sublethal effects are unlikely to occur. However, since not all sublethal biological endpoints have been evaluated for each active ingredient, and most evaluations only consider technical grade material and not EUPs, there is potential that some sublethal effects may not have been observed during reported testing. This concern is also present in the literature, with many authors recognizing NOECs as a limitation in the available science (Crane and Newman 2000; Iwasaki et al. 2015; Mebane 2015). Nonetheless, NOECs remain the best available information from which to evaluate the action and they were utilized in both the BLMs (BLM 2018) and NMFS' analyses as screens for potential risk to ESA-listed fish.

Additional uncertainty with the available toxicity information exists in translating laboratory assays to field conditions and an individual organism's response. Traditional chemical evaluations have not routinely considered fish in impaired baseline habitat settings, which exist in portions of the action area (see Section 2.4). This uncertainty contributes to our conclusion that some sublethal effects are likely to occur from the proposed action. However, proposed BMP are expected to greatly reduce both the frequency and magnitude of exposures to infrequent and brief events in isolated locations. Since HQs do not exceed 1 and the BLM's proposed effective BMP for treatments, NMFS has increased confidence that most exposures will occur at reasonably safe levels. Glyphosate, picloram, and fluroxypyr likely pose the greatest threat given they have the highest HQs of the active ingredients evaluated. However, all products are assumed to have potential, albeit minor, to cause harm for short periods of time under the right delivery and environmental conditions. In addition, the highest HQs are tied to worst-case WCRs, which are unlikely to actually occur.

Table 11. Calculated fish hazard quotients from herbicides proposed for use on BLM-administered land within the Challis and Salmon field offices.

Active Ingredient and Product Name	Upper Bound Peak EEC (mg/L)[1]	Central Estimate Peak[1] EEC (mg/L)	Lowest 96-hour[2] LC50 (mg/L a.e. or a.i.)	Lowest Sublethal Effect Threshold[4] (mg/L)	Upper Bound Sublethal Hazard Quotient	Central Bound Hazard Quotient[3]
2,4-D amine *Weedar 64*	1.76	0.08	162[5] Non-toxic	4.78[6]	0.37	0.017
Aminopyralid *Milestone*	0.066	0.011	>100[7] Non-toxic	Partial loss of equilibrium at NOEC=50[4] mg/L[8]	0.001	0.0002
Chlorsulfuron *Telar XP*	0.024	0.025	40[9] Slightly	NOEC = 30[9]	0.0008	0.0008
Clopyralid *Transline*	0.035	0.01	103.5[11] Non-toxic	5.175[12]	0.007	0.002
Dicamba *Banvel*	0.02	0.006	28[13] Slightly	1.4[14]	0.014	0.0004
Glyphosate (w/ surfactant) *Roundup Original*	0.332	0.044	**1**[15] Highly Toxic	NOAEC = 0.05[16]	0.664	0.088
Glyphosate (no surfactant) *Roundup Custom*	0.332	0.044	**10**[15a] Moderately	NOEC = 0.5[16]	0.664	0.088
Imazapic *Plateau*	0.0003	0.00009	>100[17] Non-toxic	NOEC = 100[17]	0.00006	0.00002
Metsulfuron-methyl *Escort*	0.0003	0.0003	150[18]	NOEC = 10[18]	0.00003	0.00003
Picloram *Tordon 22K*	0.18	0.011	**4.8**[19] Moderately	NOEC = 0.19[20]	0.95	0.06[20a]
Sulfometuron methyl *Oust*	0.008	0.0004	**7.3**[21] Moderately	NOEC=7.3[22]	0.001	0.00006
Triclopyr TEA *Garlon 3A*	Acid: 0.48 TCP: 0.04	Acid: 0.006	Acid: 117[23] Non-toxic TCP: 1.5 Moderately	Acid NOAEC = 20[24] TCP: 0.075[24]	Acid: 0.024 TCP: 0.533	Acid: 0.0003
Fluroxypyr *Vista XRT*	0.04	0.011	16[25] Slightly	NOEC = 0.06[26]	0.667	0.183
Imazapyr terrestrial *Arsenal*	0.0135	0.03	115 Non-toxic	NOAEC = 10.4[29]	0.001	0.003
Rimsulfuron *Matrix*	NA	NA	>390 Non-toxic	NOAEL = 130[30]	NA	NA

[1]Peak estimated environmental concentration (EEC) is extrapolated from SERA assessments using the max application rate at the upper bound (i.e., worst-case scenario) and the central bound (more reasonable scenario) WCRs. Values are based modeling herbicide drift using a backpack sprayer (and aerial broadcast for aminopyralid, chlorsulfuron, imazapic, dicamba, metsulfuron-methyl, picloram and sulfometuron methyl) using Worksheet Maker 6.0. Each EEC is an extreme level and should be viewed as an extreme-case situation.
[2]EPA Toxicity Classifications to Address Acute Risk (LC50 mg/L) to Aquatic Organisms from Chemical Use - <0.1 (very highly toxic); 0.1-1 (highly toxic); >1-10 (moderately toxic); >10-100 (slightly toxic); and >100 (practically non-toxic).
[3]HQ values from Worksheet Maker 6.0 based on maximum application rates using central acute concentration levels for sensitive species. When sensitive species studies are unavailable, HQ values for tolerant species are used and noted. Chronic exposure levels were lower than acute levels unless noted.
[4]Either the NOEC or No Observed Adverse Effect Concentration (NOAEC) (as reported in SERA assessments) or 1/20th of the lowest LC50 for freshwater fish.
[5]Mayes et al. 1989c reported in USFS 2006
[6]LC50 = 95.6 mg/L for carp (SERA 2006) ÷ 20 = 4.78 mg/L
[7]SERA 2007
[8]For Rainbow trout, Marino et al. (2001a, MRID 46235814) in SERA 2007. The NOEC for chronic exposure is 1.36, HQ=0.003
[9]Grande, 1994 for brown trout, SERA 2004a
[10]Pierson, 1991 in SERA 2004a
[11]Dow Chemical 1980e using an unspecified life stage of rainbow trout reported in SERA 2004b LC50 = 103.5 mg/L (÷20 = 5.175). The NOEC for chronic exposure is 10. HQ=0.0004
[12]Fairchild, 2009 in SERA 2004b
[13]Woodward, 1982 in SERA 2004c
[14]Johnson and Finley, 1980 using rainbow trout reported LC_{50} = 28 mg/L in SERA 2004c (÷20 = 1.4)
[15]EPA and OPP 2008
[15a]Wan et al. 1989 rainbow trout in low pH in SERA 2011a
[16]SERA 2011a
[17]SERA 2004d
[18]Hall 1984a using rainbow trout reported in SERA 2004e
[19]Johnson and Finley, 1980 using rainbow trout reported in SERA 2011b
[20]Woodward, 1979 for cutthroat trout reported in SERA 2011b
[20a]The NOAEC is 0.0035 for aerial application with an HQ of 0.2
[21]Brown 1994a MRID 43501801 on Fathead minnow in SERA 2004f.
[22]SERA 2004f
[23]Value based on geometric mean of 130.7 for Triclopyr TEA (triethylamine) as reported in SERA 2011c
[24]Value based on Triclopyr TEA (triethylamine) as reported in SERA 2011c
[25]Wan et al 1992 in SERA 2009.
[26]Rick et al 1996a in SERA 2009.
[27]Yurk and Wisk 1994b MRID 43193231 using rainbow trout in SERA 2010.
[28]SERA 2010 for sheepshead minnow
[29]SERA 2011d; NOAEC is 4 for chronic exposures with an HQ of 0.009
[30] BLM ERA 2014
NA – Not Applicable. Although there is no current SERA report with a WCR or EEC listed for rimsulfuron, BLM completed a similar risk assessment for this chemical in 2014 (AECOM 2014).

Indirect Effects. In addition to effects of direct exposure on ESA-listed fish, indirect effects of pesticides can occur through their effects on the aquatic environment and non-target species. Due to the paucity of information, there are uncertainties associated with the following factors: (1) The fate of herbicides in streams; (2) the resiliency and recovery of aquatic communities; (3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; (4) the effects of pesticide mixtures that include adjuvants or other ingredients that may affect species differently than the active ingredient; and (5) the mitigating or exacerbating effects of local environmental conditions. Where uncertainties cannot be resolved using the best available scientific literature, the benefit of the doubt should be given to the threatened or endangered species in question [H.R. Conf. Rep. No. 697, 96th Cong., 1st Sess. (1979)].

The likelihood of adverse indirect effects is dependent on environmental concentrations, bioavailability of the chemical, and persistence of the herbicide in salmon habitat. For most herbicides, including those in the proposed action, there is little information available on environmental effects such as negative impacts on primary production, nutrient dynamics, or the trophic structure of macroinvertebrate communities. Most available information on potential environmental effects must be inferred from laboratory assays; although a few observations of environmental effects are reported in the literature.

Indirect effects of contaminants on ecosystem structure and function are a key factor in determining a chemical's cumulative risk to aquatic organisms (Preston 2002). Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to acute toxic effects of herbicides. Therefore, chemicals can potentially affect the structure of aquatic communities at concentrations below thresholds for direct impairment in salmonids. Because the integrity of the aquatic food chain is an essential biological requirement for salmonids, the possibility that herbicide applications will limit the productivity of streams and rivers is an unknown risk of the proposed action.

Juvenile Pacific salmon feed on a diverse array of aquatic invertebrates, with terrestrial insects, aquatic insects, and crustaceans comprising the large majority of the diets of fry and parr in all salmon species (Higgs et al. 1995). Prominent taxonomic groups in the diet include *Chironomidae* (midges), *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), *Tricoptera* (caddisflies), and *Simuliidae* (blackfly larvae); as well as amphipods, harpacticoid copepods, and daphnids. Chironomids in particular are an important component of the diet of nearly all freshwater salmon fry (Higgs et al. 1995). In general, insects and crustaceans are more acutely sensitive to the toxic effects of environmental contaminants than fish or other vertebrates. However, with a few exceptions (e.g., daphnids), the impacts of pesticides on salmonid prey taxa have not been widely investigated.

Factors affecting prey species are likely to affect the growth of salmonids, which is largely determined by the availability of prey in freshwater systems (Mundie 1974). Food supplementation studies (e.g., Mason 1976) have shown a clear relationship between food abundance and the growth rate and biomass yield of juveniles in streams. Therefore, herbicide applications that kill or otherwise reduce the abundance of macroinvertebrates in streams can also reduce the energetic efficiency for growth in salmonids. Less food can also induce density-dependent effects, such as increased competition among foragers as prey resources are reduced (Ricker 1976). These considerations are important because juvenile growth is a critical determinant of freshwater and marine survival (Higgs et al. 1995). A study on size-selective mortality in Chinook salmon from the Snake River (Zabel and Williams 2002) found that naturally reared wild fish did not return to spawn if they were below a certain size threshold when they migrated to the ocean. There are two primary reasons mortality is higher among smaller salmonids. First, fish that have a slower rate of growth suffer size-selective predation during their first year in the marine environment (Parker 1971; Healey 1982; Holtby et al. 1990). Growth-related mortality occurs late in the first marine year and may determine, in part, the strength of the year class (Beamish and Mahnken 2001). Second, salmon that grow more slowly may be more vulnerable to starvation or exhaustion (Sogard 1997).

It is possible that the action may also cause detrimental effects when non-target plants are killed by herbicides. Herbicide spraying in riparian areas can kill non-target plants that provide streambank stability, shade, and cover for fish. Spraying can also increase surface runoff by creating areas of bare soil devoid of any vegetation. This is particularly true for non-selective herbicides that kill all plants, such as glyphosate. However, non-target species killed by herbicides tend to be mostly forbs, grasses, and legumes, which are capable of reestablishing themselves within a few growing seasons. Although shrubs and trees are also susceptible to herbicide effects, the quantity of herbicide applied during spot spraying in riparian areas is not likely to kill mature shrubs or trees that have matured beyond the pole stage. In addition, the BLM will conduct site assessments prior to spraying to determine the most appropriate spray patterns, herbicides, and application rates to use to further reduce the potential for injuring or killing non-target species.

In contrast to the potential for non-target plant impacts to negatively influence fish growth and survival, eradication or control of invasive plants may produce some beneficial effects to fish. Beneficial effects may result from reestablished desirable vegetation and associated potential for reduced sediment delivery as infested site acreage is reduced (Herron et al. 2001; Larson 2003). Over the 15-year action period, these types of beneficial effects could be significant, particularly in localized areas where existing infestations are high and currently impairing riparian health and function or contributing to stream sedimentation, both of which can reduce salmonid survival and or growth. Invasive plant expansion is recognized as a threat in NMFS' draft recovery plan, so successful treatment of existing and prevention of future infestations should assist with reducing threats to the recovery and survival of affected fish populations, even if only to a minor level.

The majority of active ingredients proposed for use will not remain persistent in soils beyond the season of application, with only a few persisting for more than 50 days Table 9. Although aminopyralid, imazapic, imazamox, imazapyr, and picloram tend to be most persistent, only imazapyr is expected to persist beyond the year of application. Imazapyr is proposed for both upland and riparian treatments, and the BA identified both the aquatic (Habitat) and terrestrial (Arsenal) formulations for potential use. Neither formulation will be applied directly to water, to areas where surface water is present, or to areas below the OHWM in watersheds with ESA-listed species. Even though persistent in soils, it is not expected to affect fish long-term as it is rapidly degraded by sunlight in solution should it reach action area waters; and it is considered practically non-toxic to fish with LC_{50} values of >100 milligrams a.e. per liter (mg a.e./L) (Appendix A).

Available Information. Available information on the toxicological effects of each of the active ingredients and EUP proposed for use is summarized in Appendix A (Table A-1). Tables 11 and 12 summarize toxicity information for active ingredients and surfactants, respectively. NMFS did not calculate HQs for the surfactants because no EECs were available. Rather, NMFS characterized their ecological risk using EPA's classification system for ecotoxicity. The ecological risk characterizations are: <0.1 (very highly toxic); 0.1–1 (highly toxic); >1–10 (moderately toxic); >10–100 (slightly toxic); and >100 (practically non-toxic). Table 11 summarizes the ecotoxicity data for each active ingredient, and proposed surfactant known at this time. Additional surfactants may be added with Level 1 approval. In order to address toxicity concerns related to the use of adjuvants/surfactants in riparian areas, BLM proposes to use only Washington State aquatic-certified adjuvants in riparian areas or in aerial applications in watershed with ESA listed fish (Washington State 2016).

As previously discussed, many of the proposed EUPs contain significant proportion of inert ingredients and many recommend adding a surfactant. The designation as "inert" does not mean an additive is chemically inactive, and it does not convey any information about the toxicity of the ingredient (Tu et al. 2003). In addition to increasing the herbicidal effect of the active ingredient, inert ingredients can have toxic properties in and of themselves. Because many manufacturers consider inert ingredients to be proprietary, they do not list specific chemicals. In some cases the toxicity of the inert ingredient may be greater than the toxicity of the active ingredient (Solomon and Thompson 2003).

Manufacturers of many of the EUPs proposed for use by the BLM recommend the addition of a surfactant. There are numerous surfactants available on the market, some of which have reported toxicity (i.e., acute lethality) information. Toxicity (LC_{50}) values reported for surfactants commonly added to glyphosate field solutions typically range from 1 to 10 milligrams per liter (mg/L) (SERA 2011a). However, there are some surfactants that are considered slightly toxic (LC_{50} values ranging from >10 to 100 mg/L) to practically non-toxic (LC_{50} values greater than 100 mg/L). As identified previously, the BLM proposes to use only Washington State aquatic-certified adjuvants in riparian areas (Washington State 2016). The toxicity of these surfactants are considered very low. These surfactants are not hazardous nor are they categorized by EPA as List 1 (inert ingredients of toxicological concern) or List 2 (potentially toxic other ingredients/high priority for testing inerts) compounds when used as intended and label directions are followed (CH2MHILL 2004). The toxicities of mixtures of these surfactants with the EUPs are largely unknown. Mitchell et al. (1987) tested the toxicity of Rodeo with and without a surfactant. Without the surfactant, the 96-hour LC_{50} for rainbow trout was 429 mg a.e./L. With the surfactant X-77, the 96-hour LC_{50} ranged from 96.4 mg a.e./L (rainbow trout) to 180.2 mg a.e./L (Chinook salmon). The addition of X-77 altered the toxicity of the formulation by up to four times. The SERA (2011a) assessment on glyphosate reports formulations with the POEA surfactant are many times more toxic than formulations without a surfactant and that non-POEA surfactants can also increase the toxicity of the active ingredient, but to a lesser degree than POEA surfactants. Knowing that the addition of a surfactant can increase the toxicity of an EUP is taken into account when evaluating the risk to ESA-listed species.

Table 12. Toxicity of active ingredients and surfactants proposed for use on BLM-administered land within the Challis and Salmon field offices.

Active Ingredient	Rainbow trout 96-hour LC_{50} (mg a.e./L)[1]	Lowest Sublethal Effect Threshold (mg a.e./L)[1]	Daphnid 48-hour LC50 (mg a.e./L)
2,4-D amine	162	4.78	25
Aminopyralid	>100[6]	NOEC = 50	>100
Clopyralid	103.5	5.175	225
Chlorsulfuron	40	NOEC = 30	>100
Dicamba[8]	28	1.4	100
Glyphosate (more toxic forms)	1.3–429	NOAEC = 0.05	1.5–62
Glyphosate (less toxic formulations)	10 -429	NOAEC = 0.5 - 21	>200
Imazapic	>100	NOEC = 100	>100
Imazapyr	115	NOAEC = 10.4	350
Metsulfuron-methyl	150	NOEC = 10	>150
Picloram	4.8	NOEC = 0.19	48
Sulfometuron-methyl	148	NOEC = 7.3	>150
Triclopyr	Acid: 117	Acid: NOAEC = 20	Acid: 132.9
	TCP: 1.5	TCP: 0.075	TCP: 10.9
Fluroxypyr	16	NOEC = 0.06	100
Rimsulfuron	>390 a.i/L	NOEAL = 130	16.7 a.i/L (EC_{50})

Active Ingredient	Rainbow trout 96-hour LC_{50} (mg a.e./L)[1]	Lowest Sublethal Effect Threshold (mg a.e./L)[1]	Daphnid 48-hour LC50 (mg a.e./L)
Surfactants			
Ethoxylated fatty amines			
Entry™ II (POEA)	4.27	NA	2.07
	0.56–7.4[7]	NA	2.07
Alkylphenol ethoxylate-based wetter/spreaders			
Activator 90	2.02	NA	2.02
*Spreader 90	3.35	NA	7.3 (96-hr)[5]
Super Spread 90[7]	NA	NA	9.3 -31.4
Acidifiers			
*LI 700	17–130[3,4]	NA	170–190[3]
Super Spread 7000[7]	NA	NA	NA
Oils			
*MSO Concentrate	35	NA	18
*Agri-Dex	>1,000	NA	1,000
Blends vegetable oils and silicone-based surfactants			
Syl-Tac	>5[5]	NA	>5[5]
*Phase	NA	NA	NA
*Competitor	95	NA	>100
*Dyne-Amic	23.2	NA	60
*Kinetic	13.9	NA	60.7
Colorants			
Hi-Light	NA	NA	NA
Hi-Light WSP		NA	
Bullseye	NA	NA	35,747
Marker Dye		NA	
Signal		NA	
Spreader/Sticker			
*Bond	>100	NA	100
*****Tactic	>100	NA	310
Other			
*Bronc Max (Fertilizer Based)	>100	NA	>100
*Bronc Plus Dry EDT (Fertilizer Based)	382.9	NA	223.6
Choice Weather Master (Water Conditioning)	NA	NA	100
*Cut-Rate (Water Conditioning)	782.2	NA	223.6
*Liberate (Deposition Aid)	17.6	NA	9.3
*Cygnet Plus (Deposition Aid)	45	NA	6.6

[1] Lowest available LC_{50} values for salmonids, obtained from the most recent SERA risk assessments. Additional detail also available in Table 21. For triclopyr, the values presented are for the formulated product and a metabolite. For Glyphosate a range was presented, please see SERA 2011a due to extreme variability between EUP, adjuvants, and studies. For fluroxypyr, 14.3 was for bluegill, and was the only LC_{50} for a known formulation. However, it is above the solubility of fluroxypyr in water and actual concentration in water will be much lower than nominal concentration, making adverse effects unlikely. For Rimsulfuron, multiple coldwater fish species were used.

[2] McLaren-Hart Environmental Engineering Corporation 1995; [3]LI 700 Safety Data Sheet (SDS); [4]Smith et al. 2004; [5]Bakke 2003 and 2007; [6]No mortality in any study, maximum concentration evaluated was 100 mg a.e./L; [7]SDS Milliken.

Key: NOEC – no observed effect concentration; NOAEC – no observed adverse effect concentration; NOAEL – no observed adverse effect level: and NA – not available.

*Indicates Washington State approved aquatic surfactant

2.5.1.5 Assessment of Ecological Risk

Assessing the potential ecological risk associated with the use of pesticides is a complicated task. This is in part because there are numerous active ingredients, EUPs, adjuvants, and mixtures that can be applied on the ground. There is also limited available information upon which to evaluate the risk of pesticide use on the survival and recovery of endangered species. A general discussion about each of these is below and is followed by a discussion of the assessment methodology and summary.

Active Ingredients, End-Use Products, and Adjuvants. Toxicological effects of herbicides must be assessed before they can be registered for use. The EPA registers several types of chemicals and chemical formulations under FIFRA: pure (or nearly pure) active ingredients (also known as the technical grade active ingredient [TGAI]), manufacturing use products (MUP), and EUP. The TGAI is the component which kills/controls the target species. A MUP is any pesticide product other than an EUP. It may consist of just the technical grade active ingredient, or a combination of the TGAI along with inert ingredients such as stabilizers or solvents. An EUP is a product that may be any combination of TGAIs, MUPs, and additional inert ingredients. An EUP may not be used to manufacture or formulate other pesticide products, and it must have a label specifying the directions for use. Each TGAI registered by EPA may have more than one registered MUP, which in turn may have more than one registered EUP. By 1997, approximately 890 active ingredients and more than 20,000 EUPs were registered under FIFRA (Aspelin and Grube 1999).

The MUPs or EUPs containing the same active ingredient may have different toxicities to aquatic organisms. This is because they have different formulations (i.e., different proportion of active ingredient, different inert ingredient composition, or different proportions of each inert ingredient). The EPA's registration process does not require that all EUPs be tested for their toxicity. Rather, EUPs that are similar in their formulation and their use may be "batched." Batching the registration process allows manufacturer(s) to select a representative EUP and conduct toxicity tests on that single EUP. The other EUPs within that batch are assumed to have similar toxicities; therefore, there are some EUPs whose toxicological effects have not been directly tested.

Because not all EUPs have been directly tested, evaluating the risk to ESA-listed fish requires NMFS to examine whether EUPs can be considered similar. The best way to assess the similarity of EUPs is to examine their labels and SDS to see the form of active ingredient, proportion of active ingredient, and type/composition of inert ingredients. Table 13 summarizes the available information for potential EUPs the BLM may potentially use relative to each active ingredient.

In addition to not having toxicity information for all EUPs, there is generally little, if any, toxicity information available for adjuvants and EUP mixtures. Adjuvants are generally defined as any substance added separately to a pesticide EUP (typically as part of a spray tank mixture) to enhance the activity of the herbicide or assist with the application. Adjuvants most commonly used on the BLM are surfactants and dyes. When a formulation does not contain a surfactant, the product label will often indicate that a nonionic surfactant must or should be added to the field solution prior to application. Some surfactants are toxic by themselves and have been documented to increase the toxicity of formulations in comparison to technical grade active ingredients (SERA 2011; Stark and Walthall 2003). The increase in toxicity is not necessarily additive, but depends on the type of surfactant used as well as the proportion of surfactant in the formulation or tank mixture. Even in light of this, the surfactants used in formulations are not always known and there is a paucity of toxicity testing on many of the surfactants.

Limitations of Available Information. Although toxicity data are needed to register active ingredients and EUPs, much of the available information still only addresses toxicity of the active ingredient, and does not address all individual EUPs (including their inert ingredients) and adjuvants. Furthermore, much of the available toxicity information focuses on direct lethality from the active ingredient and little published chronic toxicity data is available to assess the risk of herbicides on fish (Fairchild et al. 2009a; Fairchild et al. 2009b). This may be due to their limited toxicity in available acute tests (ENTRIX 2003). The lethal endpoint has little predictive value for assessing whether pesticide exposure will cause sublethal neurological and behavioral disorders in wild salmon (Scholz et al. 2000; Weis 2014). Many of the toxicological endpoints previously listed have not been investigated for the herbicides used in the proposed action (Stehr et al. 2009). Although Stehr et al. (2009) did not find evidence of early life history developmental impacts on salmonid surrogates exposed to six forestry herbicides (each proposed in this action) at higher concentration than anticipated under this action, there is little information available on the sublethal effects (e.g., feeding, spawning, or migration) or ecological effects (e.g., effects on fish behavior, prey composition or availability) of the active ingredients, EUPs, and tank mixtures (Baldwin et al. 2009; Weis 2014). Most toxicity studies are performed in laboratory settings, with strictly controlled environmental conditions. Baseline environmental conditions are not controlled and in many locations are functioning at risk or unacceptable risk – typically in the form of higher sediment levels, elevated water temperatures, reduced space, and simplified habitats (see Section 2.4). Test conditions also lack exposure to predators, reduced competition (Jones et al. 2011), some pathogens and other natural hazards. Some authors have suggested laboratory bioassays may provide poor predictions of a toxicant's effects on natural populations when considered at an ecosystem level (Kimball and Levin 1985; Cairns 1983) while others, when evaluating metals toxicity, suggest there may be little differences between lab and natural condition impacts on fish (Larson et al. 1985). Laetz et al. (2014) found elevated temperature alone increased toxicity of mixed pesticides. In the event field conditions are more stressful to fish or their prey, herbicide exposure may have different effects than produced under laboratory conditions. It is also possible that environmental factors such as sediment availability or sunlight may bind or degrade herbicides at different rates than under laboratory conditions and thus present lower toxicity. Given there is some uncertainty in extrapolating laboratory effects of herbicide exposures directly to field conditions some level of caution is warranted to ensure protection of ESA-listed fish.

In summary, a portion of the herbicides applied to the action area may contaminate water in concentrations high enough to cause adverse effects to ESA-listed fish or other aquatic organisms. These effects will be most likely when herbicide is applied in riparian areas. However, the effects will occur infrequently, be of small magnitude, be widely spaced geographically, and produce very low herbicide concentrations.

Table 13. Characteristics of end-use products that may be used on BLM-administered land within the Challis and Salmon field offices.

Active Ingredient	Examples of End Use Product[1]	EPA Registration Number	Manufacturer	% a.i. (*other a.i.s. in EUP*)	% Other Ingredients	Rainbow trout LC_{50} (mg a.e./L)[2]
2,4-D amine*	2,4-D Amine 4[3]	1381-103	WinField Solutions	47.3	Not Otherwise Specified (NOS) (52.7%)	Not Reported
	Weedar 64[4]	71368-1	Nufarm Americas	46.8	NOS (53.2%)	250 (a.i.); 208 (a.e.)
	Riverdale Weedestroy (PLATOON)AM-40[5]	228-145	Nufarm Americas	46.8	NOS (53.2%)	250 (a.i.); 208 (a.e.)
Aminopyralid	Milestone	62719-519	Dow AgroSciences	40.6	Water (59.4%)	>100
Chlorsulfuron	Telar XP	352-651	Du Pont	75	NOS (25%)	>122
Clopyralid*	Transline	62719-259	Dow AgroSciences	40.9	Isopropanol (5%) Polyglycol (1%) NOS (53.1%)	103.57[6]
Dicamba*	Banvel	66330-276	Arysta Lifescience North America	48.2	NOS (51.8%)	>1,000 (a.i.); >350 (a.e.)
	Vanquish	100-884	Syngenta	56.8	NOS (43.2%)	135.4 (a.i.); 52.1 (a.e.)
Glyphosate*	Rodeo	62719-324	Dow AgroSciences	53.8	Water (46.2%)	>2,500 (a.i.); >430 (a.e.)
	AquaMaster	524-343	Monsanto	53.8	Water (46.2%)	>1,000 (a.i.); >172 (a.e.)
	AquaNeat Aquatic Herbicide	228-365	Nufarm Americas	53.8	Water (46.2%)	86
	Glyfos Aquatic	4787-34	Cheminova Inc.	53.8	Water (46.2%)	>1,000 (a.i.); 172 (a.e.)
Imazapic	Plateau	241-365	BASF Corporation	23.6	NOS (76.4%)	>100 (a.i.); >94 (a.e.)
Imazapyr*	Habitat	241-426	SePro	28.7	NOS (71.3%)	>100 (a.e)
	Arsenal	241-346	BASF Corporation	27.8	NOS (72.2)	21 (a.e.)
	Chopper	241-296	BASF	27.6	NOS (72.4%)	Not Reported
Metsulfuron methyl	Escort XP	352-439	Du Pont	60	NOS (40%)	>150
Picloram*	Tordon 22K	62719-6	Dow AgroSciences	24.4	Polymer (1.7%) NOS (73.9%)	Not Reported
Sulfometuron methyl	Oust XP	352-601	Du Pont	75	NOS (25%)	>148
Triclopyr TEA*	Garlon3A	62719-37	Dow AgroSciences	44.4	Ethanol (2.1%) NOS (50.5%)	286
Fluroxypyr	Vista Ultra, Vista XRT	62719-586	Dow AgroSciences	45.52	NOS 54.5%	>100

Active Ingredient	Examples of End Use Product[1]	EPA Registration Number	Manufacturer	% a.i. (*other a.i.s. in EUP*)	% Other Ingredients	Rainbow trout LC_{50} (mg a.e./L)[2]
Fluroxypyr	Alligare Fluroxypyr Herbicide	66330-385-81927	Alligare LLC	45.5	Napthalene <5.4%; N-Methyl-2-pyrrolidinone 7.5%; Heavy aromatic naptha solvent 38.1–38.4%; 2-methylnapthalene <9.4%; 1-mehylnapthalene <4.7%; Benzenesulfonic acid, mono-C11-13- branched alkyl derivs., calcium salts 109–2.1%	13.4 – 100
Rimsulfuron	Matrix®	352-768	Dupont Crop Protection	25	NOS 75%	>390 (a.i./L)

*These active ingredients (a.i.) are no longer under patent and are now produced generically by various manufacturers, including the original manufacturer.
[1]EUP shown here represents brands most commonly used by Forest Service, although brands other than those listed may also be used under the proposed action.
[2]The LD_{50}/LC_{50} is the dose/concentration of a chemical that kills 50 percent of the test organisms.
[3]This product is also sold under the following names: 2,4-D Lo V (Universal Crop Protection Alliance) and 2,4-D Amine.
[4]This product is sold under the following additional names: Base camp Amine 4 (by Wilbur-Ellis Company) and tenkoz amine 4 2,4-d (by Tenkoz, Inc.).
[5]This product is sold under 20 different product names (PAN 2012).
[6]Value is for the 3,6-dichloropicolinic acid and not the EUP. The Rainbow trout LC_{50} for the Monoethanolamine salt (a.i.) of clopyralid is 700 mg a.e./L.

2.5.2 Effects on Designated Critical Habitat

The action area contains designated critical habitat for Snake River spring/summer Chinook salmon, and Snake River Basin steelhead. Critical habitat within the action area has an associated combination of PBFs essential for supporting freshwater rearing, migration, and spawning for both species.

The critical habitat elements most likely to be affected by the proposed action include water quality, riparian vegetation, natural cover/shelter, and forage/food. Modification of these PBFs may affect freshwater spawning, rearing or migration in the action area. Proper function of these PBFs is necessary to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and the growth and development of juvenile fish.

The proposed weed treatment areas are scattered in various sized patches across BLM-managed lands. Potential effects of weed spraying on designated critical habitat will vary at each location depending on the size of the treatment area, the chemicals used, method of application, distance from water, and vegetative characteristics of the treatment areas. If chemicals were to reach the water in an appreciable amount, a variety of biological effects could occur, including harmful effects on listed fish or other aquatic organisms due to direct exposure to the chemicals or indirectly from changes in the biotic community. In general, most instream effects of herbicides are short-lived, discreet events associated with spills, drift, or runoff events. Following the events causing contamination, critical habitat elements are likely to return to normal within a few hours to a few days. None of the chemicals proposed for use would result in long-term alteration of critical habitat through water contamination.

Long-term changes in critical habitat features are possible as a result of changes in terrestrial vegetation, but the effects are subtle and poorly understood. Herbicide use may affect critical habitat beneficially by restoring natural plant communities and reducing erosion (Herron et al. 2001; Larson 2003); or affect it adversely, where desired plant species are killed unintentionally.

The use of herbicides can potentially affect physical watershed and stream functions through the removal of vegetation and exposing bare soil. With the proposed spot spraying, injecting, painting, dipping, and wicking, the potential for significant increases in erosion or water yield is limited because treatments would consist of small, scattered areas, and vegetation would likely be reestablished within a few months to a year. The potential for non-target mortality of meaningful numbers of riparian plants is negligible given the proposed application methods. Broadcast aerial helicopter spraying has a higher potential to affect larger tracts of vegetation, potentially exposing larger patches of bare soil post treatment. However, 300-foot no-spray buffers will be employed for all aerial spraying, and weather conditions will be monitored to best ensure that herbicide drift does not occur into those 300-foot buffers and streams. These buffers should be adequate to ensure that any sediment generated as a result of aerial application will be effectively filtered out by unharmed riparian vegetation. Therefore, aerial application is not expected to affect the conservation value of the riparian vegetation PBF in the action area.

Noxious weed control measures will reduce weed competition between weeds and native plant species. Herbicide spraying in riparian areas will be minimal and will primarily be associated with spot spraying of small patches of noxious weeds or individual plants. No measurable adverse effects to peak/base flow, water yield, or sediment yield are likely to occur from implementation of noxious weed control and rehabilitation measures. Chemical removal of dense noxious weed stands may result in short-term, negligible increases in surface erosion that would diminish as native vegetation reoccupies the treated site. Only spot spraying, wicking, dipping, painting, and injecting applications using only aquatic approved herbicides and surfactants are proposed within 50 feet of live water. This precautionary measure significantly reduces risks associated with spraying of non-target riparian vegetation and the likelihood of accidentally spraying herbicides directly into the water. Given the above considerations, the potential for adverse effects on physical characteristics of critical habitat (other than water quality) is negligible due to treatment areas being scattered in small blocks, precautionary measures to keep chemicals out of the water, and limited potential for herbicides to adversely alter riparian vegetation or other vegetation characteristics that affect critical habitat.

The potential for adverse effects on biological components of critical habitat (such as invertebrates and aquatic plants) from water contamination by herbicides is negligible at spatial scales of an individual stream or larger, but local adverse effects on biological components are possible in treatment areas where herbicides reach water. Adverse effects on the biological component of critical habitat that are most likely to occur as lethal and sublethal toxicological effects on species either foraged on or used as cover by ESA-listed fish (e.g., aquatic invertebrates, or macrophytes). Effects of salmonid exposure to herbicides were evaluated in this Opinion in the previous section. Such effects are expected to be isolated to short segments of stream where a delivery occurs, persist only briefly (due to physical herbicide properties and rapid dilution to benign levels), and affect only small areas that are scattered widely across the broad action area. Secondarily, there is a risk of adverse effects on aspects of the biological community that supports listed fish. However, secondary effects are unlikely given the limited circumstances where herbicides are likely to enter water and the small amount of herbicides used at any particular location.

Although the incidence of herbicides reaching water in an appreciable amount under the proposed action is likely to be infrequent, herbicides are capable of altering the biotic composition of aquatic species when they reach water (Macneale et al. 2010). A notable concern is the potential for impacts on benthic algae. Benthic algae are important primary producers in aquatic habitats and are thought to be the principal source of energy in many mid-sized streams (Minshall 1978; Vannote et al. 1980; Murphy 1998). Herbicides can cause significant shifts in the composition of benthic algal communities at concentrations in the low ppb (Hoagland et al. 1996). Moreover, based on the data available, herbicides have a high potential to elicit significant effects on aquatic microorganisms at concentrations that may occur with normal usage under the label instructions (DeLorenzo et al. 2001) that do not include many of the precautionary measures (such as buffers, wind restrictions, application methods, etc.) that are part of the proposed action. In most cases, the sensitivities of algal species to herbicides and their response to herbicides are not known. Herbicides have the potential to decrease or increase algal production and, by extension, alter the trophic support for stream ecosystems. However, the community response to changes in the algal community is unpredictable. Limited information is available on the ecological effects of the herbicides in streams, making it difficult to predict the degree of ecological risk to salmon and steelhead from alteration of the biological community. In general, human activities that modify the physical or chemical characteristics of streams often lead to changes in the trophic system that ultimately reduce salmonid productivity (Bisson and Bilby 1998, Baldwin et al. 2009; Macneale et al. 2010). Consequently, herbicides have the potential to affect salmonid productivity through their effects on the biotic community. However, the potential for alteration of the biotic community under the proposed action is limited due to precautionary measures intended to keep herbicides from reaching water.

The herbicides may either increase or decrease growth in various algae and microphyte species, and the growth effects for a given species may go either direction, depending on the concentration. Similarly, certain aquatic invertebrates may decrease in number from direct exposure to herbicides or reduction in food sources, while other species may increase in number, in response to changes in primary productivity or community composition. Available tools and information cannot reliably predict such complex responses for this specific action; consequently, there is considerable uncertainty about ecological effects of the action.

Although changes in the biological community appear likely from herbicides that reach the water, adverse effects of herbicides on primary production and the invertebrate community are likely to be limited in size to stream reaches in the vicinity of application areas where herbicides may reach water in appreciable concentrations. The invasive plant program includes numerous safeguards intended to eliminate or minimize water contamination; and any water contamination from herbicides is not likely to persist due to the small amount of chemicals proposed for use at any given application site and the dispersed use of chemicals. Therefore, the proposed action is unlikely to appreciably diminish the conservation value of designated critical habitat within action area streams.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.3).

The action area occurs in Lemhi and Custer Counties. Between 2010 and 2017, the populations of Lemhi and Custer Counties are estimated to have decreased approximately 0.8 percent and 4.4 percent[5], respectively. A significant portion of the valley bottom segments of the Salmon, East Fork Salmon, Pahsimeroi, and Lemhi Rivers are in private ownership. The action area is

---

[5] U.S. Census Bureau, State and County Quickfacts, Custer and Blaine Counties. Available at https://www.census.gov/quickfacts/fact/table/custercountyidaho,lemhicountyidaho,US/PST045217

limited to the BLM-managed lands. Although the action area is limited to BLM-administered lands, many BLM parcels occur immediately downstream of private parcels and some State parcels. Typical private and state land uses in the area are agriculture, timber harvest, road construction/maintenance, residential development, recreation, mining, and livestock grazing. Current levels of these uses are likely to continue, but detailed information on other non-federal activities in the action area is not generally available.

Livestock grazing on adjacent state or private lands may partially counteract weed control efforts on the BLM land. Cattle can spread weeds through their manure, and create conditions that increase the likelihood that invasive weeds will out-compete native plants. Extensive grazing on non-BLM managed lands may increase the need for weed treatments on and off the BLM during the 15-year term of the action. Grazing on non-federal lands may also degrade water temperature and water quality in portions of the action area.

Streamflows in the action area are appreciably affected by water diversions, with numerous stream diversions existing on private lands. Reduced streamflows in small streams could affect the herbicide dilution rates should they reach action area waters, increasing the likelihood of herbicide concentrations reaching levels that might result in adverse effects. Impaired water quality from ongoing agricultural activities is likely to be one of the largest cumulative effects present in the action area.

City, state, and county governments also have ongoing weed spraying programs with less-stringent measures to prevent water contamination. Weeds are sprayed along road right-of-ways annually by city, state, and county transportation departments, sometimes several times a year. Any herbicide contamination that occurs from the proposed BLM action could potentially combine with contaminants from other non-federal activities, and contribute to formation of chemical mixtures or concentrations that could kill or harm listed steelhead or salmon. In addition, fish stressed by elevated sediment and temperatures are more likely to be susceptible to toxic effects of herbicides. While the mechanisms for cumulative effects are clear, the actual effects cannot be quantified.

Active invasive plant treatments will continue to occur on private, county, and state managed lands – likely through actions conducted by CWMA participants or private individuals. Analysis of cumulative effects therefore addresses an analysis area encompassing all land ownerships within the 1.7 million-acre action area of which approximately 4 percent is private or state owned. Infested acres likely reflect infestation rates on the BLM, but concrete information is not available. Even if infestations are assumed to be twice as high as on federal lands, which is not likely accurate, the total infested area would still be small given the relatively small total holdings. The CWMA applicators are licensed and therefore likely to ensure proper adherence to labels and other BMPs. The CWMAs also routinely coordinate with federal agencies in order to avoid duplicating effort. These practices, and the applicators' training, reduce the likelihood of herbicide delivery to action area waters and thus also reduces the likelihood of cumulative effects related to water quality impacts within the area. Some private landowners are likely to treat their own infestations, and since they are not licensed and not always formally trained in proper application, they may present a greater potential for herbicide delivery to water.

There is not consistent or complete information for the herbicides used adjacent to the BLM. This led the BLM (BLM 2018) to assume the following for the purposes of analyzing cumulative effects:

1. Herbicides are being applied per the label.

2. Herbicides are being used on known non-native plants adjacent to the project area.

3. Herbicide treatments, including aerial and ground application of herbicides will continue on state-owned and privately-owned lands adjacent to and surrounding the BLM.

4. Applications of herbicides outside the project area are spatially distinct from treatments within the project area.

5. Herbicide treatments will not be concentrated in any one subwatershed in a given year.

Given the relatively small proportion of treatment across the landscape, the implementation of design criteria designed and utilized to protect sensitive species, and the use of label guidelines for proper application, cumulative adverse effects to aquatic species are not expected from the implementation of proposed activities. All the proposed treatments used in conjunction with treatment methods that neighboring land management agencies, landowners, and CWMA partners implement may serve to increase the efficacy of treatments which could result in beneficial cumulative impacts to aquatic habitats as invasive species presence is reduced over time.

Ongoing and future State and private activities will likely influence water quality, quantity, and habitat conditions for fish in the action area. For example, State road maintenance activities, which often occur adjacent to action area waterways, frequently include weed treatments, chemical applications to road surfaces, and/or soil disturbances. Those activities may have brief impacts on individual channel segments resulting in temporary habitat alteration. Similarly, private activities are likely to continue to include agricultural and development practices that contribute sediment, elevate water temperatures, and potentially contaminate water via herbicide and other pesticide applications. Herbicides and pesticides in particular are frequently found in waters of the western United States. The U.S. Geological Survey's National Water Quality Assessment program reported more than 50 different pesticides and pesticide breakdown products in surface waters of multiple western river basins and there is at least some potential for chemical contamination to be additive or synergistic (Laetz et al. 2009). Rodney et al. (2013) found little evidence of pesticide synergism at realistic environmental concentrations, suggesting little risk of synergism between State and private future activities and the proposed action.

Where ongoing State and private activities influence habitat conditions to the degree individual fish are affected (i.e., reduced growth, elevated stress, etc.) even minor chemical contamination resulting from the proposed action may result in sublethal effects that may not occur if habitat conditions were unaffected by future State/private actions. Cumulative effects are likely to affect ESA-listed species, PBFs, and the conservation role of critical habitat in a manner similar to that described in the effects analysis of this Opinion. Although quantifying an incremental change in survival for the DPS/ESUs or in the conservation role of critical habitat considered in this consultation due to cumulative effects is not possible, it is reasonably likely that small, temporary to short-term adverse effects on ESA-listed species and critical habitat could occur when herbicide is applied in riparian areas. However, the effects will occur infrequently, be of small magnitude, be widely spaced geographically, and produce very low herbicide concentrations.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species.

As described above, outright acute lethality of ESA-listed fish species as a result of the proposed action is unlikely to occur. Likewise, cumulative effects are unlikely to result in mortality of the species under consideration. However, there is the potential for delayed mortality and sublethal effects to occur from both the proposed action and cumulative effects. As previously described, lethal concentrations of herbicides are unlikely to occur, even when considering the status of the baseline and cumulative effects in the action area. Most of the available information pertains to acute lethality; however, acute mortality data is not appropriate for estimating whether a pesticide will have adverse, non-lethal effects on the essential behavior patterns of salmonids (e.g., feeding, spawning, or migration). Although not all-inclusive, a variety of sublethal effects on fish are reported for the herbicides evaluated in this Opinion. The effects were documented at concentrations that are likely to occur on occasion in the action area. However, it cannot be determined from the available information if the sublethal effects reported in laboratory assays are severe enough to "harm" listed fish through mortality at a later life stage or through reduced reproductive output. From this information, we can infer that the likelihood of harm occurring from sublethal effects of the herbicides cannot be discounted; however, the actual likelihood of harm occurring from the proposed action is unknown. The most likely way that fish will suffer adverse effects will be from riparian treatments and that the effects of these treatments will be.

The populations affected in ESA-listed species (ESUs/DPSs) do not currently meet VSP criteria; however, in spite of uncertainties regarding toxic effects of the herbicides, the effects will not be substantial enough to negatively influence VSP criteria at the population scale. The likelihood of jeopardizing listed salmon or steelhead through harm from sublethal effects or outright mortality is highly improbable due to the following circumstances:

1. Any harm that might occur from sublethal effects is expected to affect only a small portion of the action area in any given treatment year.

2. Detectable water contamination is not expected to occur.

3. Any contamination that does occur will be isolated and of short duration (e.g., small, localized spikes in herbicide concentration following a rainfall).

4. The areas where herbicides would be applied are widely scattered and the aerial treatment areas will have a 300-foot no application aerial herbicide buffer around all live water (perennial streams, flowing intermittent streams, lakes, ponds, springs, and wetlands). Consequently, only scattered portions of listed salmon and steelhead populations would be exposed to risks from this action.

5. Weed treatment areas are most prevalent in dry portions of the action area. The dry areas are typically herbaceous communities that lack a tree canopy and receive little summer precipitation. There are few streams in these environments that naturally support anadromous fish. Consequently, herbicides that would be used in a large portion of the treatment areas have little or no potential for reaching waters supporting ESA-listed fish.

In terrestrial areas, the proposed action is not likely to alter hydrologic processes or riparian vegetation to an extent that affects the stream environment. The proposed action will have localized short-term effects on riparian vegetation through the intentional eradication of weeds and any incidental mortality of desired riparian plants exposed to herbicides. In the long term, weed control will help restore ecological functions of riparian communities where those functions have been impaired by invasion of exotic plants. Incidental losses of desired plants will be sporadic and localized in riparian areas since aerial application will occur at least 300 feet from streams, and herbicides applied in riparian areas will be applied to individual plants, primarily by wicking, painting, wiping, and spot spraying.

In aquatic environments, herbicides are capable of altering the biotic composition of aquatic species when they reach water, thereby affecting salmonid productivity. Limited information is available on the ecological effects of the herbicides in streams, making it difficult to predict the degree of ecological risk to salmon and steelhead from alteration of the biological community. Riparian herbicide treatments are the most likely way that direct adverse effects to fish may occur. Although changes in the biological community appear likely from herbicides that reach the water, adverse effects of herbicides on primary production and the invertebrate community are likely to be limited in size to stream reaches or waterbodies in the vicinity of application areas where herbicides may reach water in appreciable concentrations. The weed program includes numerous safeguards intended to eliminate or minimize water contamination; any water contamination from herbicides is not likely to persist due to the small amount of chemicals proposed for use at any given application site and the dispersed use of chemicals. Considering this, the proposed action is unlikely to appreciably diminish the conservation value of designated critical habitat for the following reasons:

1. Any significant chemical contamination is likely to be infrequent, dispersed, and of short duration due to restrictions on the specific herbicides allowed in riparian areas, methods for applying the herbicides, and amount of herbicide applied to any given area which preclude large or persistent herbicide concentrations.

2. Where chemical contamination occurs, concentrations are not likely to reach levels that alter the biological community in a manner that would appreciably alter PBFs of designated critical habitat at spatial and temporal scales relevant to conservation of the species.

Climate change has been affecting environmental conditions in the action area for at least 50 years. Available data regarding environmental conditions relied upon to describe the environmental baseline for this consultation capture the change caused by global processes that have already occurred and its impacts on ESA-listed salmonids and their designated critical habitats. As we determined above, with the exception of improved vegetative conditions, the direct or indirect effects of the proposed action are not expected to persist beyond the year of any application. Despite the action extending up to 15 years, plant treatments will not modify the environment, or cause fish to respond differently to herbicide exposures as a result of climate change influences on habitat or the species. Climate change cannot be meaningfully predicted for the short time period of the action given the intrinsic climate fluctuations that occur on interannual-to-decadal timescales; masking any signal from climate change over that time. Thus, the effects of the proposed action described in this Opinion fully incorporate our consideration of climate change for application of the ESA jeopardy and critical habitat standards.

2.8 Conclusion

After reviewing the current status of the listed species and their designated critical habitat, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' Opinion that the proposed action is not likely to jeopardize the continued existence of Snake River spring/summer Chinook salmon, Snake River sockeye salmon, and Snake River Basin steelhead. NMFS has also determined that the action is not likely to destroy or adversely modify their designated critical habitats.

2.9 Incidental Take Statement

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.8.1 Amount or Extent of Take

The proposed action is reasonably certain to result in incidental take of ESA-listed species. NMFS is reasonably certain the incidental take described here will occur because: (1) Recent and historical surveys indicate that listed species occur in the action area; and (2) the proposed action is likely harm individual listed salmon and steelhead through sublethal exposure to herbicides. These effects may occur as a result failure of design criteria to keep chemicals from entering water (i.e., human error), unexpected sublethal effects that have not been reported in the scientific literature, additive or synergistic effects of herbicides from multiple sources in the action area, or fish or invertebrate response to herbicide exposures at lower exposures due to other environmental stresses. Herbicides applied by the BLM are not expected to reach streams in concentrations that kill listed fish, and most take resulting from the action is likely to be short-term sublethal effects that are harmful to fish or secondary effects from brief changes in water quality or food availability.

NMFS anticipates that incidental take will not occur in upland treatment sites or in the majority of instances where herbicides are applied within 50 or feet of streams. Take is expected to occur when products with unknown highly toxic inert ingredients are used in riparian areas and in occasional circumstances where precipitation transports other herbicides into water in concentrations where sublethal or lethal effects are likely. Such circumstances are expected to occur only in sites where weeds are sprayed in the vicinity of small stream channels that are occupied by ESA-listed fish, and showers or thunderstorms deliver a pulse of herbicides to the occupied stream channels.

Despite the use of best scientific and commercial data available, NMFS cannot quantify the specific amount of incidental take of individual fish or incubating eggs for this action. The amount of take from the proposed action depends on the circumstances at the specific times and locations that weed treatments will occur, such as rainfall, wind, humidity, and proximity of invasive plants to individual fish or redds and physical conditions that influence drift or runoff. Because circumstances causing take are likely to arise, but cannot be quantitatively predicted from available information, the extent of incidental take is described, pursuant to 50 CFR 402.14[I].

Similarly, it is difficult for NMFS to quantify the extent of take for the action as proposed. The action generally restricts use of herbicides near water to those formulations with the lowest known toxicity and proposed design criteria minimize the frequency and severity of water contamination events and thus reduce the amount of incidental take likely to occur. However, the BMP do not completely eliminate potential for incidental take since herbicides will be used in sites where they can reasonably be expected to reach waters where ESA-listed fish are present. Therefore, it is difficult for NMFS to quantify the extent of take for the action as proposed.

The amount of riparian acres where herbicides are applied adjacent to waters occupied by anadromous fish is a reasonable surrogate for describing the extent of take since these are the locations where chemicals are most likely to reach streams under the proposed action and affect the species being evaluated. Consequently, the amount of riparian acres treated adjacent to streams occupied by anadromous fish is a reasonable surrogate for describing the extent of incidental take in this ITS.

NMFS will therefore use the acreage where herbicides are applied within 50 feet of live water as a reasonable surrogate for describing the extent of take. In many places where herbicides are applied within 50 feet of water, take is not anticipated to occur. The choice of the particular herbicides and the BMP in the proposed action are likely to minimize the frequency and severity of incidental take in those places where chemicals reach the stream. However, chemicals are most likely to reach streams when they are applied to riparian areas, road ditches, floodplains, or ephemeral drainage features in close proximity to water. Consequently, the acreage treated within 50 feet of live water will be used to describe the extent of incidental take in this ITS, and it represents those areas where chemicals are most likely to reach the stream, and harm ESA-listed fish. There is no practical alternative to using proximity to water and treatment acreage as a surrogate measure of take without knowing ahead of time the precise locations where herbicides will be used, and without consideration of weather following herbicide application, along with site-specific features affecting herbicide transport and concentration in waterbodies. Take is not expected from biological controls, mechanical controls, or rehabilitation activities.

The BLM proposes a maximum of 5,000 acres per year of integrated riparian treatments over the next 15 years (cumulative total of Challis and Salmon Field Office treatments), a significant increase from past practices. However, as previously described, this acreage is a function of how the BLM reports treatment areas for monitoring purposes, actually overestimating the actual acres contacted by applied chemicals. Spot spray methods, used to treat riparian acres, do not treat the entire area reported and result in 10 to 25 percent of each riparian acre actually being chemically treated. The difference is attributed to low application rates and treatment of individual plants, which may be at low density within the total infested area. Therefore, treatment of 5,000 acres as reported by the BLM will result in the fully treated equivalent of 500 to 1,250 acres (i.e., 0.09 percent or less of the BLM-managed lands in the basin) annually.

Therefore, the extent of take will be exceeded if the BLM chemically treats more than 5,000 integrated riparian treatment acres (i.e., 1,250 applied riparian acres) annually. In the event the BLM treats more than the established limits in a given year reinitiation of consultation will be required. In addition, since no direct mortality is anticipated to occur from the proposed action, reinitiation shall also be required if direct mortality of any anadromous fish results from implementation of the action.

2.8.2 Effect of the Take

In the Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.8.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The BLM has the continuing duty to regulate the activities covered in this ITS where discretionary federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) will lapse if the BLM fails to exercise its discretion to require adherence to terms and conditions of the ITS, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions. Similarly, if any applicant fails to act in accordance with the terms and conditions of the ITS, protective coverage will lapse.

NMFS believes that full application of conservation measures included as part of the proposed action, together with use of the RPMs and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of ESA-listed species due to completion of the proposed action.

The BLM shall minimize incidental take by:

1. Implementing precautionary measures that keep herbicides, adjuvants, and other chemicals out of water.

2. Update NMFS by April 1 on preliminary field application areas for chemical treatments within 50 feet (ground) and 300 feet (aerial) of anadromous waters (i.e., occupied or designated critical habitat), prior to the start of each spray season.

3. Accurately projecting and tracking ground applications within 50 feet of anadromous waters in the action area to ensure extent of take limits are not accidentally exceeded for riparian acres treated.

4. Ensuring completion of an annual weed treatment report describing action area treatment activities by April 1. If no activities occur, a report of no action is still required.

To be exempt from the prohibitions of section 9 of the ESA, the BLM and its cooperators, including the applicant, if any, must fully comply with conservation measures described as part of the proposed action and the following terms and conditions that implement the RPMs described above. Partial compliance with these terms and conditions may invalidate this take exemption, result in more take than anticipated, and lead NMFS to a different conclusion regarding whether the proposed action will result in jeopardy or the destruction or adverse modification of critical habitats.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the BLM or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The BLM or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. To implement RPM 1, the BLM shall:

    a. Ensure the BMPs and herbicide limitations/restrictions identified in Section 1.3.6 are applied consistently across all areas identified as riparian areas in the BLM's BA. Specifically, ensure the BLM's definition of riparian areas for the duration of the action is as follows: Areas within 50 feet of live water or in annual floodplains where soil permeability is high (e.g., silt/loam and sandy soils), areas with soils over shallow water tables (e.g., supersaturated soils), and hydrologically connected wet ditches.

    a. Use added precaution when applying herbicides near streams or roadside ditches that drain directly into streams, regardless of application method. Herbicides approved for use within riparian areas, and use of the least toxic surfactant compatible with the EUP, shall be the product of choice under appropriate site conditions.

    b. To the extent practicable, avoid the use of picloram, clopyralid, chlorsulfuron, fluroxypyr, and metsulfuron-methyl within annual floodplains and where soil permeability is expected to be high (e.g., silt loam and sand soils). Where necessary to achieve weed management objectives use application methods with the lowest potential for off-site transport (e.g., large droplet size, hand held sprayer, etc.).

    c. When adding adjuvants to herbicides, only use the Washington State aquatic-certified adjuvants (Washington State 2016 or latest list) in riparian areas as proposed in the BA. When adding new adjuvants, the BLM shall notify NMFS, via the Level 1 process, of the newly proposed adjuvant prior to its use. NMFS will then evaluate the product to ensure effects are likely to be consistent with this Opinion's analysis.

    d. Ensure all chemical storage, chemical mixing, transportation, and post-application equipment cleaning is completed in such a manner as to prevent the potential contamination of any riparian area, perennial or intermittent waterway, ephemeral waterway, hydrologically connected road ditch, or wetland.

    b. Facilitate Salmon-Challis Level 1 Team review and approval of any new herbicide formulations where the active ingredients and/or maximum application rates are inconsistent with those already described in the proposed action.

    e. Select herbicides for use within 300 feet of water that have the lowest toxicological profile to anadromous fish and still able to meet desired treatment objectives.

    f. Ensure all aerial treatment units are mapped for the presence of live water prior to making applications and ensure helicopter GPS units accurately display the appropriate buffer distances before applying herbicides.

g. For aerial applications on units requiring surface water buffers, an appropriate drift control agent shall be used to further reduce potential for drift to waterbodies.

h. Drift monitoring cards shall be placed out to 300 feet from and perpendicular to perennial streams for at least 25 percent of the aerial units bordering anadromous waters to monitor for herbicide drift. Monitoring used to validate aerial buffer effectiveness for riparian areas and water edges will be included with the annual monitoring results.

i. Ensure that proper handling of spray cards occurs so that accurate monitoring can validate drift within designated no application buffers.

2. To implement RPM 2, above, the BLM shall:

    a. Provide NMFS, via the respective BLM's Level 1 process, an annual update by April 1, prior to applications. The proposals will include the methods, treatment objectives, locations, projected ground treatment acres within 50 feet of anadromous waters, projected aerial treatment acres within 300 feet of anadromous waters, and any special mitigation measures BLM specialists may determine necessary.

    b. For treatments within 50 feet of anadromous waters, the BLM shall present Pesticide Use Proposal's with planned EUPs (name, active ingredient, registration number) to the Level 1 Team prior to use. The Level 1 Team shall agree that EUPs, and their effects to ESA-listed fish and critical habitats, are substantially similar to formulations identified in this Opinion. Should a concern be raised regarding an EUPs potential to affect ESA-listed fish and critical habitats, the Level I Team member raising the concern will provide documentation, research or best available science supporting why the EUP should not be used. All parties shall work to conclude discussions in a timely manner so as not to delay treatments. If the BLM proposes to add a new active ingredient not identified in the BA and analyzed in this Opinion the action agencies will request consultation for that new chemical.

3. To implement RPM 3, above, the BLM shall:

a. Require each applicator to maintain a daily log of all weed treatments, and including the following information:

    (1) The number of acres treated within 50 feet of live water and greater than 50 feet from live water. Identify treatment areas by 6th field HUC.

    (2) The product names, herbicide formulations, including adjuvants and surfactants, used.

    (3) The herbicide application rate.

(4) The application method.

(5) Wind speed and air temperature at the time of application.

(6) For aerial applications, all drift card monitoring locations and results to validate that aerial drift is not occurring or is occurring at levels that are considered insignificant.

c. The daily logs shall be retained by the BLM administrative units, and be available annually by April 1 for review by NMFS, if they are needed.

d. Use herbicide indicator dye for all riparian treatment areas. In public-use areas with visual resource concerns, diluted dye indicator solution is approved. These indicators will provide visual verification that application methods are minimizing exposure risk to ESA-listed salmonids. Findings from these indicators will be included in the annual monitoring results.

4. To implement RPM 4, above, the BLM shall:

a. Annually, report to NMFS by April 1, the following: (1) Acres of applied herbicide treatments within 300 feet of streams in the action area; (2) any spills and spill response that may have occurred; (3) drift card monitoring locations and results validating aerial drift did not occur or occurred at insignificant levels; and (4) a statement affirming the BLM (including any permittees) successful implementation of the action, all Project Design Criteria, and mandatory terms and conditions. Submit the report to the Snake Basin Office email at nmfswcr.srbo@noaa.gov.

d. NOTICE: If a sick, injured or dead specimen of a threatened or endangered species is found in the project area and it appears that it may be as a result of the proposed action, the finder must notify NMFS through the contact person identified in the transmittal letter for this Opinion, or through NMFS Law Enforcement at (206) 526-6133, and follow any instructions. If the proposed action may worsen the fish's condition before NMFS can be contacted, the finder should attempt to move the fish to a suitable location near the capture site while keeping the fish in the water and reducing its stress as much as possible. Do not disturb the fish after it has been moved. If the fish is dead, or dies while being captured or moved, report the following information: (1) NMFS consultation number; (2) the date, time, and location of discovery; (3) a brief description of circumstances and any information that may show the cause of death; and (4) photographs of the fish and where it was found. NMFS also suggests that the finder coordinate with local biologists to recover any tags or other relevant research information. If the specimen is not needed by local biologists for tag recovery or by NMFS for analysis, the specimen should be returned to the water in which it was found, or otherwise discarded.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). The following recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the BLM:

1. The BLM should use herbicides and surfactants with the least toxicity to ESA-listed fish and other non-target organisms whenever possible.

2. To the maximum extent attainable, BLM should utilize their existing programs to protect and restore riparian habitat, including native plant species. Doing so can help improve baseline conditions for aquatic species by reducing sedimentation, nutrification, and deposition of pesticides and other contaminants into aquatic habitats.

3. To mitigate the effects of climate change on ESA-listed salmonids, follow recommendations by the Independent Scientific Advisory Board (2007) to plan now for future climate conditions by implementing protective tributary and mainstem habitat measures. In particular, implement measures to protect or restore riparian buffers, wetlands, and floodplains; remove stream barriers; and to ensure late summer and fall tributary streamflows.

4. The BLM should only use surfactants or adjuvants outside riparian areas where the effects of the ingredients have been tested on salmonids and have been found to be of low toxicity and the products do not contain any ingredients on EPA's List 1 or 2.

5. Minimize the use of combining herbicides where practicable.

Please notify NMFS if the BLM carries out these recommendations so that we will be kept informed of actions that minimize or avoid adverse effects and those that benefit listed species or their designated critical habitats.

2.11 Reinitiation of Consultation

This concludes formal consultation for the BLM Integrated Weed Control Program. As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In addition, since take related to herbicide spills is not exempted by this Opinion, the

BLM will likely need to reinitiate consultation in the event of a spill that results in take of anadromous fish.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the BLM and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for spawning, rearing, and migration life-history stages of Chinook salmon. Existing habitat areas of particular concern (HAPC) present in the action area include: complex channel and floodplain habitat, spawning habitat, thermal refugia, and submerged aquatic vegetation.

3.2 Adverse Effects on Essential Fish Habitat

The proposed action and action area are described in the BA and this Opinion. The action area includes habitat which has been designated as EFH for various life stages of Chinook salmon. The effects of proposed herbicide applications on anadromous fish habitat are described in the habitat effects section of the previous Opinion. Briefly, the effects analysis found that herbicide spraying is "likely to adversely affect" habitat quality for Chinook salmon in instances where herbicides would be applied in drainages containing or upstream from, occupied habitat.

Although the likelihood of contamination is minimized in the proposed action through the use of BMPs, water contamination cannot be completely avoided since the likelihood of contamination is partly dependent on the weather at the time of, and following herbicide application, herbicide properties, and is subject to human error. The proposed action will adversely affect the quality of EFH as a result of incidental water contamination that may occur from application of herbicides in the vicinity of streams designated as EFH. Water contamination from herbicides is expected to occur (albeit infrequently) when unanticipated precipitation carries the herbicides to water through overland flow, percolation, or in shallow ground water; and/ or in the unlikely event that herbicides fall directly in the water from spray drift or by accidentally directing the spray stream into water.

For an herbicide to have an adverse effect on EFH, the chemical must be of sufficient concentration or present for adequate duration in water to cause a reduction in the quantity or quality of EFH. Given the small amounts of chemical proposed for use in any given area, maximum possible concentrations of the herbicides can seldom reach thresholds where toxic effects are likely to occur. In the limited circumstances where toxic thresholds are reached, the effects are likely to be sublethal and herbicide concentrations are likely to rapidly drop with increasing distance from the treatment area due to dispersion of the herbicides and increasing stream discharge. Most of the herbicides proposed for use break down chemically in a matter of months, although clopyralid and picloram may be present in the environment for longer periods. Under the worst possible contamination scenario, herbicides are not likely to reach lethal concentrations, sublethal concentrations would likely occur in only a few treatment locations, and sublethal water quality levels will exist only briefly. For these reasons adverse effects to EFH are likely to occur infrequently and last for brief periods of time before water quality returns to pre-application conditions.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS believes that the following Conservation Recommendations are necessary to avoid, mitigate, or offset the impact that the proposed action has on EFH. These Conservation Recommendations are a non-identical set of the ESA Terms and Conditions.

1. The BLM should review the BLM herbicide spill plan with all applicators, including permittees, prior to herbicide applications. The plan should meet all regulatory requirements regardless of party performing the application.

2. Appropriate spill cleanup kit should be on-site throughout any permitted herbicide application.

3. To most effectively avoid/minimize potential effects to EFH, all BMPs described in the proposed action and summarized in this Opinion should be consistently applied in the action area to reduce the likelihood of surface runoff, drift, or other groundwater contamination pathways.

4. Added precaution should be used when applying herbicides in roadside ditches that drain directly into streams, even when they are dry. Glyphosate herbicides without surfactants or toxic additives, such as Rodeo®, should be the product of choice under appropriate site conditions. Where glyphosate is not appropriate, 2,4-D amine salt may be used over hydrologically connected ditches, regardless of whether or not they are wet during applications.

5. The BLM should use added precaution when applying herbicides near streams or roadside ditches that drain directly into streams. Herbicides approved for use within riparian areas, and use of the least toxic surfactant compatible with the EUP, should be the product of choice under appropriate site conditions.

6. The BLM should use added precaution or limit use of herbicides with high persistence in soil (e.g., picloram, clopyralid, chlorsulfuron, fluroxypyr, and metsulfuron-methyl) within annual floodplains and where soil permeability is expected to be high (e.g., silt loam and sand soils). Where necessary to achieve weed management objectives, use application methods with the lowest potential for off-site transport (e.g., large droplet size, hand spraying, etc.).

7. When selecting herbicides for use within 300 feet of water, products chosen should have the lowest toxicological profile to anadromous fish and still able to meet desired treatment objectives.

8. The BLM should ensure all aerial treatment units are mapped for the presence of live water prior to making applications and ensure helicopter GPS units accurately display the appropriate buffer distances before applying herbicides.

9. For aerial applications on units requiring buffers from surface water, an appropriate drift control agent should be used.

10. For treatments within 50 feet of anadromous waters, the BLM should present Pesticide Use Proposal's with planned EUPs (name, active ingredient, registration number) to the Level 1 Team prior to use. The Level 1 Team shall agree that EUPs, and their effects to ESA-listed fish and critical habitats, are substantially similar to formulations identified in this Opinion. Should a concern be raised regarding an EUPs potential to affect ESA-listed fish and critical habitats, the Level I Team member raising the concern will provide documentation, research or best available science supporting why the EUP should not be used. All parties should work to conclude discussions in a timely manner so as not to delay treatments.

NMFS expects that full implementation of these EFH Conservation Recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2 above on all EFH present in the action area and potentially affected by plant treatments over the 15-year consultation term.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the BLM must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the federal agency have agreed to use alternative time frames for the federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The BLM must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The DQA specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this Opinion are the BLM. Other interested users could include any permittees, CWMAs, or local citizens interested in the conservation of the affected ESUs/DPS. This Opinion will be posted on the Public Consultation Tracking System website (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including NMFS' ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. REFERENCES

AECOM. 2014. Human Health Risk Assessment – Final. Created for the US Department of the Interior, Bureau of Land Management. March 2014.

Ahrens, W. H. 1994. Herbicide Handbook. Seventh Edition. Weed Society of Americ~Champaign, Illinois. 352 pages.

Aspelin, A. A. and A. H. Grube. 1999. Pesticide industry sales and usage. 1996 and 1997 market estimates. 733-R-99-001. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. Available: https://nepis.epa.gov/Exe/ZyNET.exe/200001IL.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C95thru99%5CTxt%5C00000015%5C200001IL.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL. (May 2012).

Bakke D. 2003. USPS. Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications. Internal Report, Pacific Southwest Region (Region 5).

Bakke, D. 2007. Analysis of issues surrounding the use of spray adjuvants with herbicides. USDA Forest Service Pacific Southwest Region. Unpub. Report. 61 pp.

Baldwin, D. H., J. A. Spromberg, T. K. Colier, and N. L. Scholz. 2009. A fish of many scales: extrapolating sublethal pesticide exposures to the productivity of wild salmon populations. Ecological Applications, 19 (8), pp. 2004-2015.

Beamish, R. J. and C. Mahnken. 2001. A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate and climate change. Progress in Oceanography 49:423-437.

Berg, N. 2004. Assessment of Herbicide Best Management Practicess: Status of Our Knowledge of BMP Effectiveness. Final Report, March 2004, Pacific Southwest Research Station, USDA Forest Service, Albany, CA.

Bureau of Land Management (BLM). 1999a. Bull Trout Section 7 Consultation, Lemhi River. Combined agency watershed biological assessment for ongoing actions submitted by BLM – Salmon Field Office to U.S. Fish and Wildlife Service, February 10, 1999. 193 pages.

BLM, 1999b. Bull Trout Section 7 Consultation, Salmon River – North Fork to Pahsimeroi. Combined agency watershed biological assessment for ongoing actions submitted by BLM – Salmon Field Office to U.S. Fish and Wildlife Service, February 10, 1999. 119 pages.

BLM, 1999c. Steelhead Section 7 Consultation, Lemhi River. Combined agency watershed biological assessment for ongoing actions submitted by BLM – Salmon Field Office to National Marine Fisheries Service, February 10, 1999. 187 pages.

BLM. 1999d. Steelhead Section 7 Consultation, Salmon River – North Fork to Pahsimeroi. Combined agency watershed biological assessment for ongoing actions submitted by BLM – Salmon Field Office to National Marine Fisheries Service, February 10, 1999. 122 pages.

BLM. 1999e. Bull Trout Section 7 Consultation, East Fork Salmon River. Combined agency watershed biological assessment for ongoing actions submitted by BLM - Challis Field Office to U.S. Fish and Wildlife Service, March 2, 1999. 142 pages.

BLM. 1999f. Bull Trout Section 7 Consultation, Pahsimeroi River. Combined agency watershed biological assessment for ongoing actions submitted by BLM - Challis Field Office to U.S. Fish and Wildlife Service, March 2, 1999. 84 pages.

BLM. 1999g. Steelhead Section 7 Consultation, Pahsimeroi River. Combined agency watershed biological assessment for ongoing actions submitted by BLM - Challis Field Office to NMFS, March 2, 1999. 84 pages.

BLM. 1999h. Steelhead Section 7 Consultation, East Fork Salmon River. Combined agency watershed biological assessment for ongoing actions submitted by BLM - Challis Field Office to NMFS, April 12,1999. 123 pages.

BLM. 1993a. Chinook Salmon Biological Evaluation for the Lemhi River Basin. BLM Salmon Field Office watershed biological assessment for ongoing actions. Submitted to National Marine Fisheries Service, 1993.

BLM. 1993b. Chinook Salmon Biological Evaluation for the Salmon River Basin. BLM Salmon Field Office watershed biological assessment for ongoing actions. Submitted to National Marine Fisheries Service, 1993.

BLM. 2007a. Final vegetation treatments using herbicides on Bureau of Land Management Lands in 17 western states programmatic environmental impact statement. U.S. Department of Interior, Bureau of Land Management, Washington, D.C.

BLM. 2007b. Final vegetation treatments on Bureau of Land Management Lands in 17 western states programmatic environmental impact statement. U.S. Department of Interior, Bureau of Land Management, Washington, D.C.

BLM. 2009. Finding of No Significant Impact and Decision Record for the Challis-Salmon Integrated Weed Control Program Environmental Assessment. Challis and Salmon, Idaho: U.S. Department of the Interior, Bureau of Land Management, Idaho Falls District, Challis and Salmon field offices, 26 March 2009

BLM. 2014. 2014 BLM Biological Assessment of 2014 – 2024 Riparian Noxious Weed Control Preprogram for Federally Listed Fish Species. Bureau of Land Management,Idaho Falls District, Challis Field Office and Salmon Field Office. March 17, 2014. 98 pgs.

BLM. 2016. Final Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement

BLM. 2018. Biological Assessment of 2018 – 2028 (modified by email to 2033) Integrated Weed Control Program for Federally Listed Fish Species. Bureau of Land Management,Idaho Falls District, Challis Field Office and Salmon Field Office. February, 2018. 119 pgs.

BLM Ecological Risk Assessment (BLM ERA). 2014. Final Rimsulfuron Ecological Risk Assessment Final Report. Prepared for the USDOI BLM. Washington, D.C. Available: https://eplanning.blm.gov/epl-front-office/projects/nepa/70301/94290/113793/Rimsulfuron_Ecological_Risk_Assessment.pdf (March 2014).

Bisson, P. A. and R. E. Bilby. 1998. Organic matter and trophic dynamics. Pages 373 - 398 *in*: Naiman, R. J. and R. E. Bilby, editors. River ecology and management: lessons from the Pacific coastal ecoregion. Springer-Verlag, New York, NY.

Budy, P., G. P. Thiede, N. Bouwes, C. E. Petrosky, H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fisheries Management 22:35-51.

Cairns, J. Jr. 1983. Are single species toxicity tests alone adequate for estimating environmental hazard? Hydrobiologia. Vol. 100, Issue 1, pgs. 47-57.

CH2MHILL. 2004. Programmatic Biological Assessment of Effects of the Noxious Weed Management Program on Lands Administered by the Salmon-Challis National Forest on Federally Listed, Proposed, and Candidate Plant, Wildlife, and Fish Species and Critical Habitat. Prepared for the USFS, Salmon-Challis National Forest, Salmon, Idaho. April 2004.

Coutant, C. C. 1999. Perspectives on temperature in the Pacific Northwest’s fresh waters. Oak Ridge National Laboratory, Report ORNL/TM-1999/44, Oak Ridge, Tennessee.

Crane, M. and M. C. Newman. 2000. What Level of Effect is a No Observed Effect? Environmental Toxicology and Chemistry. Volume 9, No2, pp. 516-519.

DeLorenzo, M. E., G. I. Scott, and P. E. Ross. 2001. Toxicity of pesticides to aquatic microorganisms: A review. Environmental Toxicology and Chemistry 20:84-98.

Dent and Robben. 2000. Oregon Department of Forestry: Aerial Pesticide Application Monitoring Report. Technical Report 7. March 2000

Dominguez, F., E. Rivera, D. P. Lettenmaier, and C. L. Castro. 2012. Changes in Winter Precipitation Extremes for the Western United States under a Warmer Climate as Simulated by Regional Climate Models. *Geophysical Research Letters* 39(5).

Ebel, W. J., H. L. Raymond, G. E. Monan, W. E. Farr, and G. K Tanoka. 1975. Effects of atmospheric gas saturation caused by dams on salmon and steelhead trout of the Snake and Columbia rivers. U.S. National Marine Fisheries Service, Seattle, Washington.

Ecovista. 2004. "Salmon Subbasin Assessment". In Draft Intermountain Subbasin Plan, prepared for the Northwest Power and Conservation Council. Portland, Oregon, May 2004. https://www.nwcouncil.org/sites/default/files/SalmonAssessment.pdf

Fairchild, J. F., A. Allert, K. P. Feltz, K. J. Nelson, and J. A. Valle. 2009a. An ecological risk assessment of the acute and chronic effects of the herbicide clopyralid to rainbow trout (*Oncorhynchus mykiss*). Archives of Environmental Contamination and Toxicology 57:725-731.

Fairchild, J. F., K. P. Feltz, L. C. Sappington, A. L. Allert, K. J. Nelson, and J. Valle. 2009b. An ecological risk assessment of the acute and chronic toxicity of the herbicide picloram to the threatened bull trout (*Salvelinus confluentus*) and the rainbow trout (*Oncorhynchus mykiss*). Archives of Environmental Contamination and Toxicology 56(4):761-769.

Felsot, A. S. Assessing the Safety of Herbicides for Vegetation Management in the Missoula Valley Region. Washington State University. Richland, WA. 10-13. April, 2001.

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-113, 281 p. http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/multiple_species/5-yr-sr.pdf

Healey, M. C. 1982. Timing and relative intensity of size-selective mortality of juvenile chum salmon (*Oncorhynchus keta*) during early sea life. Canadian Journal of Fisheries and Aquatic Sciences 39:952-957.

Herron, G. J., R. L. Sheley, B. D. Maxwell, J. S., Jacobsen. 2001. Influence of Nutrient Availability on the Interaction Between Spotted Knapweed and Bluebunch Wheatgrass. Restoration Ecology. Vol. 9 No. 3, pp. 326–331

Higgs, D. A., J. S. MacDonald, C. D., Levings, and B. S. Dosanjh. 1995. Nutrition and feeding habits in relation to life history stage. Pages 161-315 *in:* Groot, C., L. Margolis and W.C. Clark, editors. Physiological ecology of Pacific Salmon. UBC Press, Vancouver, Canada.

Hoagland, K. D., J. P. Carder, and R. L. Spawn. 1996. Effects of organic toxic substances. Pages 469- 496 *in*: Stevenson, R. J., M. L. Bothwell, and R. L. Lowe, editors. Algal ecology: Freshwater Benthic Ecosystems. Academic Press. New York, NY.

Holtby, L. B, Andersen, B. C., and R. K. Kadowaki. 1990. Importance of smolt size and early ocean growth in inter-annual variability in marine survival of coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 47:2181-2194.

Interior Columbia Technical Recovery Team (ICTRT). 2007. Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs, Review Draft March 2007. Interior Columbia Basin Technical Recovery Team: Portland, Oregon. 261 pp. https://www.nwfsc.noaa.gov/research/divisions/cb/genetics/trt/trt_documents/ictrt_viability_criteria_reviewdraft_2007_complete.pdf

ICTRT. 2010. Status Summary – Snake River Spring/Summer Chinook Salmon ESU. Interior Columbia Technical Recovery Team: Portland, Oregon.

Idaho Department of Environmental Quality (IDEQ). 2010. Department of Environmental Quality Working Principles and Policies for the 2008 Integrated (303[d]/305[b]) Report. State of Idaho Department of Environmental Quality. Boise, Idaho 83706.

Independent Scientific Advisory Board (ISAB). 2007. Climate change impacts on Columbia River Basin fish and wildlife. ISAB Climate Change Report, ISAB 2007-2, Northwest Power and Conservation Council, Portland, Oregon.

Iwasaki, Y, K. Kotani, S. Kashiwad, and S. Masunaga. Does the Choise of NOEC or EC10 Affect the Hazardous Concetnration for 5% of the Species? Environmental Science and Technology. 49, 9326-9330.

Jones, D. K., J. I. Hamond, and R. A. Relyea. 2011. Competitive stress can make the herbicide Roundup more deadly to larval amphibians. Environmental Toxicology and Chemistry 30: 446-454.

Kimball, K. D. and S. A. Levin. 1985. Limitations of Laboratory Bioassays: The Need for Ecosystem-Level Testing. BioScience, Vol 35, Issue 3, pgs. 165-171.

Korman, J., D. R. Marmorek, G. L. Lacroix, P. G. Amiro, J. A. Ritter, W. D. Watt, R. E. Cutting, and D. C. E. Robinson. 1994. Development and evaluation of a biological model to assess regional-scale effects of acidification on Atlantic salmon (*Salmo salar*). Canadian Journal of Fisheries and Aquatic Sciences 51:662–680.

Kruzynski, G. M. and I. K. Birtwell. 1994. A predation bioassay to quantify the ecological significance of sublethal responses of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) to the antisapstain fungicide TCMTB. Canadian Journal of Fisheries and Aquatic Sciences 51:1780-1790.

Kruzynski, G. M., I. K. Birtwell, and G. L. Chew. 1994. Behavioural approaches to demonstrate the ecological significance of exposure of juvenile Pacific salmon (genus *Oncorhynchus*) to the antisapstain fungicide TCMTB. Journal of Aquatic Ecosystem Health 3:113-127.

Kulla, A. 2002. O'Brien Creek Winter Range Project: Water Quality/Drift Monitoring Report. Bitterroot National Forest. 2 pgs.

Laetz, C. A., D. H. Baldwin, V. Hebert, J. D. Stark, N. L. Scholz. 2014. Elevated temperatures increase the toxicity of pesticide mixtures to juvenile coho salmon. Aquatic Toxicology, 146:38-44.

Larson, A., C. Haux, and M. Sjöbeck. 1985. Fish physiology and metal pollution: Results and experiences from laboratory and field studies. Ecotoxicology and Environmental Safety. Volume 9, Issue 3, pp. 250-281.

Larson, D. 2003. Native weeds and exotic plants: relationships to disturbance in mixed-grass prairie. Plant Ecology 169: 317–333.

Lolo National Forest. 2005. 2002 – 2005 Herbicide Drift Monitoring, Lolo National Forest. Obtained from September 22, 2015, email from Carol Brown to Myra Black. Sometimes referenced as Kulla 2005.

Macneale, K. H., P. M. Kiffney, N. L. Scholz. 2010. Pesticides, aquatic food webs, and the conservation of Pacific salmon. Frontiers in Ecology and the Environment. 8(9): pp. 475–482.

Martin J. and P. Glick. 2008. A great wave rising: Solutions for Columbia and Snake River salmon in the age of global warming. Light in the River Reports. 28 p. https://www.sierraclub.org/sites/www.sierraclub.org/files/sce-authors/u7661/AGreatWaveRising.pdf

Mason, J. C. 1976. Response of underyearling coho salmon to supplemental feeding in a natural stream. Journal of Wildlife Management. 40:775-788.

Matthews, G. M., D. L. Park, S. Achord, and T. E. Ruehle. 1986. Static seawater challenge test to measure relative stress levels in spring Chinook salmon smolts. Transactions of the American Fisheries Society 115: 236–244.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42, Seattle, Washington, 156 p.

Mebane, C. 2015. In response: biological arguments for seleting effects izes in ecotoxicological testing – A governmental perspective. Environmental Toxicology and Chemistry. Vol 34, Issue 11, pgs. 2440-2442.

Minshall, G. W. 1978. Autotrophy in stream ecosystems. BioScience 28:767-771.

Moore, A. W. and C. P. Waring. 1996. Sublethal effects of the pesticide Diazinon on olfactory function in mature male Atlantic salmon parr. Journal of Fish Biology 48:758-775.

Mote, P. W., A. K. Snover, S. Capalbo, S. D. Eigenbrode, P. Glick, J. Littell, R. R. Raymondi, and W. S. Reeder. 2014. Ch. 21: Northwest. In Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, T. C. Richmond, and G.W. Yohe, Eds., U.S. Global Change Research Program, 487-513.

Mundie, J. H. 1974. Optimization of the salmonid nursery stream. Journal of the Fisheries Research Board of Canada 31: 1827-1837.

Murphy, M. L. 1998. Primary production. Pages 144-168 *in:* Naiman R. J. and R. E. Bilby, editors. River ecology and management: lessons from the Pacific coastal ecoregion. Springer-Verlag, New York, NY.

National Marine Fisheries Service (NMFS). 2007. Biological Opinion on the Bureau of Land Management's Proposed Vegetation Treatment Program for 17 Western States. Pages 82 *in* N. O. o. P. Resources, editor, Silver Spring, MD.

NMFS. 2012. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Sawtooth National Forest’s Programmatic Noxious and Invasive Weed Management Program; Upper Salmon River Subbasin HUC 17060201; Custer and Blaine Counties, Idaho (One Project). November 26, 2012. NMFS No.: 2012/01793.

NMFS. 2013. Reinitiation for the Biological Assessment of Effects of Treatment of Noxious Weeds in the Frank Church-River of No Return Wilderness Management – Salmon-Challis, Boise, Payette, Nez Perce and Bitterroot National Forests; Hydrologic Unit Codes: Salmon River 17060201, 17060203, 17060205, 17060206, 17060207, and 17060208, and Upper Selway River 17060301; Custer, Idaho, Lemhi, and Valley Counties, Idaho. (One Action). October 13, 2009. NMFS No.: 2004/01889; 2009/03999.

NMFS. 2014. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Bureau of Land Management's Challis and Salmon Field Office 2014 through 2024 Riparian Noxious Weed Control Program; 17060204 - Lemhi River; 17060202 - Pahsimeroi River; 17060203 - Middle Salmon River/Panther Creek; 17060201 - Upper Salmon River; Custer and Lemhi Counties, Idaho (One Project). July 15, 2014. NMFS No.: 2014-605

NMFS. 2015. ESA Recovery Plan for Snake River Sockeye Salmon (*Oncorhynchus nerka*), June 8, 2015. NOAA Fisheries, West Coast Region. 431 p. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/snake_river_sockeye_recovery_plan_june_2015.pdf

NMFS. 2016a. Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Salmon-Challis National Forest Invasive Plant Treatment Program (Non-wilderness Areas), Upper Salmon River (17060201); Pahsimeroi River (17060202); Middle Salmon-Panther (17060203); Lemhi River (17060204); Upper Middle Fork Salmon (17060205); Lower Middle Fork Salmon (17060206); Middle Salmon-Chamberlain (17060207); Little Lost River (17040217); Big Lost River (17040218); Lemhi and Custer Counties, Idaho. May 17, 2016. WCR-2015-3863.

NMFS. 2016b. Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Proposed Poison Ivy Control at Snake River Recreation and Administrative Sites Project. July 22, 2016. NMFS No.: 2016-4766.

NMFS. 2017a. ESA Recovery Plan for Snake River Spring/Summer Chinook & Steelhead. NMFS. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/Final%20Snake%20Recovery%20Plan%20Docs/final_snake_river_spring-summer_chinook_salmon_and_snake_river_basin_steelhead_recovery_plan.pdf

Northwest Fisheries Science Center (NWFSC). 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. 356 p.

Pacific Fishery Management Council (PFMC). 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon.

Pesticide Action Network (PAN). 2012. Pesticide Database. Available: www.pesticideinfo.org. (May 2012).

Parker, R. R. 1971. Size selective predation among juvenile salmonid fishes in a British Columbia inlet. Journal of the Fisheries Research Board of Canada 28:1503-1510.

Preston, B. L. 2002. Indirect effects in aquatic ecotoxicology: implications for ecological risk assessment. Environmental Management 29:311-323.

Rodney, S. I., R. S. Teed, D. R. J. Moore. 2013. Estimating the Toxicity of Pesticide Mixtures to Aquatic Organisms: A Review. Human and Ecological Risk Assessment: An International Journal. 19:6, 1557-1575, DOI: 10.1080/10807039.2012.723180

TechLine. 1998. Information about Invasive/Noxious Plant Management: Mormon Ridge Elk Winter Range Restoration Project, Lolo National Forest, Montana. Charles Henry: TechLine Editor.

Scholz, N. L., J. P. Incardona, C. M. Stehr, and T. L. Linbo. 2005. Evaluating the effects of forestry herbicides on early development of fish using the zebrafish phenotypic screen. FS-PIAP FY 03-04 Final Report, November 18, 2005.

Stark, J. D. and W. K. Walthall. 2003. Agricultural adjuvants: Acute Mortality and Effects on Population growth Rate of Daphnia Pulex after chronic exposure. Environmental Toxicology and Chemistry, Vol. 22, No. 12, 6 pgs.

Stehr, C. M., T. L. Linbo, D. H. Barldwin, N. L. Sholz, and J. P. Incardona. 2009. Evaluating the Effects of Forestry Herbicides on Fish Development Using Rapid Phenotypic Screens. North American Journal of Fisheries Management. 29:975-984.

Stockmann, K. 2015. September 15 Email to C. Brown (Sawtooth National Forest, retired) Re: Weed EIS – monitoring on aerial applications.

Syracuse Environmental Research Associates, Inc. (SERA). 2004a. Chlorsulfuron – Human Health and Ecological Risk Assessment – Final Report. SERA TR 04-43-18-01c. Fayetteville, New York. Prepared for: USFS Forest Health Protection, Arlington, VA. Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/112104_chlorsulf.pdf. (May 2012).

SERA. 2004b. Clopyralid – Human Health and Ecological Risk Assessment - Final Report. SERA TR 04-43-17-03c. Fayetteville, New York. Prepared for: USFS Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/120504_clopyralid.pdf. (May 2012).

SERA. 2004c. Dicamba – Human Health and Ecological Risk Assessment – Final Report. SERA TR 04-43-17-06d. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/112404_dicamba.pdf. (May 2012).

SERA. 2004d. Imazapic – human health and ecological risk assessment – final report. SERA TR 04-43-17-04b. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/122304_Imazapic.pdf. (May 2012).

SERA. 2004e. Metsulfuron methyl – human health and ecological risk assessment – final report. SERA TR 04-43-17-01b. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/120904_Metsulfuron.pdf. (May 2012).

SERA. 2004f. Sulfometuron methyl – human health and ecological risk assessment – final report. SERA TR 03-43-17-02c. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/121404_Sulfometuron.pdf. (May 2012).

SERA. 2006. 2,4-D – human health and ecological risk assessment – final report. Fayetteville, New York. Prepared for USDA Forest Service, Forest Health Protection, Arlington, VA. Available: https://www.fs.fed.us/foresthealth/pesticide/pdfs/093006_24d.pdf. (March 2012).

SERA. 2007. Aminopyralid – human health and ecological risk assessment – final report. SERA TR 052-04 Manlius, NY. Prepared for: USDA USFS, Forest Health Protection, http://www.fs.fed.us/foresthealth/pesticide/pdfs/062807_Aminopyralid.pdf (June 2007).

SERA. 2009. Fluroxypyr - Human Health and Ecological Risk Assessment FINAL REPORT. SERA TR-052-12-03a. Prepared for: USDA USFS. Available at: https://www.fs.fed.us/foresthealth/pesticide/pdfs/0521303a_fluroxypyr.pdf

SERA. 2010. Imazamox – human health and ecological risk assessment – final report. SERA TR 052-24-02a. Manlius, NY. Prepared for: USDA USFS, Forest Health Protection, Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/052-24-02a_Imazamox.pdf (December 2010).

SERA. 2011a. Glyphosate – human health and ecological risk assessment – final report. SERA TR-052-22-03b. Manlius, New York. Prepared for: USFS, Southern Region, Atlanta, Georgia. Available: https://www.fs.fed.us/foresthealth/pesticide/pdfs/Glyphosate_SERA_TR-052-22-03b.pdf. (May 2012).

SERA. 2011b. Picloram – human health and ecological risk assessment – final report. SERA TR 052-27-03a. Fayetteville, New York. Prepared for USFS, Southern Region, Atlanta, Georgia. Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/Picloram_SERA_TR-052-27-03a.pdf. (May 2012).

SERA. 2011c. Triclopyr – human health and ecological risk assessment – final report. SERA TR 052-25-03a. Fayetteville, New York. Prepared for: USFS, Southern Region, Atlanta, Georgia. Available: https://www.fs.fed.us/foresthealth/pesticide/pdfs/052-25-03aTriclopyr.pdf. (May 2012).

SERA. 2011d. Imazapyr – human health and ecological risk assessment – final report. SERA TR 052-29-03a. Manlius, NY. Prepared for: USDA USFS, Forest Health Protection, Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/Imazapyr_TR-052-29-03a.pdf (December 2011).

SERA. 2014. Preparation of Environmental Documentation and Risk Assessments for the USDA/Forest Service. SERA MD-2014-02b. November 17, 2014. http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

Sogard, S. M. 1997. Size-selective mortality in the juvenile stage of teleost fishes: a review. Bulletin of Marine Science 60:1129-1167.

Solomon, K. R. and D. G. Thompson. 2003. Ecological Risk Assessment for Aquatic Organisms from Over-Water Uses of Glyphosate. May 2003

Tu, M., C. Hurd., and J. M. Randall. 2003. Weed Control Methods Handbook: Tools & Techniques for Natural Areas. The Nature Conservancy. June 2003.

U.S. Environmental Protection Agency (EPA). 2012. Environmental Fate Effects Division Problem Formulation for the Environmental Fate, Ecological Risk, Endangered Species, and Human Health Drinking Water Exposure Assessments in Support of the Registration Review of Rimsulfuron. Office of Prevention, Pesticides, and Toxic Substances. Washington, DC. September 13, 2012

U.S. Environmental Protection Agency/Office of Pesticide Programs (EPA and OPP). 2008. Risks of Glyphosate Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*). Available at: https://www3.epa.gov/pesticides/endanger/litstatus/effects/redleg-frog/glyphosate/determination.pdf.

U.S. Forest Service (USFS). 1999a. Bull Trout Section 7 Consultation, Salmon River - Pahsimeroi R to East Fork Salmon River. Combined agency watershed biological assessment for ongoing actions submitted by USFS - Challis Ranger District, Salmon and Challis National Forests to U.S. Fish and Wildlife Service, April 18, 1999. 106 pages.

USFS. 1999b. Bull Trout Section 7 Consultation, Salmon River - East Fork to Peach Creek. Combined agency watershed biological assessment for ongoing actions submitted by USFS - Yankee Fork Ranger District, Salmon and Challis National Forests to U.S. Fish and Wildlife Service, September 20, 1999. 180 pages.

USFS. 1999c. Steelhead Section 7 Consultation, Salmon River - East Fork to Peach Creek. Combined agency watershed biological assessment for ongoing actions submitted by USFS - Yankee Fork Ranger District, 46 Salmon and Challis National Forests to NMFS, November 9, 1999. 180 pages.

USFS. 2005. Biological Assessment for Stream Crossing Structure Replacement and Removal Activities Affecting ESA-listed Species in Idaho National Forests (Payette, Boise, Sawtooth, Salmon-Challis, Nez Perce, and Clearwater National Forests) and Idaho/Nevada Bureau of Land Management Public Lands in Challis, Cottonwood, Coeur d'Alene, Four Rivers, Jarbidge, Salmon, and Upper Snake Field Offices. June 9, 2005. 147 pgs.

USFS. 2012. Biological Assessment and Biological Evaluation of the Effects from Noxious and Invasive Weed Program on Fisheries, Terrestrial Wildlife, and Rare Plant Species. April 6, 2012. 350 pages. Sawtooth National Recreation Area, Idaho.

USFS and BLM. 1995. Decision Notice/Decision Record, Finding of No Significant Impact, and Environmental Assessment for the Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California. (referred to as PACFISH).

Vannote, R. L., G. W. Minshall, K. W. Cummins, J. R. Sedell, and C.E. Cushing. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Sciences 37:130-137.

Washington State Department of Ecology and Agriculture (Washington State). 2016. Summary of Aquatic Acute Toxicity Data for Spray Adjuvants Allowed for Use on Aquatic Sites in Washington. Rev. November 23, 2016. Pesticide Management Division, Registration Services Program.

Weis, J. S., G. Smith, T. Zhou, C. Santiago-Bass, and P. Weis. 2001. Effects of contaminants on behavior: biochemical mechanisms and ecological consequences. BioScience 51(3):209-217.

Weis, J. S. 2014. Delayed Behavioral Effects of Early Life Toxicant Exposures in Aquatic Biota. Toxics, volume 2, pp. 165-187.

Zabel, R. W. and J. G. Williams. 2002. Selective mortality in Chinook salmon: what is the role of human disturbance? Ecological Applications 12(1): 173-183.

APPENDIX A

Toxicological Effects of Herbicides Proposed for Use on Bureau of Land Management-administered Land within the Challis and Salmon Field Offices

Additives and Adjuvants

Table A-1 identifies all currently approved additives and adjuvants (i.e., ingredients that improve herbicide effectiveness) available for use on Bureau of Land Management (BLM)-administered lands in Idaho. However, this Opinion only considers Washington State approved aquatic surfactants for use within riparian and aerial applications. The remaining additives and adjuvants (i.e., ingredients that improve herbicide effectiveness) were not described or analyzed in biological assessment and are not considered part of this action.

Table A-1. Approved Additives and Adjuvants.

Type	Product Name	Company	EPA Registration Number
Surfactant			
Non-Ionic	Agrisolutions Preference	Agriliance, LLC.	WA Reg. No. 1381-50011
	Aqufact	Aqumix, Inc.	NA
	Brewer 90-10	Brewer International	NA
	Baron	Crown (Estes	NA
	N.I.S. 80	Estes Incorporated	NA
	Spec 90/10	Helena	NA
	Optima	Helena	CA Reg. No. 5905-50075-AA
	Induce	Setre (Helena)	CA Reg. No. 5905-50066-AA
	Actamaster Spray Adjuvant	Loveland Products Inc.	WA Reg. No. 34704-50006
	Actamaster Soluble Spray	Loveland Products Inc.	WA Reg. No. 34704-50001
	Activator 90	Loveland Products Inc.	CA Reg. No. 34704-50034-AA
	*LI-700	Loveland Products Inc.	CA Reg. No. 34704-50035 WA Reg. No. AW36208-70004
	*Spreader 90	Loveland Products Inc.	WA Reg. No. 34704-05002-AA
	UAP Surfactant 80/20	Loveland Products Inc.	NA
	X-77	Loveland Products Inc.	CA Reg. No. 34704-50044
	Red River 90	Red River Specialties,	NA
	Cornbelt Premier 90	Van Diest Supply Co.	NA
	Spray Activator 85	Van Diest Supply Co.	NA
	R-900	Wilbur-Ellis	NA
	Super Spread 90	Wilbur-Ellis	WA Reg. No. AW-2935-70016
	Super Spread 7000	Wilbur-Ellis	CA Reg. No. 2935-50170 WA Reg. No. AW-2935-0002
	Red River 90	Red River Specialties,	NA
Spreader/Sticker	Agri-Trend Spreader	Agri-Trend	NA
	TopFilm	Biosorb, Inc.	NA
	Bind-It	Estes Incorporated	NA
	Surf-King PLUS	Crown (Estes	NA
	CWC 90	CWC Chemical, Inc.	NA
	Cohere	Helena	CA Reg. No. 5905-50083-A
	Attach	Loveland Products Inc.	CA Reg. No. 34704-50026
	*Bond	Loveland Products Inc.	CA Reg. No. 36208-50005
	*Tactic	Loveland Products Inc.	CA Reg. No. 34704-50041-AA
	Nu-Film-IR	Miller Chem. & Fert.	NA
	Lastick	Setre (Helena)	NA
	Insist 90	Wilbur-Ellis	NA
	R-56	Wilbur-Ellis	CA Reg. No. 2935-50144
	SilEnergy	Brewer International	NA
	Silnet 200	Brewer International	NA
	Bind-It MAX	Estes Incorporated	NA
	Thoroughbred	Estes Incorporated	NA

Type	Product Name	Company	EPA Registration Number
Silicone Based	Aero Dyne-Amic	Helena	CA Reg. No. 5905-50080-AA
	*Dyne-Amic	Helena	CA Reg. No. 5095-50071-AA
	*Kinetic	Setre (Helena)	CA Reg. No. 5905-50087-AA
	Freeway	Loveland Products Inc.	CA Reg. No. 34704-50031 WA Reg. No. 34704-04005
	Phase	Loveland Products Inc.	CA Reg. No. 34704-50037-AA
	Phase II	Loveland Products Inc.	NA
	Silwet L-77	Loveland Products Inc.	CA Reg. No. 34704-50043
	Sun Spreader	Red River Specialties, Inc.	NA
	Sylgard 309	Wilbur-Ellis	CA Reg. No. 2935-50161
	Syl-Tac	Wilbur-Ellis	CA Reg. No. 2935-50167
Oil-based			
Crop Oil Concentrate	Brewer 83-17	Brewer International	NA
	Majestic	Crown (Estes	NA
	*Agri-Dex	Helena	CA Reg. No. 5905-50094-AA
	Crop Oil Concentrate	Helena	CA Reg. No. 5905-50085-AA
	Crop Oil Concentrate	Loveland Products Inc.	
	Herbimax	Loveland Products Inc.	CA Reg. No. 34704-50032-AA WA Reg. No. 34704-04006
	Red River Forestry Oil	Red River Specialties,	NA
	R.O.C. Rigo Oil Conc.	Wilbur-Ellis	NA
	Mor-Act	Wilbur-Ellis	CA Reg. No. 2935-50098
Methylated Seed Oil (MSO)	SunEnergy	Brewer International	NA
	Sun Wet	Brewer International	NA
	Methylated Spray Oil Conc.	Helena	NA
	MSO Concentrate	Loveland Products Inc.	CA Reg. No. 34704-50029-AA
	Red River Supreme	Red River Specialties,	NA
	Sunburn	Red River Specialties,	NA
	Sunset	Red River Specialties,	NA
	Hasten	Wilbur-Ellis	CA Reg. No. 2935-50160 WA Reg. No. 2935-02004
	Super Spread MSO	Wilbur-Ellis	NA
Methylated Seed Oil + Organosilicone	Inergy	Crown (Estes Inc.)	NA
Vegetable Oil	Noble	Estes Incorporated	NA
	Amigo	Loveland Products Inc.	CA Reg. No. 34704-50028-AA WA Reg. No. 34704-04002
	*Competitor	Wilbur-Ellis	CA Reg. No. 2935-50173 WA Reg. No. AW-2935-04001
Fertilizer-based			
Nitrogen Based	Quest	Setre (Helena)	CA Reg. No. 5905-50076-AA
	Dispatch	Loveland Products Inc.	NA
	Dispatch 111	Loveland Products Inc.	NA
	Dispatch 2N	Loveland Products Inc.	NA
	Dispatch AMS	Loveland Products Inc.	NA
	Flame	Loveland Products Inc.	NA
	Bronc	Wilbur-Ellis	NA
	*Bronc Max	Wilbur-Ellis	NA
	Bronc Max EDT	Wilbur-Ellis	NA
	*Bronc Plus Dry EDT	Wilbur-Ellis	WA Reg. No.2935-03002
	Bronc Total	Wilbur-Ellis	NA

Type	Product Name	Company	EPA Registration Number
	Cayuse Plus	Wilbur-Ellis	CA Reg. No. 2935-50171
Special Purpose or Utility			
Buffering Agent	Buffers P.S.	Helena	CA Reg. No. 5905-50062-ZA
	Spray-Aide	Miller Chem. & Fert.	CA Reg. No. 72-50006-AA
	Oblique	Red River Specialties, Inc.	NA
	Tri-Fol	Wilbur-Ellis	CA Reg. No. 2935-50152
Colerants	Hi-Light	Becker-Underwood	NA
	Hi-Light WSP	Becker-Underwood	NA
	Marker Dye	Loveland Products Inc.	NA
	BullsEye	Milliken Chemical	NA
	Signal	Precision	NA
Compatibility/Suspension Agent	E Z MIX	Loveland Products Inc.	CA Reg. No. 36208-50006
	Support	Loveland Products Inc.	WA Reg. No. 34704-04011
	Blendex VHC	Setre (Helena)	NA
Deposition Aid	Cygnet Plus	Brewer International	CA Reg. No. 1051114-50001
	Poly Control 2	Brewer International	NA
	CWC Sharpshooter	CWC Chemical, Inc.	NA
	ProMate Impel	Helena	NA
	Pointblank	Helena	CA Reg. No. 52467-50008-AA-5905
	Strike Zone DF	Helena	CA Reg. No. 5905-50084-AA
	Compadre	Loveland Products Inc.	CA Reg. No. 34704-50050 WA Reg. No. 34704-06004
	Intac Plus	Loveland Products Inc.	NA
	*Liberate	Loveland Products Inc.	CA Reg. No. 34704-50030-AA WA Reg. No. 34704-04008
	Reign	Loveland Products Inc.	CA Reg. No. 34704-50045 WA Reg. No. 34704-05010
	Weather Gard	Loveland Products Inc.	CA Reg. No. 34704-50042-AA
	Mist-Control	Miller Chem. & Fert.	CA Reg. No. 72-50011-AA
	Secure Ultra	Red River Specialties Inc.	NA
	Bivert	Wilbur-Ellis	CA Reg. No. 2935-50163
	Coverage G-20	Wilbur-Ellis	NA
	EDT Concentrate	Wilbur-Ellis	NA
	Sta Put	Setre (Helena)	CA Reg. No. 5905-50068-AA
Defoaming Agent	Defoamer	Brewer International	NA
	Fighter-F 10	Loveland Products Inc.	NA
	Fighter-F Dry	Loveland Products Inc.	NA
	Foam Fighter	Miller Chem. & Fert.	CA Reg. No. 72-50005-AA
	Foam Buster	Setre (Helena)	CA Reg. No. 5905-50072-AA
	Cornbelt Defoamer	Van Diest Supply Co	NA
	No Foam	Wilbur-Ellis	CA Reg. No. 2935-50136
Diluent/Deposition Agent	Improved JLB Oil Plus	Brewer International	NA
	JLB Oil Plus	Brewer International	NA
	Hy-Grade I	CWC Chemical, Inc	NA
	Hy-Grade EC	CWC Chemical, Inc	NA
	Red River Basal Oil	Red River Specialties,	NA

Type	Product Name	Company	EPA Registration Number
Foam Marker	Align	Helena	NA
	R-160	Wilbur-Ellis	NA
Invert Emulsion Agent	Redi-vert II	Wilbur-Ellis	CA Reg. No. 2935-50168
Tank Cleaner	Wipe Out	Helena	NA
	All Clear	Loveland Products Inc.	NA
	Tank and Equipment Cleaner	Loveland Products Inc.	NA
	Kutter	Wilbur-Ellis	NA
	Neutral-Clean	Wilbur-Ellis	NA
	Cornbelt Tank-Aid	Van Diest Supply Co.	NA
Water Conditioning	Rush	Crown (Estes	NA
	Blendmaster	Loveland Products Inc.	NA
	Choice	Loveland Products Inc.	CA Reg. No. 34704-50027-AA WA Reg. No. 34704-04004
	Choice Xtra	Loveland Products Inc.	NA
	Choice Weather Master	Loveland Products Inc.	CA Reg. No. 34704-50038-AA
	*Cut-Rate	Wilbur-Ellis	NA

*Indicates Washington State approved aquatic surfactant

Aminopyralid

Exposure. The half-life of aminopyralid in soils ranges from 32 to 533 days, with a typical time of 103.5 days (EPA 2005b). Microbes and sunlight break it down and, in aquatic systems; the primary route of degradation is through sunlight (photolysis), with laboratory experiments yielding a product half-life of 0.6 days. In another experiment, aminopyralid photolyzed moderately slowly on a soil surface, with a half-life of 72 days. A laboratory Freundlich absorption isotherm study with eight United States and European soils yielded absorption values at 1.05 to 24.3 milliliter per gram, which shows that aminopyralid is weakly sorbed to soil (EPA Aminopyralid Fact Sheet August 10, 2005). This also represents moderate mobility in the environment with a moderate potential to leach through soils and into groundwater. Aminopyralid is "rainfast" within 2 hours, leaving less potential for runoff during a rain event. Aminopyralid does not bioaccumulate through the food chain and is absorbed through the leaves and the roots where it is transported to other parts of the plant. Fish and aquatic insect exposure to aminopyralid occurs primarily through direct contact with contaminated surface waters.

Syracuse Environmental Research Associates, Inc. (SERA) (2007) identified a peak estimated rate of contamination of ambient water associated with the normal application of aminopyralid as 0.6 milligrams acid equivalent/L (mg a.e./L) at an application rate of 1 pound acid equivalents/acre (lb a.e./acre). Typical application rates for aminopyralid in the proposed action range from 0.078 to 0.11 lb a.e./acre, and the maximum label application rate is 0.11 lb a.e./acre. At the maximum application rate of 0.11 lb. a.e./acre, the peak concentrations of aminopyralid in ambient water, using the modeled water contamination rate in SERA (2007), would be 0.066 mg a.e./L. Considering the project Best Management Practices (BMP) that will be implemented, it is likely that water concentrations of aminopyralid will be far less than that estimated from modeling performed by SERA.

End Use Products. Aminopyralid is a pyridine carboxylic acid herbicide and the current market products containing it include Milestone, Milestone VM, and Forefront HL. Both of the Milestone formulations contain the triisopropanolamine (TIPA) salt of aminopyralid (21.1 percent acid equivalent [a.e.]). These formulations contain no inert ingredients other than water and TIPA. Forefront HL also contains the TIPA salt of aminopyralid, but only as a minor component (4.28 percent a.e.) as the formulation also contains 34.25 percent a.e. 2,4-D. Forefront consists of 50.5 percent other ingredients and was not assessed in SERA (2007). Aminopyralid is considered in the same class of herbicides as clopyralid and picloram, which are described below, but lacks the carcinogen hexachlorobenzene or other chlorinated benzenes.

Toxicity: Fish. Because aminopyralid is a relatively new pesticide, very little information is available regarding its toxicological effects to endangered species act (ESA)-listed fish or other aquatic species. The information on the toxicity of aminopyralid comes from studies that have been submitted to U.S. Environmental Protection Agency (EPA) as part of the registration package for the chemical. The toxicity studies performed to date have used the technical grade aminopyralid; no toxicity studies in fish are available for the TIPA formulation of aminopyralid. In the available studies, aminopyralid has been shown to be practically non-toxic to fish and aquatic invertebrates, and slightly toxic to algae and aquatic vascular plants (SERA 2007). Aminopyralid is not expected to bioaccumulate in fish tissue (SERA 2007).

The SERA (2007) summarized several acute exposure studies that reported no mortality to organisms exposed to aminopyralid in concentrations up to 100 milligrams per liter (mg/L). Aminopyralid has a low order of acute toxicity to aquatic animals, with acute no observed effects concentration (NOEC) values falling within a narrow range of 50 mg a.e./L to 100 mg a.e./L, depending on the fish species. Only one of the studies documented sublethal effects in trout. In the study conducted by Marino et al. (2001a in SERA 2007), approximately 7 percent of rainbow trout exposed to 100 mg a.e./L for 96 hours experienced a partial loss of equilibrium. However, this result was not statistically significant relative to the control group using the Fisher Exact test ($p = 0.2457$). As such, the Environmental Fate and Effects Division of EPA classified the 100 mg/L exposure as a NOEC. National Marine Fisheries Service (NMFS) has used this value as the lowest sublethal effect threshold.

Only one chronic toxicity study is available for aminopyralid, and it involves the fathead minnow (*Pimephales promelas*) (Marino et al. 2003 in SERA 2007). The NOEC of 1.36 mg a.e./L was derived from this egg to fry study. In this study, the percent larval survival and growth (wet weight and length) were significantly ($p < 0.05$) reduced at 2.44 mg a.e./L relative to controls. Sublethal effects such as pale coloration, immobility, deformed or underdeveloped bodies, and scoliosis (curvature of the spine) were also observed at concentrations at or exceeding 2.44 mg a.e./L. The EPA (2005b) classified the LOEC (lowest observed effects concentration) as 2.44 mg a.e./L.

The sublethal effects of aminopyralid and its end-use products (EUPs) on ESA-listed fish are unknown. Due to the relatively low toxicity and low application rates for aminopyralid, the estimated risks to fish and aquatic invertebrates from the BLM use patterns or accidental exposure are estimated to be low. However, due to this chemical’s fairly new emergence on the market, the overall effects whether sublethal or lethal are uncertain. Future research may reveal additional effects associated with the use of this herbicide.

Toxicity: Other Aquatic Organisms. Aminopyralid has been shown to be practically non-toxic to aquatic invertebrates, and slightly toxic to algae and aquatic vascular plants (EPA 2005b). Similar to fish, acute toxicity values for amphibians and aquatic invertebrates fall within 50 mg a.e./L to 100 mg a.e./L. *Daphnia magna* did not exhibit mortality or sublethal effects when exposed to a measured 98.6 mg a.e./L concentration for a 48-hour exposure period (Marino et al. 2001b in SERA 2007). Aquatic invertebrates are much less sensitive to chronic exposures to aminopyralid than fish. In a daphnid study, no adverse effects on adults, offspring, or reproductive parameters were observed in concentrations up to 102 mg a.e./L. As such, EPA (2005b) classified 102 mg a.e./L as the NOEC. In a separate study using midges, the NOEC was 130 mg a.e./L based on mean measured water column test concentrations and 82 mg a.e./L based on pore water concentrations.

Algae and aquatic macrophytes are only somewhat more sensitive than fish and aquatic invertebrates with NOEC values for algae in the range of 6 mg a.e./L to 23 mg a.e./L and a single NOEC of 44 mg a.e./L for an aquatic macrophyte. No chronic toxicity tests were reported (SERA 2007).

2,4-D (amine salt only)

Exposure. The Salmon and Challis Field Offices propose to use the Weedar 64 Amine formulation. Weedar 64 amine is a 2,4-D acid/salt formulation labeled for riparian treatments to treat broadleaf weeds. The EPA classifies the toxicity of 2,4-D to freshwater and marine fish as practically non-toxic for 2,4-D acid/salts and highly toxic for esters. (SERA 2006). The BLM does not approve the use of ester formulations of 2,4-D. Risk is greater under scenarios of direct application to water bodies or accidental direct spills.

The herbicide 2,4-D is highly soluble in water, but it rapidly degenerates in most soils, and is rapidly taken up in plants. 2,4-D ranges from being mobile to highly mobile in sand, silt, loam, clay loam, and sandy loam (EPA 2005a). Consequently, 2,4-D may readily contaminate surface waters when rains occur shortly after application, but is unlikely to be a ground-water contaminant due to the rapid degradation of 2,4-D in most soils and rapid uptake by plants. Most reported 2,4-D ground-water contamination has been associated with spills or other large sources of 2,4-D release. 2,4-D may remain active for 1 to 6 weeks in the soil and will degrade to half of its original concentration in several days. Soils high in organic matter will bind 2,4-D the most readily. 2,4-D is degraded in soil by microorganisms and degradation is more rapid under warm, moist conditions. Some forms of 2,4-D evaporate from the soil.

Transport of 2,4-D into rivers by storm runoff is likely to occur from rain events within or shortly following the spray season, based on documented studies. The Washington State Department of Ecology and Agriculture (Washington State) collected 32 stream samples downstream from a helicopter application of 2,4-D conducted according to Washington State BMPs. 2,4-D was found in all samples collected and in highest concentrations following a rainstorm the day after the spraying (Rashin and Graber 1993). In a national study of surface water quality, 2,4-D was found in 19 of 20 basins sampled throughout the United States (USGS 1998). In the U.S. Geological Survey (1998) study, 2,4-D was found in 12 percent of agricultural stream samples, 13.5 percent of urban stream samples, and in 9.5 percent of the samples from rivers draining a variety of land uses.

The SERA (2006) identified a peak estimated rate of contamination of ambient water associated with the normal application of 2,4-D as 0.44 mg a.e./L at an application rate of 1 lb a.e./acre. Typical application rates for 2,4-D in the proposed action range from 1.0 to 2.0 lb a.e./acre, and the maximum label application rate is 4 lb a.e./acre. At the maximum application rate of 4 lb. a.e./acre, the peak concentrations of 2,4-D in ambient water, using the modeled water contamination rate in SERA (2006), would be 1.76 mg a.e./L. Considering the BMP that will be implemented, it is likely that water concentrations of 2,4-D will be far less than modeling estimates performed by SERA.

End-Use Products. The herbicide 2,4-D is available in a variety of chemical forms (e.g., esters, amine salts, and acids) with different toxicities to fish. For this consultation, the BLM is proposing to use the amine salt forms of 2,4-D and has specifically requested the use of Weedar 64, and possibly Amine 4 (various manufacturers), and Weedstroy. The active ingredient in these products is the 2,4-D dimethylamine salt (DMA).

Both Weedar 64 and Weedstroy (and their substantially similar products as identified on the Pesticide Action Network pesticide database) consist of approximately 47 percent 2,4-D DMA. Unspecified, inert ingredients comprise the remaining 53 percent of the product. 2,4-D Amine 4 and its substantially similar products include 47.3 percent 2,4-D DMA and 52.3 percent of unspecified inert ingredients. The most recent SERA risk assessment (2006) included these products in the effects analysis.

Toxicity: Fish. The BLM is not proposing to use the ester formulation, which is more toxic to fish than the other forms. Instead, they propose to use the amine form, which has the lowest toxicity among the various 2,4-D formulations. Toxicities for the acid and amine salts of 2,4-D indicated that both forms are practically non-toxic to freshwater or marine fish, with LC_{50}s ranging from more than 80.24 mg a.e./L to 2,244 mg a.e./L (EPA 2005a). Of the EPA-required studies, the most sensitive results were obtained for rainbow trout exposed to the TIPA salt (96-hour LC_{50} of 162 mg a.e./L). The comparable most tolerant results of the EPA-required studies were obtained with rainbow trout (*Oncorhynchus mykiss*) exposed to the DMA salt (96-hour LC_{50} of 830 mg a.e./L). These values are similar to the LC_{50} values of 362 mg a.e./L (Martinez-Tabache et al. 2004) and 358 mg a.e./L (Alexander et al. 1985) obtained when rainbow trout were exposed to 2,4-D acid.

Most of the potential sublethal effects from exposure to 2,4-D have not been investigated for endpoints important to the overall health and fitness of salmonids. Exposure to 2,4-D has been reported to cause changes in schooling behavior, red blood cells, reduced growth, impaired ability to capture prey, and physiological stress (NLM 2012; Gomez 1998). Tierney et al. (2006) found modifications in electro-olfactogram response when exposing juvenile coho salmon (*O. kisutch*) to 100 mg a.e./L of 2,4-D. Little et al. (1990) examined behavior of rainbow trout exposed for 96 hours to sublethal concentrations of 2,4-D acid and observed inhibited spontaneous swimming activity (at 5 mg/L), swimming stamina (at 50 mg/L), predator avoidance (50 mg/L), and prey capture (5 mg/L).

Early life-state tests evaluating the effects of various forms of 2,4-D on growth and larval survival of the fathead minnow were submitted to EPA as part of the registration process. For the acid and salts, the reported NOECs for survival and reproduction ranged from 14.2 mg a.e./L (DMA) to 63.4 mg a.e./L (2,4-D acid). The LOEC values associated with these results are 23.6 mg a.e./L (length) and 102 mg a.e./L (larval survival), respectively (SERA 2006).

Toxicity: Other Aquatic Organisms. The EPA (2005a) classifies the acid and amine salts of 2,4-D as slightly toxic to practically non-toxic to aquatic invertebrates. *Daphnia* was the most sensitive species of freshwater species exposed to the 2,4-D acid, with a 48-hour LC_{50} of 25 mg a.e./L (Alexander et al. 1985). When *Daphnia* were exposed to the DMA of 2,4-D, the reported 48-hour LC_{50} values range from 153[6] mg a.e./L (Alexander et al. 1985) to 642.8 mg a.e./L (EPA 2005a). Some chronic studies (21-day) have been conducted to evaluate the effects of 2,4-D formulations on survival and reproduction. Ward (1991) reported a 21-day LC_{50} of 75.7 mg a.e./L for *Daphnia* from exposure to the DMA form of 2,4-D. A NOEC was not reported.

2,4-D is an effective herbicide that adversely affects aquatic plants. Based on the data available, it appears that the vascular plants are more than two orders of magnitude more sensitive than the non-vascular plants (EPA 2005a). The SERA (2006) reported the 5-day effect concentration where 50 percent of the organisms exhibited toxic effects (EC_{50}s) (algal cell growth) for 2,4-D acids and salts as ranging from 3.88 mg a.e./L (a corresponding NOEC of 1.41 mg a.e./L) to 156 mg a.e./L (a corresponding NOEC of 56.32 mg a.e./L). The most sensitive species was *Navicula pelliculosa* (a freshwater diatom), and the least sensitive species was a freshwater blue-green alga, *Anabaena flos-aquae*. Aquatic macrophytes appear to have a greater range of toxicity values, with target species having lower tolerances. Roshon et al. (1999) reported 14-day EC_{50} toxicity values for common water milfoil (*Myriophyllum sibiricum*), a target species, of 0.018 mg/L (shoot growth) and 0.013 mg/L (root length). Sprecher et al. (1998) report no effects on sago pondweed (*Potamogeton pectinatus*), a non-target species, at concentrations of up to 2 mg/L of WEEDAR 64.

NMFS Pesticide Registration Opinion. Chemical concentrations examined in the in the 2011 registration biological opinion (Opinion) (NMFS Tracking # 2004/02673) did not vary drastically from those summarized here. The 2,4-D registration Opinion reported acute toxicity data for rainbow trout ranging from 162 mg a.e./L (2,4-D TIPA salt) to 2,244 mg a.e./L (2,4-D isoproylamine). For the 2,4-D DMA, the acute toxicity information ranged from >100 mg a.e./L to 807 mg a.e./L. Information presented in the 2011 Opinion for EPAs registration of 2,4-D does not suggest a different endpoint as being more appropriate than that which was used in this Opinion.

The registration Opinion concluded there was no overlap between the estimated environmental concentrations (EECs) for forestry uses and the fish and invertebrate toxicity endpoints for

[6] The SERA risk assessment (2006) reports a LC_{50} of 184 mg a.e./L; however, the Alexander et al. (1985) paper specifically states that results are reported as the technical product and not as acid equivalents. NMFS used a conversion factor of 0.831 to convert from technical product to acid equivalents.

amine, salt, and acid forms of 2,4-D. Generally, the toxicity endpoints were several orders of magnitude higher than the EECs. There was some overlap with the algal and aquatic vascular plant endpoints with the floodplain estimate EEC. The registration Opinion concluded that use of 2,4-D in terrestrial applications was not likely to result in mortality of fish; however, it may result in some sublethal effects.

CHLORSULFURON

Exposure. Chlorsulfuron has a soil half-life of 1 to 3 months, with a typical half-life of 40 days. Soil microbes break down chlorsulfuron and can break it down faster in warm, moist soils (WSDOT 2006). Alternatively, EPA (2005b) describes soil half-life ranging from 14 to 320 days. The Washington Department of Transportation reported that chlorsulfuron has a high potential to contaminate groundwater, with contamination potentially resulting from application drift, surface runoff, and/or leaching through soil into groundwater (WSDOT 2006). The EPA (2005b) also describes chlorsulfuron as likely to be persistent and highly mobile in the environment, transported to non-target areas by surface runoff and/or spray drift.

The SERA (2004a) identified a peak estimated rate of contamination of ambient water associated with the normal application of chlorsulfuron at 0.2 mg a.e./L at an application rate of 1 lb a.e./acre. The maximum application rate listed in the proposed action is 2.6 ounces/acre, which is equivalent to 0.12 lbs a.e./acre; consequently, maximum peak exposure would be approximately 0.024 mg a.e./L. For longer-term exposures, average estimated rate of contamination of ambient water associated with the normal application of chlorsulfuron is 0.0006 (0.0001 to 0.0009) mg a.e./L at an application rate of 1 lb a.e./acre.

End-Use Products. The product formulation of chlorsulfuron proposed for use is Telar, which we interpreted as Telar XP. The XP formulation is the same formulation as previously registered and now obsolete Telar DF, but it has a different granule shape to improve mixing properties. The manufacturer requested a new registration number for Telar XP for internal tracking purposes. Telar XP contains 25 percent inert ingredients that have not been disclosed publicly. None of the inert ingredients are classified as toxic by the EPA (SERA 2004a).

Toxicity: Fish. The EPA (2005b) describe chlorsulfuron as “practically non-toxic” to fish, and it does not bioaccumulate in fish (WSDOT 2006). The 96-hour LC_{50} value for rainbow trout has been reported as greater than 250 parts per million (Smith 1979). Although full dose-response curves have not been generated (due to limited water solubility of chlorsulfuron), fish do not appear to be susceptible to chlorsulfuron toxicity. The LC_{50} values in most species exceed the limit of solubility for chlorsulfuron (SERA 2004a). Grande et al. (1994) exposed brown trout (*Salmo trutta*) to Glean (a product formulation consisting of 75 percent chlorsulfuron) and reported a 96-hour LC_{50} of 40 mg/L. Because the formulated product was tested, we cannot rule out the possibility that some of the toxicity may be due to the inert ingredients. There was not a paired study done on chlorsulfuron alone.

Pierson (1991) is the only study available regarding the toxicity of long-term (77 days) exposure of chlorsulfuron to fish or fry. Survival of rainbow trout embryos and alevins was not affected at concentrations up to 900 mg/L. However, fingerlings experienced 40 percent mortality at

900 mg/L. No mortality of fingerlings occurred in groups that were exposed to concentrations less than 900 mg/L (Pierson 1991). The NOEC for growth (as measured at the end of the study) was determined to be 32 mg/L and the LOEC was reported as 66 mg/L (Pierson 1991). These studies indicate that outright mortality from exposure to the active ingredient is unlikely from the proposed action since peak estimated exposure from SERA (2004a) is about three orders of magnitude lower than the reported LC_{50} for brown trout and approximately four orders of magnitude lower than the reported LC_{50} for rainbow trout. Because there are limited studies available, there is substantial uncertainty surrounding potential sublethal effects of chlorsulfuron and Telar XP. There is no assurance that the proposed action will not cause lethal or sublethal effects to ESA-listed fish if the fish are exposed to the product in any appreciable amount.

Toxicity: Other Aquatic Organisms. The effects of chlorsulfuron on aquatic plants and invertebrates are limited to assays reported for *Daphnia* and several species of plants. Chlorsulfuron is described by EPA (2005b) as "practically non-toxic" to aquatic invertebrates, with 48-hour LC_{50} values for *Daphnia* greater than 100 mg/L. Chlorsulfuron does not bioaccumulate in aquatic invertebrates (WSDOT 2006).

SERA (2004a) summarized standard toxicity bioassays in *Daphnia* (Goodman 1979; Ward and Boeri 1989) and mysids (Ward and Boeri 1991) to assess the effects of chlorsulfuron on aquatic invertebrates. Mysids and daphnia had similar LC_{50} values. The 96-hour LC_{50} and NOEC (for lethality) values for *Mysidopsis bahia* were reported as 89 mg/L and 35 mg/L, respectively (Ward and Boeri 1991). The reported 48-hour LC_{50} value in *Daphnia pulex* ranged between 32 and 100 mg/L, and the reported NOEC (for lethality) was 32 mg/L (Hessen et al. 1994). *D. magna* appear to be more resistant to chlorsulfuron toxicity based on a 48-hour LC_{50} value range of >100 to 370.9 mg/L. The reported NOEC for lethality was 10 mg/L (Goodman 1979). For reproductive effects, a NOEC of 20 mg/L was reported in a 21-day exposure study in *D. magna* (Ward and Boeri 1989).

Studies have demonstrated that aquatic plants are far more sensitive than aquatic animals to chlorsulfuron, with studies occurring for both algae and aquatic macrophytes. Study results summarized by SERA (2004a) revealed substantial differences in the response of algae and various cyanobacteria to chlorsulfuron. However, due to the many variations in experimental protocols, including the duration of exposure and the specific variables used to determine EC_{50} values, identifying the species most sensitive and most resistant to chlorsulfuron is difficult. *Selenastrum capricornutum* (a microalga) is fairly sensitive to chlorsulfuron toxicity, with reported EC_{50} values ranging from 0.05 mg/L to 0.8 mg/L (Abdel-Hamid 1996; Blasberg et al. 1991; Fairchild et al. 1997; Kallqvist and Romstad 1994). *Selenastrum* is an algal species that occurs in lakes and ponds, and it is used as a toxicity test species because it is sensitive to toxins. *Selenastrum* is generally not found in mountain streams and rivers, but it is a general indicator of potential algal responses in freshwater habitats. Results of a standard toxicity bioassay in *S. capricornutum* yield a NOEC of 0.01 mg/L (exposure duration of 120 hours) (Blasberg et al. 1991), which is consistent with the NOEC of < 0.019 mg/L reported by Fairchild et al. (1997). Fairchild et al. 1997 also reported an LOEC in *S. capricornutum* of 0.019 mg/L. *Cryptomonas pyrenoidifera,* another freshwater algal species, has an EC_{50} of 213 mg/L (Nystrom et al. 1999). The longest chlorsulfuron exposure duration for laboratory studies in algae was 92 hours; with no laboratory studies with longer exposure durations identified.

Chlorsulfuron can cause changes in phytoplankton communities at concentrations as low as 0.010 mg/L (Kallqvist et al. 1994). A decrease in biomass development was observed following exposure to chlorsulfuron concentrations of 0.010 mg/L for 13 days. A dose-dependent decrease in species diversity (based on the Shannon-Weiner diversity index) was also observed, with the lowest values recorded on the second and last days of the exposure period. With these low concentrations where changes have been observed, the proposed use of chlorsulfuron is likely to alter the algal communities in locations where it reaches water. However, any community effect is likely to be transient, and localized, since exposure is likely to occur through discrete runoff events or spillage with limited duration, and any such incidents are likely to be widely scattered.

Only three studies were identified by SERA (2004a) regarding the toxicity of chlorsulfuron to aquatic macrophytes: a 96-hour exposure study and a 7-day exposure study in duckweed (Fairchild et al. 1997; Peterson et al. 1994); and a 4-week exposure study in sago pondweed (Coyner et al. 2001). The 96-hour EC_{50} value for growth inhibition based on biomass in duckweed is reported as 0.0007 mg /L, with an NOEC value of 0.0004 mg/L and an LOEC of 0.0007 mg/L (Fairchild et al. 1997). Exposure of duckweed to 0.02 mg/L for 7 days resulted in 86 percent inhibition of growth (Peterson et al. 1994). Results of the 4-week exposure in sago pondweed yield an LC_{50} value of 0.001 mg/L, with 100 percent plant death following a 96-hour exposure to 0.002 mg/L (Coyner et al. 2001). No field studies assessing the effects of chlorsulfuron in aquatic plants have been identified.

Very little information is available regarding the toxicity of chlorsulfuron degradation products to aquatic plants or algae. Based on a single study described by SERA (2004a), comparing chlorsulfuron and two chlorsulfuron degradation products in *Chlorella pyrenoidosa* (a green algae), chlorsulfuron breakdown products appear to be considerably less toxic than chlorsulfuron; EC_{50} values for the degradation products are at least 100-fold greater than for chlorsulfuron (Wei et al. 1998).

CLOPYRALID

Exposure. Clopyralid's half-life in the environment averages 1 to 2 months and ranges up to 1-year. It is degraded almost entirely by microbial metabolism in soils and aquatic sediments, and is not degraded by sunlight or hydrolysis. Clopyralid is highly soluble in water, does not adsorb to soil particles, is not readily decomposed in some soils, and may leach into ground water. Clopyralid is extremely stable in anaerobic sediments, with no significant decay noted over a 1-year period (Hawes and Erhardt-Zabik 1995; Tu et al. 2001). Because clopyralid does not bind with sediments readily, it can be persistent in an aquatic environment, where clopyralid half-life ranges from 8 to 40 days (Tu et al. 2001). Clopyralid is stable in water over a pH range of 5 to 9 (Woodburn 1987), and the rate of hydrolysis in water is extremely slow with a half-life of 261 days (Concha and Shepler 1994).

Clopyralid does not bind tightly to soil and has a high potential for leaching. While clopyralid will leach under conditions that favor leaching (e.g., sandy soil, a sparse microbial population, and high rainfall), the potential for leaching or runoff is functionally reduced by the relatively rapid microbial degradation of clopyralid in soil (Baloch-Haq et al. 1993; Bergstrom et al. 1991; Bovey and Richardson 1991). A number of field lysimeter studies and the long-term field study by Rice et al. (1997) indicate that leaching and subsequent contamination of groundwater are likely to be minimal. This conclusion is also consistent with a short-term monitoring study of clopyralid in surface water after aerial application (Leitch and Fagg 1985).

SERA (2004b) estimated peak rates of contamination of ambient water associated with the normal application of clopyralid to be 0.07 mg a.e./L at an application rate of 1 lb a.e./acre. For longer-term exposures, average estimated rate of contamination of ambient water associated with the normal application of clopyralid is 0.007 (0.001 to 0.013) mg a.e./L at an application rate of 1 lb a.e./acre.

End-Use Products. Clopyralid is available in two forms (acid and amine salt). The BLM may use both, but likely will only use Transline, which contains 40.9 percent clopyralid as the monoethanolamine salt. It also contains 59.1 percent inert ingredients. Two of the inert ingredients include: isopropyl alcohol (5 percent) and a polyglycol (1 percent), neither of which are classified by EPA as toxic. Transline is currently produced by DowAgroSciences.

Toxicity: Fish. Little information is reported for toxic effects of clopyralid. The acid and amine forms of clopyralid have different toxicities to fish. The monoethanolamine salt of clopyralid appears to have lower toxicity compared to the acid formulation present in some other products. Toxicity of the acid formulation of clopyralid for a 96-hour LC_{50} is reported in SERA (2004b) to be 103.5 mg a.e./L, using an unspecified life stage of rainbow trout. For the monoethanolamine salt form used in the proposed action, SERA (2004b) reported a 96-hour LC_{50} of 700 mg a.e./L. Fairchild et al. (2008) exposed rainbow trout and bull trout to clopyralid and reported 96-hour LC_{50} values of 700 mg a.e./L and 802 mg a.e./L, respectively. The authors also used accelerated life testing procedures in EPA's Acute-to-Chronic Estimation with Time-Concentration-Effect Models program to estimate chronic lethal concentrations resulting in 1 percent mortality (LC_1) at 30-days. The reported chronic LC_1 was 477 mg a.e./L, with a 95 percent confidence interval of 53 mg a.e./L to 900 mg a.e./L.

Only one longer-term toxicity study for clopyralid was available. Fairchild et al. (2009a) conducted 30-day chronic toxicity tests with juvenile rainbow trout. No mortality was observed at the highest concentrations tested (273 mg a.e./L). They found no significant effects on growth of juvenile trout after 15 days of exposure to clopyralid at concentrations up to 256 mg a.e./L. However, both length and weight of trout were significantly affected after exposure to clopyralid for 30-days, with a calculated LOEC of 136 mg a.e./L. The 30-day NOEC value was reported as 68 mg a.e./L. No other longer-term toxicity studies are available on the toxicity of clopyralid.

Toxicity: Other Aquatic Organisms. Toxic effects on aquatic invertebrates are reported only for *Daphnia*, which has an LC_{50} of 350 mg a.e./L for the monoamine salt and 225 mg a.e./L for the acid LC_{50} (SERA 2004b). Results from a single, standard chronic reproduction bioassay exposing *Daphnia* to the monoethanolamine salt of clopyralid indicate a NOEC value of 23.1 mg a.e./L (SERA 2004b). If other invertebrates respond similarly to *Daphnia*, then lethal effects on aquatic invertebrates are unlikely.

Aquatic plants are more sensitive to clopyralid than fish or aquatic invertebrates (SERA 2004b). The EC_{50} for growth inhibition in duckweed, an aquatic macrophyte, is 89 mg/L. However, at lower concentrations, in the range of 0.01 to 0.1 mg/L, growth of other aquatic macrophytes is stimulated (Forsyth et al. 1997). From information reported in SERA (2004b) it appears that there could be potential losses in primary productivity from algae killed by clopyralid, based on an EC_{50} for algae of 6.9 mg/L. However, concentrations lethal to algae are unlikely to occur unless clopyralid is directly added to water, or if a rainfall washes the chemical into a stream shortly after it is applied.

DICAMBA

Exposure. Dicamba is highly mobile in and poorly adsorbed by most soil types. It is also highly soluble in water, so its transport is influenced by precipitation. At low rainfall rates, dicamba dissipation had a half-life of about 20 days. At high rainfall rates using modeled runs, virtually all the dicamba was washed from the soil. The environmental fate of dicamba has been extensively studied. In general, dicamba is very mobile in most soil types, with the only reported exception being peat, to which dicamba is strongly adsorbed (Grover and Smith 1974). For many soil types, the extent of soil adsorption is positively correlated with and can be predicted from the organic matter content and exchangeable acidity of the soil (Johnson and Sims 1993). In a monitoring study by Scifres and Allen (1973), dicamba levels in the top 6 inches of soil dissipated at a rate of about 0.22-day-1 (t1/2=3.3 days) over the first 2 weeks following application. After 14 days no dicamba was detected, with the limit of detection of 0.01 mg/kg, in the top 6 inches of soils. The rates of dissipation in clay and loam were essentially identical.

Available monitoring data indicate that ambient water may be contaminated with dicamba after standard applications of the product. The range of average to maximum dicamba levels in water, reported in a monitoring study by Waite et al. (1992), are from approximately 0.1 to 0.4 microgram per liter. SERA (2004c) estimated peak rates of contamination of ambient water associated with the normal application of dicamba to range from less than 0.00001 mg a.e./L to 0.0005 mg a.e./L at an application rate of 1 lb a.e./acre. The estimated water contamination rate for an accidental direct spray of a stream was reported as 0.01 mg a.e./L. Because dicamba has been detected in surface water at concentrations higher than those modeled by groundwater loading effects of agricultural management systems (GLEAMS), SERA (2004c) opted to use the 0.01 mg a.e./L as the peak water contamination rate in their risk assessment.

End-Use Products. Dicamba is available as a diglycolamine (DGA) salt and DMA. Common products are Banvel and Vanquish. Banvel is formulated with the DMA of dicamba, with roughly 52 percent inert ingredients. Vanquish is the DGA salt of dicamba, and contains approximately 43 percent inert ingredients.

Toxicity: Fish. There is wide variation in the reported acute toxicity of dicamba to fish, with 96-hour LC_{50} values ranging from 28 mg/L (rainbow trout) to 465 mg/L (mosquito fish [*Gambusia affinis*]). Although limited data are available, salmonids appear to be more sensitive to dicamba than other freshwater fish. Rainbow trout had the lowest reported 96-hour LC_{50} value. The reported 96-hour LC_{50} value for cutthroat trout (*O. clarki*) was more than 50 mg/L (Woodward 1982). For coho salmon, reported 48- and 144-hour LC_{50} values were 120 mg/L and more than 109 mg/L, respectively (Bond et al. 1965; Lorz et al. 1979). In a study by Lorz et al.

(1979), yearling coho mortality was observed at 0.25 mg/L during a seawater challenge test which simulates their migration from rivers to the ocean.
There are limited studies on sublethal effects from acute or chronic exposures. The only study providing histopathologic evaluation is that of Lorz et al. (1979) using coho salmon. In this study, non-lethal concentrations of dicamba at a concentration of 100 mg/L were associated with histopathological changes in the liver but not in the kidneys or gills. Acute NOEC values have been reported for bluegill sunfish (*Lepomis macrochirus*) (56 mg/L in Vilkas 1977a; 100 mg/L in McAllister et al. 1985a), rainbow trout (56 mg/L in McAllister et al. 1985b), and sheepshead minnow (*Cyprinodon variegatus*) (>180 mg/L from Vilkas 1977b). However, these NOEC values are based on relatively gross endpoints – i.e., no mortality and no behavioral changes. A significant issue with these values is the fact that some reported NOEC values are greater than values reported to cause an adverse effect. For example, as noted above, McAllister et al. (1985b) report an NOEC of 56 mg/L in rainbow trout. While this is consistent with the LC_{50} value of 320 mg/L reported by Bond et al. (1965) in rainbow trout, Johnson and Finley (1980) report an LC_{50} of 28 mg/L in rainbow trout. These sorts of discrepancies are not uncommon with compounds for which many studies are conducted at different times by several different laboratories. The reported NOEC values for dicamba will not be used directly in this Opinion because they may not fully encompass sublethal toxicity and because some of the reported NOEC values exceed other reports of concentrations that are associated with lethality.

Toxicity: Other Aquatic Organisms. The range of toxicity values of dicamba to aquatic invertebrates suggests wide variation among species. The lowest reported 48-hour LC_{50} is 5.8 mg/L for *Gammarus lacustris* (Sanders 1969). While *Daphnia magna*, a common test species, appears to be relatively tolerant to dicamba with reported 48-hour LC_{50} values from 100 mg/L to >1000 mg/L (Johnson and Finley 1980; Forbis et al. 1985). *Daphnia pulex* is much more sensitive with a 48-hour LC_{50} value of 11 mg/L (Hurlbert 1975). As with fish, no longer-term studies are available on the lethal and sublethal toxicity of dicamba to aquatic invertebrates.

Algae species are more sensitive to dicamba than aquatic animals (SERA 2004c). The most sensitive species on which data are available is the freshwater algae, *Anabaene flos-aquae,* with a 5-day EC_{50} of 0.061 mg/L (Hoberg 1993a). The aquatic macrophyte, *Lemna gibba*, had reported 14-day NOEC and LOEC values of 0.25 mg/L and 0.51 mg/L, respectively (Hoberg 1993b). A higher 4-day NOEC of 100 mg/L was reported for *Lemna minor* (Fairchild et al. 1997). Whether this value reflects a true difference in species sensitivity or whether is simply reflects a shorter duration of exposure is unknown.

GLYPHOSATE

Exposure. Glyphosate strongly binds to most soils, but dissolves easily in water. Glyphosate remains unchanged in the soil for varying lengths of time, depending on soil texture and organic matter content. The half-life of glyphosate can range from 3 to 249 days in soil and from 35 to 63 days in water (USFS 2000a). Soil microorganisms break down glyphosate and the potential for leaching is low due to the soil adsorption. However, glyphosate can move into surface water when the soil particles to which it is bound are washed into streams or rivers (EPA 1993). Studies examined glyphosate residues in surface water after forest application in British Columbia with and without no-spray streamside zones. With a no-spray streamside zone, very low concentrations were sometimes found in water and sediment after the first heavy rain (USFS 2000a). Although glyphosate is chemically stable in pure aqueous solutions, it is degraded relatively fast by microbial activity, and water levels are further reduced by the binding of glyphosate to suspended soil particulates in water and dispersal (SERA 2011a).

Biodegradation represents the major dissipation process. After glyphosate was sprayed over two streams in the rainy coastal watershed of British Columbia, glyphosate levels in the streams rose dramatically after the first rain event, 27 hours after application, and fell to undetectable levels in 96 hours (NLM 2012). The highest residues were associated with sediments, indicating that they were the major sink for glyphosate. Residues persisted throughout the 171-day monitoring period. Suspended sediment is not a major mechanism for glyphosate transport in rivers, but glyphosate sprayed in roadside ditches could readily be transported as suspended sediment and cause acute exposures following rain events.

The SERA (2011a) estimated peak rates of contamination of ambient water associated with the normal application of glyphosate to be 0.083 mg a.e./L at an application rate of 1 lb a.e./acre. For longer-term exposures, average estimated rate of contamination of ambient water associated with the normal application of glyphosate is 0.00019 (0.000088 to 0.0058) mg a.e./L at an application rate of 1 lb a.e./acre. Peak contamination rates in a stream after a direct spray were modeled to be 0.091 mg a.e/L.

End-Use Products. Glyphosate is available in a variety of formulations that contain the ammonium, DMA, isopropylamine (IPA), or potassium salts of glyphosate. Some formulations contain only one of these salts as an aqueous solution (e.g., Accord, AquaNeat, and Rodeo), and other formulations (e.g., Roundup®) contain surfactants. The BLM proposes to use products that are formulated as salts in water with no added surfactants. Products that appear to fit these criteria include: Rodeo, Accord Concentrate, GlyPro, AquaMaster, AquaNeat Aquatic Herbicide, and Foresters. All of these EUPs have the same proportion of the IPA salt of glyphosate. Manufacturers of these EUPs recommend that a surfactant be added to the formulation in a tank mix prior to application.

Toxicity: Fish. The EPA (1993) classified glyphosate (technical grade) as slightly toxic to practically non-toxic to fish. The rainbow trout 96-hour LC_{50} values for glyphosate acid and the IPA salt of glyphosate range from 10 mg a.e./L to 240 mg a.e/L. Wan et al. (1989) found the toxicity of glyphosate is affected by pH. The authors tested the toxicity of glyphosate to various salmonids (rainbow trout, coho salmon, chum salmon [*O. keta*], Chinook salmon [*O. tshawytscha*], and pink salmon [*O. gorbuscha*]) in water with pH values ranging from 6.3 to 8.2. Rainbow trout were the most sensitive to pH variance, with 96-hour LC_{50} values ranging from 10 mg a.e./L (pH 6.3) to 197 mg a.e./L (pH 8.2).

The various formulations of glyphosate have different toxicities to fish (rainbow trout 96-hour LC_{50} values ranging from 1.3 mg a.e./L to 429 mg a.e./L), which highlights the role of inert ingredients in toxicity (SERA 2011a). Of the glyphosate formulations tested, both Rodeo and Accord (and other equivalent formulations) are the least toxic. These formulations consist of only the active ingredient and water; however, the manufacturer recommends the EUP be mixed with a surfactant prior to applying the herbicides. Mitchell et al. (1987) tested the toxicity of

Rodeo with and without a surfactant. Without the surfactant, the 96-hour LC_{50} for rainbow trout was 429 mg a.e./L. With the surfactant X-77, the 96-hour LC_{50} ranged from 96.4 mg a.e./L (rainbow trout) to 180.2 mg a.e./L (Chinook salmon). For this Opinion we applied the values reported by SERA (2011a) for 96-hour LC_{50} – (1) Most toxic formulations = 1 to 10 mg a.e/L; and (2) less toxic formulations = 10 to 429 mg a.e/L.

The most toxic formulation tested was Roundup® Original and its apparently equivalent formulations (Honcho, Gly Star Plus, and Cornerstone). These Roundup® formulations contain glyphosate IPA and the polyoxyethyleneamine (POEA) surfactant MON 0818. The reported range of 96-hour LC_{50} values for Roundup® formulations that appear to contain this POEA surfactant is 0.96 mg a.e./L to 10 mg a.e./L (SERA 2011a). Other formulations with the trade name of Roundup® have been found to be much less toxic (i.e., rainbow trout LC_{50} of 800 mg a.e./L for Roundup® Biactive) than standard Roundup® formulations (SERA 2011a). The decreased toxicity of these formulations is likely due to the use of different surfactants.

Of the numerous surfactants that may be used in glyphosate EUPs, POEA is the most important class of surfactants. The POEA is commonly used to designate surfactants used in some glyphosate formulations; however, it is not a single surfactant. The POEA surfactants are mixtures, and not all POEA surfactants used in glyphosate formulations are equivalent (even among formulations provided by the same manufacturer). Data indicate that some POEA surfactants may be equally toxic or more toxic than glyphosate itself.

The surfactant MON0818® in Roundup® formulations has been studied most extensively (of all the surfactants used with glyphosate products). It is considered highly toxic to fish (typical LC_{50} values ranging from about 1 to 3 mg/L). MON0818® is more toxic than glyphosate by factors of 3.1 (i.e., pink salmon at pH 6.3) to 135.6 (i.e., pink salmon at pH of 8.2) (SERA 2011a). Unlike technical grade glyphosate, the toxicity of MON0818® increases with increasing pH. Toxicity (LC_{50}) values reported for other surfactants added to glyphosate field solutions typically range from 1 to 10 mg/L (SERA 2011a). However, there are some surfactants that are considered slightly toxic (LC_{50} values ranging from >10 to 100 mg/L) to practically non-toxic (LC_{50} values greater than 100 mg/L). The surfactants Agri-Dex, LI 700 and Geronol CF/AR have LC_{50} values greater than 100 mg/L (McLaren/Hart 1995).

As noted previously, the surfactants can substantially alter the toxicity of a formulation (e.g., toxicity increased four times when X-77 was added to Rodeo). The BLM identified the following surfactants for use: Activator 90, Spreader 90, L1700, Syl-tac, R11, and MSO. Three of these surfactants have reported rainbow trout 96-hour LC_{50} values: Activator 90 (2.0 mg/L); R-11 (3.8 mg/L); LI700 (130 mg/L). The toxicity of X-77 is reported to be similar to that of R-11. As such, we will assume that the Rodeo/R-11 mixture has a similar toxicity to that of the Rodeo/X-77 (LC_{50} of 96.4 mg a.e./L) mixture for this Opinion. Additional surfactants may be presented to the Level 1 Team for use during the 15-year term of this action.

Information on sublethal effects of glyphosate and glyphosate formulations is extremely limited and not available for many of the endpoints important to the overall health and fitness of salmonids. Xie et al. (2005) exposed juvenile rainbow trout to 0.11 mg a.e./L[7] glyphosate for 7 days and did not observe any significant increase in vitellogenin concentrations. The authors also exposed juvenile trout to mixtures of glyphosate (0.11 mg a.e./L) and either the surfactant R-11 (0.06 mg/L) or TPA (0.02 mg/L) for 7 days and observed some increases in vitellogenin concentrations. However, those increases were not statistically significant. No other studies evaluating sublethal effects to salmonids from acute exposures to technical grade glyphosate were found.

There have been some acute studies performed using Roundup® formulations. Morgan et al. (1991) reported that trout do not exhibit avoidance responses to glyphosate formulations (Vision with 15 percent surfactant and Vision with 10 percent surfactant) at concentrations less than the 96-hour LC_{50}. However, behavioral changes such as changes in coughing and ventilation rates, changes in swimming, loss of equilibrium, and changes in coloration were observed at concentrations as low as 50 percent of the LC_{50} over exposures of up to 96 hours (some erratic swimming behavior was observed after just 24 hours). In this study, rainbow trout exposed to concentrations of up to 6.75 mg a.e./L of Vision (with 15 percent surfactant) did not exhibit abnormal behavior during the exposure period. Similarly, no abnormal behavior was observed in fish exposed to concentrations of up to 18.75 mg a.e./L of Vision (with 10 percent surfactant). Tierney et al. (2007) reported that rainbow trout may be able to sense glyphosate (Roundup® formulation) at about 0.076 mg a.e./L (as measured by olfactory-mediated behavioral and neurophysiological responses) during 30-minute exposure periods, but will not exhibit an avoidance response at this concentration. Rather, avoidance responses were exhibited at concentrations that were close to those causing acute lethality. The SERA (2011a) concluded that more toxic formulations (i.e., Roundup) had a surrogate lowest sublethal effect of 0.5 mg a.e./L for trout while the less toxic formulations (i.e., Rodeo, etc.) produced sublethal effects at concentrations ranging from 0.5 to 21 mg a.e./L.

One full life-cycle study assessing the chronic toxicity of technical grade glyphosate has been performed using the fathead minnow. In this study, no adverse effects to survival or reproduction occurred at exposures up to 25.7 mg a.e./L (the highest concentrations tested). Morgan and Kiceniuk (1992) conducted a long-term study (2 months) exposing rainbow trout to Vision at concentrations up to 0.046 mg a.e./L. No mortality or signs of toxicity were observed during the exposure period, and the authors did not find any evidence or pathology or changes in growth. The authors noted a decrease in the frequency of wigwag behavior in exposed trout at 0.0045 mg a.e./L; however, this effect was not observed at higher exposure concentrations (0.043 mg a.e./L). Because the change in wigwag behavior did not have a clear dose-response relationship, the authors were uncertain about its biological significance. No other chronic studies using salmonids were located.

[7] SERA (2011a), reported the exposure concentration as 1.25 mg a.e./L; however, following review of the original publication (Xie et al. 2005), it appears as though 0.11 mg a.e./L glyphosate was measured, and the 1.25 mg a.e./L concentration was applicable to the chemical triclopyr.

Toxicity: Other Aquatic Organisms. The EPA (1993) classified glyphosate (technical grade) as slightly toxic to practically non-toxic to aquatic invertebrates. The 48-hour EC_{50} values for aquatic invertebrates exposed to glyphosate or glyphosate IPA generally range from 50 to 650 mg a.e./L (SERA 2011a). For *Daphnia magna*, studies provided to EPA in support of the registration for glyphosate reported EC_{50} values ranging from 128 to 647 mg a.e./L. Pereira et al. (2009) reported an extremely high acute EC_{50} (more than 2,000 mg a.e./L). Even though this result is much higher than any previously reported EC_{50} values, the test protocol used appeared to be relatively standard (SERA 2011a).

As expected, Rodeo has similar toxicities to the active ingredient and is much less toxic than formulations that contain surfactants. For aquatic invertebrates, the LC_{50} values for Rodeo range from 86 mg a.e./L[8] to more than 2,000 mg a.e./L. Simenstad et al. (1996) found no significant differences in the short term (28 days post treatment) or long term (119 days post treatment) between benthic communities of algae and invertebrates on untreated mudflats and mudflats treated with Rodeo® and the surfactant X-77 spreader.

Similar to fish, Roundup® and similar formulations of glyphosate are much more toxic to aquatic invertebrates than glyphosate, glyphosate IPA, and Rodeo. Toxicity values for most Roundup® formulations range from approximately 1.5 to 62 mg a.e./L. In a study of avoidance behavior, Folmar (1978) noted that mayflies avoided Roundup® at concentrations of 10 mg/L; however, no effect was noted at concentrations of 1 mg/L. Hildebrand et al. (1980) found that Roundup® treatments of an experimental pond at concentrations up to 196 lbs/acre did not significantly affect the survival of *Daphnia*.

Glyphosate is highly toxic to all types of terrestrial plants and is used to kill floating and emergent aquatic vegetation. Differences in species sensitivities to glyphosate acid are apparent for both algae (EC_{50} values from about 2 to 600 mg a.e./L) and aquatic macrophytes (EC_{50} values from 10 to near 200 mg a.e./L). The toxicity of Rodeo (no surfactant) to the algae *Ankistrodesmus* sp. was reported to be 29 mg a.e./L (Gardner et al. 1997). Perkins (1997) found Rodeo to be much more toxic to the aquatic macrophyte watermilfoil (14-day EC_{50} of 0.84 mg a.e./L) and *Lemna gibba* (7.6 mg a.e./L).

IMAZAPIC

Exposure. Imazapic has an average soil half-life of 120 days, with degradation primarily occurring through soil microbial metabolism (Tu et al. 2001). Imazapic is moderately persistent in soils, and has not been found to move laterally with surface water (generally moving only 6 to 12 inches laterally but can leach to depths of 18 inches in sandy soils). Although the extent to which imazapic is degraded by sunlight is believed to be minimal when applied to terrestrial plants, it is rapidly degraded by sunlight in aqueous solutions (half-life of 1 to 2 days). Imazapic is water soluble and is not degraded hydrolytically in aqueous solution (Tu et al. 2001).

---

[8] Henry et al. (1994) reported an LC_{50} value of 218 mg formulation/L for *Daphnia magna*. It appears as though SERA (2011a) erroneously reported this value as milligrams acid equivalent per liter (mg a.e./L). The formulation used contained 53.5 percent IPA salt of glyphosate. The ratio of glyphosate acid to the IPA salt in the formulation is 0.74. Thus, a toxicity value of 218 mg formulation/L equates to 86.3 mg a.e./L (218 * 0.535 * 0.74).

Simulations of imazapic runoff were conducted for both clay, loam, and sand at annual rainfall rates from 5 to 250 inches and the typical application rate of 0.1 lb a.e./acre (SERA 2004d). Based on the modeling, under arid conditions (i.e., annual rainfall of about 10 inches or less), no runoff is expected and degradation, not dispersion, accounts for the decrease of imazapic concentrations in soil. At higher rainfall rates, plausible offsite movement of imazapic may reach up to 3.5 percent of the applied amounts in clay soils. In very arid environments substantial contamination of water is unlikely. In areas with increasing levels of rainfall, exposures to aquatic organisms are more likely to occur. Thus, the anticipated water contamination rates (WCRs) (concentration of imazapic in ambient water per lb a.e./acre applied) associated with runoff encompass a very broad range, from 0 to 0.002 mg/L, depending on rainfall rates and soil type (SERA 2004d).

In their risk assessment, SERA (2004d) utilized a peak estimated rate of contamination of ambient water associated with the normal application of imazapic of 0.01 mg a.e./L at an application rate of 1 lb a.e./acre. Typical application rates for imazapic in the proposed action range from 0.1 to 0.19 lb a.e./acre, and the maximum label application rate is 0.19 lb a.e./acre. At the maximum application rate of 0.19 lb. a.e./acre, the peak concentrations of imazapic in ambient water, using the modeled water contamination rate in SERA (2004d), would be 0.002 mg a.e./L. Considering the BMPs that will be implemented, it is likely that water concentrations of imazapic will be far less than that estimated here.

End-Use Products. Imazapic is available in acid and ammonium salt forms. The BLM proposes to use Plateau, which is formulated with 23.6 percent of the ammonium salt of imazapic. No other EUPs are proposed for use.

Toxicity: Fish. The ammonium salt form of imazapic is less toxic than the acid form. Fish appear to be relatively insensitive to imazapic exposures, with LC_{50} values >100 mg/L for both acute toxicity and reproductive effects (SERA 2004d). In acute toxicity studies, all tested species (channel catfish [*Ictalurus punctatus*], bluegill, sunfish, trout, and sheepshead minnow) evidenced 96-hour LC_{50} values of >100 mg/L. The low toxicity of imazapic to fish is probably related to a very low rate of uptake of this compound by fish. In a 28-day flow-through assay, the bioconcentration of imazapic was measured at 0.11 Liters per kilogram (Barker et al. 1998) indicating that the concentration of imazapic in the water was greater than the concentration of the compound in fish. No studies are reported in the SERA assessment (2004d) for sublethal effects of imazapic to ESA-listed fish. Barker et al. (1998) observed no effects on reproductive parameters in a 32-day egg and fry study using fathead minnow.

Even though imazapic itself appears to be only moderately toxic to fish, based on the LC_{50}, Plateau contains roughly 76 percent inert ingredients that are not identified by the manufacturer. With many herbicides, the inert ingredients may be more toxic to fish and other aquatic organisms than the active ingredient. While toxicity tests are reported for imazapic, there is no apparent information regarding the toxicity to salmon and trout for the product formulation in Plateau, which includes imazapic and unspecified inert ingredients. Although none of the inert ingredients contained in Plateau are classified as toxic by the EPA (SERA 2004d), no studies are available lending insight into how the inerts may affect the toxicity of Plateau. Consequently the toxic effects of salmon or trout exposure to Plateau are unknown.

Toxicity: Other Aquatic Organisms. Similar to fish, there is relatively little information about the effects of imazapic on aquatic organisms in the natural environment. No adverse effects to *Daphnia* or mysid shrimp were observed at nominal concentrations of imazapic of up to 100 mg/L in 96-hour studies (SERA 2004d); however, the report did not specify if the analysis included any sublethal endpoints. Additionally, no adverse effects were noted in a life-cycle study that exposed *Daphnia* to concentrations up to 100 mg/L.

Effects of imazapic on aquatic plants is highly variable. *Lemna gibba*, a freshwater macrophyte, is the most sensitive aquatic plant reported in the literature, with an EC_{50} value based on decreased frond counts of 0.0061 mg/L. Algae were less sensitive than macrophytes (reported LC_{50} values >0.045 mg/L), and responses included both growth inhibition and growth stimulation (SERA 2004d).

IMAZAPYR

Exposure. In soil, imazapyr has reported soil half-lives ranging from 313 to 2,972 days, with an overall average of 2,150 days. Imazapyr is rapidly degraded by sunlight in aquatic solutions. In soils, however, there is little or no photodegradation of imazapyr, it is slowly degraded by microbial metabolism, and it can be relatively persistent. As of September 2003, imazapyr (tradename Habitat®) is registered for use in aquatic areas, including brackish and coastal waters, to control emerged, floating, and riparian/wetland species. Arsenal is also labeled for aquatic applications.

End-Use Products. Imazapyr is available as an IPA salt. The BLM proposes to use mainly Habitat® and Arsenal. Habitat is formulated with 28.7 percent of the IPA salt of imazapyr and 71.3 percent other ingredients while Arsenal, also an IPA salt, contains 27.8 percent imazapyr and 72.2 percent other ingredients, including an unspecified solvent. No other EUPs are proposed for use.

Toxicity: Fish. Based on LC_{50} values of >100 mg a.e./L, imazapyr acid is classified as practically non-toxic to fish (SERA 2011d). Based on acute bioassays in both bluegills and trout, the IPA salt of imazapyr is also practically non-toxic to fish.

Toxicity data are also available on the Arsenal formulation of imazapyr. This formulation consists of the IPA salt of imazapyr (27.8 percent 40 a.i, 22.6 percent a.e.) and 72.2 percent inerts which include an unspecified solvent. The 96-hour LC_{50} of 41 Arsenal Herbicide is about 41 mg a.e./L in bluegills and 21 mg a.e./L in trout (SERA 2011d). The SERA (SERA 2011d) document describes a study in trout, which notes the higher toxicity of the formulation relative to imazapyr and IPA salt of imazapyr. The substantially lower LC_{50} values of Arsenal Herbicide, expressed in acid equivalents, suggests that the inerts in the formulation contribute to its greater toxicity, as discussed further in the dose-response assessment (SERA 2011d). Given the results of the Arsenal formulation study, toxicity of imazapyr formulations appear more toxic than the AI alone.

Effective aquatic applications of imazapyr will cause oxygen depletion in the water column secondary to rotting vegetation. The event will occur after the application of any effective aquatic herbicide and may kill fish as well as other aquatic organism. While hypoxia in fish due to oxygen depletion in water is identified as an endpoint of concern for fish and other aquatic organisms, potential hazards to fish associated with hypoxia should be minimal, if label directions are followed and only partial sections of standing bodies of water are treated at one time (SERA 2011d). Aquatic treatments are not proposed in the assessed action area and thus this effect will not occur.

Toxicity: Other Aquatic Organisms. The acute toxicity data on aquatic invertebrates are similar to the data on fish. Both imazapyr acid and IPA salt of imazapyr are classified as practically non-toxic to Daphnia magna as well as saltwater invertebrates – i.e., oysters and pink shrimp (SERA 2011d).

METSULFURON-METHYL

Exposure. The persistence of metsulfuron-methyl in soil is highly variable; reported soil half-lives range from a 14 to 180 days, with an overall average of 30 days. The rate of metsulfuron-methyl degradation depends on factors like temperature, rainfall, pH, organic matter, and soil depth. Metsulfuron-methyl in the soil is broken down to non-toxic and non-herbicidal products by soil microorganisms and chemical hydrolysis. Degradation will occur more rapidly under acidic conditions, and in soils with higher moisture content and higher temperature (Extoxnet 1996).

The mobility of metsulfuron methyl ranges from moderate to highly mobile (NLM 2012). Off-site movement of metsulfuron-methyl is governed by the binding of metsulfuron-methyl to soil, the persistence in soil, as well as site-specific topographical, climatic, and hydrological conditions. The adsorption of metsulfuron-methyl to soil varies with the amount of organic matter present in the soil, soil texture, and pH. Adsorption to clay is low. In general, metsulfuron-methyl absorption to a variety of different soil types will increase as the pH decreases. Metsulfuron-methyl dissolves easily in water. There is a potential for metsulfuron-methyl to contaminate ground waters at very low concentrations. Metsulfuron-methyl readily leaches through silt loam and sand soils.

Fate and transport simulations reported in SERA (2004e) were conducted for clay, loam, and sand at annual rainfall rates ranging from 5 to 250 inches and the typical application rate of 0.03 lb a.e./acre. In all soil types under arid conditions (i.e., annual rainfall of about 10 inches or less), substantial contamination of surface water is unlikely. In areas with increasing levels of rainfall, peak WCRs of about 0.0001 to 0.002 mg a.e./L (per application of 1 lb a.e./acre) can be anticipated, under worst case conditions, at rainfall rates ranging from 15 to 250 inches per year. SERA (2004e) also estimated the water contamination rate associated with an accidental direct spray to be 0.010 mg/L at an application rate of 1 lb a.e./acre. For this Opinion, the higher water contamination rate was multiplied by the maximum label application rate to estimate the EEC (i.e., 0.010 mg a.e./L x 0.15 lb a.e./acre = 0.002 mg a.e./L).

End-Use Products. There are several formulations of metsulfuron-methyl registered for use; however, the BLM propose to use mainly the formulation Escort or Escort XP. Escort XP is the same formulation as Escort, but the shape has been changed to provide better mixability. Escort XP is manufactured by DuPont and is comprised of 60 percent metsulfuron methyl and 40 percent inert ingredients (SERA 2004e). The inert ingredients include sodium naphthalene sulfonate-formaldehyde condensate, a mixture of a sulfate of alkyl carboxylate and sulfonated alkyl naphthalene (sodium salt), polyvinyl pyrrolidone, trisodium phosphate, and sucrose.

Both trisodium phosphate and sucrose are generally recognized as safe compounds and are approved as food additives. Although none of the remaining inerts are categorized by EPA as being of toxicological concern (List 1) or as being potentially toxic or as having a high priority for testing (List 2), there is insufficient information available to assess their potential toxicity to fish. Polyvinyl pyrrolidone is marketed as a disinfectant for fish aquaria and treatment of certain fish infections; consequently, the product is not likely to be toxic to listed salmonids at environmental concentrations encountered under the proposed action.

The label for Escort XP recommends the use of a non-ionic surfactant, except in certain circumstances. There is limited information on the toxicity of surfactants (refer to the discussion included in Section 2.4.1.5 of the Opinion and the "glyphosate" section of this appendix.

Toxicity: Fish. Based on available studies, metsulfuron-methyl appears to have a low toxicity to and does not bioaccumulate in fish. The reported rainbow trout 96-hour LC_{50} values for metsulfuron-methyl range from more than 150 mg a.e./L to more than 1,000 mg a.e/L (SERA 2004e). The lowest concentration at which rainbow trout mortality was observed is 100 mg/L; however, in the same study, no mortality was observed in rainbow trout exposed to 1,000 mg/L (Hall 1984). Because of the lack of a dose-response relationship, Hall (1984) asserts that the mortality in the 100 mg/L exposure group was probably incidental rather than treatment related. This Opinion uses a LC_{50} of 150 mg a.e./L to evaluate the potential for use of metsulfuron-methyl to adversely affect ESA-listed fish.

Debilitating sublethal effects (i.e., erratic swimming, rapid breathing, and lying on the bottom of the test container) were observed by Muska and Hall (1982) after exposure to 150 mg/L for 24 hours. In tests with rainbow trout, no significant long-term effects (90-day exposure) were observed by Kreamer (1996) on hatch rate, last day of hatching, first day of swim-up, larval survival, and larval growth at concentrations up to 4.7 mg/L. However, concentrations greater than 8 mg/L resulted in small but significant decreases in hatching and survival of fry.

Indirect Effects on Aquatic Organisms. Toxicity studies on aquatic invertebrates are reported only for *Daphnia*. For acute exposures, the range of EC_{50} values for immobility ranges from more than 150 mg/L to 720 mg/L. For chronic exposures, the NOEC of 17 mg/L for growth inhibition is used, although higher chronic NOECs, ranging from 100 to 150 mg/L, have been reported for survival, reproduction and immobility (SERA 2004e). The only effect reported by Hutton (1989) in a 21-day *Daphnia* study was a decrease in growth at concentrations as low as 5.1 mg/L, but decreased growth at concentrations less than 30 mg/L was not statistically significant. In aquatic invertebrates, decreased growth appears to be the most sensitive endpoint. Wei et al. (1999) report that neither metsulfuron-methyl nor its degradation products are acutely toxic to *Daphnia* at concentrations that approach the solubility of the compounds in water at pH 7.

The available data suggest that metsulfuron-methyl, like other herbicides, is much more toxic to aquatic plants than to aquatic animals. Macrophytes appear more sensitive to metsulfuron-methyl than algae (SERA 2004e). There are substantial differences in sensitivity to effects of metsulfuron-methyl among algal species, but all EC_{50} values reported in SERA (2004e) are above 0.01 mg/L, and some values are substantially higher. Toxicity in algae increases with lower pH, most probably because of decreased ionization leading to more rapid uptake. At a concentration of 0.003 mg/L, metsulfuron-methyl was associated with a 6 percent to 16 percent inhibition (not statistically significant) in algal growth rates for three species but stimulation of growth was observed in *Selenastrum capricornutum* and the aquatic macrophyte, duckweed (SERA 2004e). Wei et al. (1998; 1999) assayed the toxicity of metsulfuron-methyl degradation products in *Chlorella pyrenoidosa* and found that the acute toxicity of the degradation products was about two to three times less than that of metsulfuron-methyl itself in a 96-hour assay. One field study cited in SERA (2004c) on the effects of metsulfuron-methyl in algal species found that concentrations of metsulfuron-methyl as high as 1 mg/L are associated with only slight and transient effects on plankton communities in a forest lake.

PICLORAM

Exposure. Picloram is relatively persistent and can remain effective in the soil for up to 3 years after application. Picloram is resistant to biotic and abiotic degradation processes and has a field half-life of 20 to 300 days. Picloram is highly soluble in water and can readily leach through some soil types. Ismail and Kalithasan (1997) found that picloram moves rapidly out of the top 2 inches of soil with a half-life of about 4 to 10 days. Somewhat longer half-lives of 13 to 23 days have been reported by Krzyszowska et al. (1994), who also noted that picloram is degraded more rapidly under anaerobic than aerobic conditions and also degrades more rapidly at lower application rates.

The SERA (2011b) identified a peak estimated rate of contamination of ambient water associated with the normal application of picloram as 0.011 (0.001 to 0.18) mg a.e./L at an application rate of 1 lb a.e./acre. Typical application rates for picloram in the proposed action range from 0.5 to 0.75 lb a.e./acre, and the maximum application rate is 1 lb a.e./acre. The estimated peak water contamination rate of picloram in ambient water normalized to an application rate of 1 lb a.e./acre is 0.18 mg a.e./L (SERA 2011b).

Multiplying the maximum application rate by the peak water contamination rate results in an EEC of 0.18 mg a.e./L. Considering the BMPs that will be implemented (e.g., no application of picloram within 50 feet of water), it is likely that water concentrations of picloram will be far less than that modeled by SERA. The most likely scenario where picloram will enter the stream is where weeds are treated on floodplains with a high water table and highly permeable soils.

End-Use Products. The proposed action includes the use of Tordon 22K, which contains the potassium salt of picloram (24.4 percent weight per volume). The remaining 75.6 percent of the formulations consist of inert ingredients. One inert is listed as a polymer of ethylene oxide, propylene oxide, and di-sec-butyl-phenol (CAS No. 69029-39-6).

Toxicity: Fish. The EPA (1995) classified picloram acid and picloram potassium salt as moderately toxic to freshwater fish with reported rainbow trout LC_{50}s of 5.5 mg a.e./L and 13 mg a.e./L, respectively. The SERA (2011b) reported a variety of 96-hour LC_{50} values for rainbow trout, which ranged from 5.5 mg a.e./L to 41 mg a.e./L. These tests used either technical grade picloram, picloram acid, or the picloram potassium salt. The 96-hour LC_{50} of 5.5 mg a.e./L was obtained by Batchelder (1974) in a test of the technical grade picloram. Earlier production of picloram contained impurities, which have been minimized in more recent production of picloram. As such, the 5.5 mg a.e./L might not be representative of current toxicity. Fairchild et al. (2009) reported an 96-hour LC_{50} of 36 mg a.e./L for juvenile rainbow trout. The authors did not observe any mortality at a concentration of 12 mg a.e./L. Johnson and Finely (1980), as cited in SERA 2011b) found a 4.8 mg/L LC_{50} for cutthroat trout exposed to technical grade material and 1.5 mg/L LC_{50} for slightly larger cutthroat trout exposed to potassium salt. We applied the 4.8 mg/L value in this Opinion.

Fish size or life stage can sometimes be an important factor in the toxicity of pesticides. Mayer and Ellersieck (1986) studied the toxicity of picloram on yolk sac rainbow trout fry, swim up fry, and advanced fry. They found LC_{50}s of 8 mg a.e./L, 8 mg a.e./L, and 11 mg a.e./L (yolk sac fry, swim up fry, and advanced fry, respectively), which demonstrates little difference in sensitivity among the various stages tested.

Most of the potential sublethal effects for picloram have not been investigated in regard to toxicological endpoints that are important to the overall health and fitness of salmonids (e.g., growth, life history, mortality, reproduction, adaptability to environment, migration, disease, predation, or population viability). Of the very little research that has been conducted on the potential sublethal effects of picloram on aquatic life, the focus has primarily been on growth. Woodward (1979) found that picloram concentrations greater than 0.61 mg/L decreased growth of cutthroat trout, and a similar finding was reported by Mayes (1984). Exposure regimes where the maximum exposure concentration did not exceed 0.29 mg a.e./L had no adverse effects on the survival and growth of cutthroat trout fry (Woodward 1979). In a study of lake trout (*Salvelinus namaycush*), picloram concentrations of 0.04 mg a.e./L reduced the rate of yolk sac absorption, as well as fry survival, weight, and length (Woodward 1976). Mayes et al. (1987) reported that picloram concentrations of 0.9 mg a.e./L reduced the length and weight of rainbow trout larvae and concentrations of 2 mg a.e./L reduced survival of the larval fish. The authors reported the lowest NOEC as 0.55 mg a.e./L. Fairchild et al. (2009a) reported a LOEC for growth of juvenile rainbow trout of 2.37 mg a.e./L, and a NOEC of 1.18 mg a.e./L. For juvenile bull trout, Fairchild et al. (2009a) reported a LOEC for growth of 1.18 mg a.e./L and a NOEC of 0.6 mg a.e./L. Yearling coho salmon exposed to nominal concentrations of 5 mg a.e./L for 6 days suffered "extensive degenerative changes" in the liver and wrinkling of cells in the gills (Lorz et al. 1979). For this Opinion we applied the adjusted value of 0.19 mg a.e./L documented in SERA (2011b).

Toxicity: Other Aquatic Organisms. Although picloram is toxic to salmonids, it is not as toxic to *Daphnia* or algae at the same concentrations. For *Daphnia,* the reported acute (48-hour) LC_{50} values range from 48 mg a.e./L to 173 mg a.e./L (SERA 2011b). Chronic studies using reproductive or developmental parameters in *Daphnia* reported a NOEC of 11.8 mg a.e./L and a LOEC of 18.1 mg a.e./L (Gersich et al. 1984). Boeri et al. (2002) studied the effects of picloram acid on *Daphnia* reproductive endpoints and reported a NOEC of 6.79 mg a.e./L and a LOEC of 13.5 mg a.e./L. No toxicity studies involving the exposure of *Daphnia* to Tordon 22K are readily available.

The toxicity of picloram to aquatic plants varies substantially among different species. Based on the available toxicity bioassays, the most sensitive species is *Navicula pelliculosa*, a freshwater diatom, with an EC_{50} (i.e., the concentration causing 50 percent inhibition of a process for growth) of 0.93 mg a.e./L and a NOEC of 0.23 mg a.e./L. The least sensitive aquatic plants appear to be from the genus *Chlorella* (another group of freshwater algae), with EC_{50} values greater than 160 mg a.e./L (Baarschers et al. 1988). The macrophyte *Lemna gibba* (duckweed) has a reported 14-day EC_{50} of 47.8 mg a.e./L and a 14-day NOEC of 12.2 mg a.e./L (Kirk et al. 1994). Other studies on the toxicity of picloram to macrophytes were not used in the 2011 risk assessment (SERA) because the test agent wasn't specified, the reporting units were not clear, or the test agent was a formulation of picloram not used by the Forest Service.

Effects on Non-Target Plants. While most grasses are resistant to picloram, it is highly toxic to many broad-leafed plants. Crop damage from irrigation water contaminated by picloram has been documented by the EPA (EPA 1995; USFS 2000b). Picloram is persistent in the environment, and may exist at levels toxic to plants for more than a year after application at normal rates. In normal applications, non-target plants may be exposed to chemical concentrations many times the levels that have been associated with toxic effects. Picloram's mobility allows it to pass from the soil to nearby, non-target plants. It can also move from target plants, through roots, down into the soil, and into nearby non-target plants. Given this capability, an applicator does not have to spray the buffer zone in order to affect the riparian vegetation. Spray drift may also kill plants some distance away from the area being treated. The proposed 50-foot no-spray buffer for picloram should reduce the unintended mortality of streamside trees, shrubs and other broadleaf plants.

SULFOMETURON-METHYL

Exposure. Sulfometuron-methyl can be moderately persistent in soils, with reported half-lives ranging from 10 to 170 days (SERA 2004f). Sulfometuron-methyl readily biodegrades in aerobic soil conditions, with reported half-lives of 12 to 25 days for various soil conditions (e.g., pH levels and moisture content). Sulfometuron-methyl does not bind strongly to soils and it is slightly soluble in water. Depending on soil conditions, sulfometuron-methyl can be mobile and may be transported to off-site soil by runoff or percolation. The potential for leaching depends on soil conditions such as organic matter content, moisture, and soil pH. Under acid conditions, sulfometuron-methyl hydrolyzes quickly and has less potential for movement.

At least one percent of the applied sulfometuron-methyl applied to an area could run off from the application site to adjoining areas after a moderate rain, based on studies of runoff from 3.3 inches of total rainfall (1.7 inches/hour for 2 hours) by Hubbard et al. (1989) and from 0.47 to 1.18 inches of rainfall by Wauchope et al. (1990). Losses could be much greater and might approach 50 percent in cases of extremely heavy rain and a steep soil slope (SERA 2004f).

Using the root zone model GLEAMS, SERA (2004f) estimated the peak WCRs of streams associated with the normal application (1 lb a.e./acre) of sulfometuron-methyl as ranging from 0.00006 to 0.02 mg a.e./L. Neary and Michael (1989) applied sulfometuron methyl in the form of dispersible granules at a rate of 0.36 lbs/acre to a study site in Florida. They monitored nearby surface water for chemical contamination for up to 203 days after treatment. The maximum concentration of sulfometuron methyl was reported as 0.07 mg/L. Normalizing this water concentration to an application rate of 1 lb/acre gives a WCR of 0.02 mg a.e./L. At the proposed maximum application rate of 0.378 lbs a.e./acre, the expected levels of sulfometuron methyl (under conditions similar to those in the Neary and Michael [1989] study) in surface water would be 0.008 mg a.e./L.

End-Use Products. The only commercial formulation of sulfometuron-methyl that the BLM proposes to use is Oust XP. Oust XP is the same formulation as Oust DF, which was analyzed in the 2007 Opinion; however, the granule shape has been changed to provide better mixability. Oust XP is manufactured by DuPont and is comprised of 75 percent sulfometuron-methyl and 25 percent inert ingredients (SERA 2004f). The inert ingredients include sucrose, sodium salt of naphthalene-sulfonic acid formaldehyde condensate, polyvinyl pyrrolidone, sodium salt of sulfated alkyl carboxylated and sulfated alkyl naphthalene, and hydroxypropyl methylcellulose. None of these inert ingredients are classified by EPA as toxic. The toxicity of Oust XP appears to be similar to that of technical grade sulfometuron methyl; providing further support that the inerts are not very toxic.

Toxicity: Fish. Sulfometuron-methyl does not appear to be highly toxic to fish; however, investigations of acute toxicity have been hampered by the limited water solubility of sulfometuron-methyl. Furthermore, the available studies have focused on lethal endpoints rather than sublethal ones. In the available studies, none of the fish died from acute exposure to sulfometuron-methyl, even at the highest concentration tests. As such, NOEC values (based on lethality) were placed at the highest concentrations tested: 7.3 mg a.e./L for fathead minnow (Muska and Driscoll 1982) and 148 mg a.e./L for rainbow trout (Brown 1994). Only one study regarding chronic toxicity of sulfometuron-methyl to fish has been performed. Muska and Driscoll (1982) did not observe any effects on fathead minnow embryo hatch, larval survival, or larval growth over 30-day exposure periods where concentrations of sulfometuron ranged up to 1.17 mg a.e./L. We applied the 7.3 mg a.e./L value in this Opinion.

Toxicity: Other Aquatic Organisms. Sulfometuron-methyl also appears to be relatively non-toxic to aquatic invertebrates, based on acute bioassays in daphnids, crayfish, and field-collected species of *Diaptomus*, *Eucyclops*, *Alonella*, and *Cypria*. The absolute LC_{50} values reported in SERA (2004f) for daphnids, crayfish, and the aquatic invertebrates are above 601 mg a.e./L, some by more than a factor of 10. A couple of studies using daphnids as the test species did not test concentrations high enough to cause lethality (i.e., 48-hour LC_{50} values of >12.5 mg/L and >150 mg/L). One daphnid reproduction study noted a reduction in the number of neonates at 24 mg/L, but not at 97 mg/L or at any of the lower concentrations tested (Baer 1990). This study did not have a clear dose-response effect.

Aquatic plants appear more sensitive than aquatic animals to the effects of sulfometuron-methyl, although there appear to be substantial differences in sensitivity among species of macrophytes and unicellular algae. The macrophytes, however, appear to be generally more sensitive. The 14-day NOEC (growth inhibition as measured by frond count) for duckweed exposed to technical grade sulfometuron-methyl was reported as 0.00021 mg a.e./L (Kannuck and Sloman 1995). For algae, the most sensitive algal species tested was *Selenastrum capricornutum*, with a 72-hour NOEC of 0.0025 mg/L and a 72-hour EC_{50} of 0.0046 mg a.e./L, based on a reduction in cell density relative to controls (Hoberg 1990). The most tolerant algal species tested was *Navicula pelliculosa*, with a 120-hour NOEC of 0.37 mg/L (Thompson 1994). The EC_{50} values for other freshwater algal species are generally greater than 10 μg/L, depending on the endpoint assayed (Landstein et al. 1993), but still fall in a range of concentrations that are likely to occur after a rainfall.

Effects on Non-Target Plants. The toxicity of sulfometuron-methyl to terrestrial plants was studied extensively and is well characterized. Assays using an application rate of 0.00892 lbs a.i./acre show high toxicity to seedlings of several broadleaf plants and grasses, either pre-emergence or post-emergence. Moreover, adverse effects were observed in most plants tested at application rates of 0.00089 lbs a.i./acre (SERA 2004f). This application rate is a factor of about 100- to 300-fold less than the application rate that the BLM would typically use. Concern for the sensitivity of non-target plant species is further increased by field reports of substantial and prolonged damage to crops or ornamentals after the application of sulfometuron methyl in both an arid region, presumably due to the transport of soil contaminated with sulfometuron methyl by wind, and in a region with heavy rainfall, presumably due to the wash-off of sulfometuron methyl contaminated soil (SERA 2004f).

TRICLOPYR

Exposure. Triclopyr herbicides can contain one of two forms of triclopyr, either the triethylamine salt (TEA) or the butoxyethyl ester (BEE). Two forms of triclopyr are used commercially as herbicides: the TEA salt and the BEE. Garlon 3A (TEA formulation) is the preferred herbicide for use on the Salmon and Challis Field Offices. The Salmon and Challis Field Offices will only apply triclopyr using cut-stump (i.e. painting or directed spray) and/or basal bark (i.e. directed spray) treatment methods.

The BA analysis focuses on the proposed use of the TEA salt to minimize effects and the Opinion follows the same approach. In both soil and aquatic environments, both the ester and amine salt formulations of triclopyr rapidly convert to the triclopyr acid and other degradates. In various soil types, the half-life of BEE has been reported to be 3 hours, and the half-life of TEA has been reported to range from 6 to 14 days. Triclopyr acid is further degraded by soil microorganisms to the metabolites trichloropyridinol (TCP) and trichloromethoxypyridine. In aerobic soils, triclopyr acid has a half-life of 8 to 18 days. The TCP is more persistent than triclopyr acid, with a soil half-life ranging from 40 to 95 days (Knuteson 1999).

In water, triclopyr TEA dissociates to the acid very rapidly (i.e., within one minute), and triclopyr BEE hydrolyzes to the acid in less than a day in natural waters with a pH of 6.7 (EPA 1998). The primary degradation mechanism for triclopyr acid in water is photolysis, with a half-life of 1-day. The TCP is more persistent in aquatic environments, having a half-life of 4 to

10 days (Petty et al. 2003). Triclopyr and TCP are not strongly adsorbed to soil particles and have the potential to be mobile, thus there is a chance that application of triclopyr near aquatic environments can result in surface water contamination.

The SERA (2011c) estimated peak WCRs (normalized to an application rate of 1 lb/acre) for three forms of triclopyr in stream water using a variety of methods. The WCRs were derived from various modeling efforts and from field studies pairing triclopyr application with surface water monitoring. Triclopyr BEE and esther formulations are not proposed for use, so WCRs are not reported here for those forms. For triclopyr acid, stream WCRs ranged from 0.00 to 0.24 mg a.e./L. The upper bound of the peak WCR (i.e., 0.24 mg a.e./L) was derived from EPA modeling efforts using PRZM/EXAMS (EPA 2009). For the metabolite TCP, modeled WCRs ranged from 0.00 to 0.03 mg TCP/L after application of triclopyr BEE and from 0.00 to 0.02 mg TCP/L after application of triclopyr TEA.

Maximum proposed application rates in the proposed action are 2.0 lbs/acre for triclopyr TEA. Multiplying the maximum application rate by the WCRs gives an EEC of: 0.48 mg a.e./L for triclopyr acid and 0.04 mg TCP/L after application of the TEA formulation. Typical application rates are likely to generate EEC's up to two times lower. Because triclopyr TEA near instantaneously dissolves to the acid, SERA (2011c) did not determine an EEC for that form of triclopyr.

End-Use Products. Triclopyr herbicides included in the proposed action contain only the use of the TEA form of triclopyr. The number of triclopyr EUPs that may be used by the agencies has increased over the years. In 1996, only two EUPs were available for use, Garlon 3A (TEA formulation) and Garlon 4 (BEE formulation). Since then, 17 additional EUPs (from eight different companies) have been approved at a national level for agencies to consider using. While the biological assessment (BA) indicated that a variety of chemical products may be used, the BA focused assessment on the Garlon 3A (terrestrial).

Although all of the triclopyr TEA EUPs proposed for use are equivalent to one another in that they contain 44.4 percent triclopyr TEA, their overall formulations may be different. The liquid formulations of 44.4 percent triclopyr TEA specify other ingredients as either ethanol (Garlon 3A, Renovate 3, and Tahoe 3A) or ethylenediaminetetraacetic acid (EDTA), which is a chelating agent (Triclopyr 3A, Triclopyr 3SL). Triclopyr 3SL also contains ethylene glycol. Based on information contained in the Safety Data Sheets (SDS) and summarized in Table A-2, the toxic effects of these EUPs should be similar, and have been analyzed accordingly in this Opinion.

The EUPs evaluated in this Opinion contain varying types and amounts of inert ingredients. Identified inert ingredients include ethylene glycol, ethanol, and EDTA. Wan et al. (1987) determined that both Garlon 3A and Garlon 4 were significantly less toxic ($p<0.01$) to salmonids than their respective active ingredients triclopyr TEA and triclopyr BEE, suggesting that inert ingredients used in formulating these products do not increase toxicity. The product labels recommend that a surfactant be added to the product prior to most applications. Some surfactants are more toxic than others. Toxicity of some surfactants proposed for use has been addressed in Section 2.4.1.5 of this Opinion.

Toxicity: Fish. Both forms of triclopyr degrade into triclopyr acid and other degradates in the environment. Triclopyr acid is further degraded into TCP and other metabolites. The other metabolites (e.g., butoxyethanol and triethanolamine) are not being evaluated further because they are rapidly dissipated by microbial degradation. The TCP is of concern because it has been shown to be more toxic than the other forms of triclopyr to many groups of non-target organisms (SERA 2011c).

Lethal Effects. Data on the toxicity of triclopyr and its various forms has been collected since as early as 1973. Wan et al. (1987) completed the most extensive comparative study on the toxicity of the various forms and metabolites of triclopyr. This study summarizes a series of static bioassays on several species of salmonids that were conducted over a 4-month period in 1986 and a 2-month period in 1987. Wan et al. (1987) reported 96-hour LC_{50} values for triclopyr acid, triclopyr ester, Garlon 3A, Garlon 4, and TCP, which are summarized in Table A-2. The authors found triclopyr ester was the most toxic chemical tested, followed in decreasing toxicity to salmonids by Garlon 4, TCP, triclopyr acid, and Garlon 3A.

Table A-2. Acute Toxicity of Triclopyr and Related Compounds to Various Species of Salmonids[1]. Results are expressed as mg a.e./L, unless otherwise noted.

Fish Species	Triclopyr TEA (Garlon 3A)	Triclopyr BEE (Garlon 4)	Triclopyr BEE (technical grade)	Triclopyr Acid	TCP (mg TCP/L)
Coho salmon	167	1.0	1.0	9.6	1.8
Chum salmon	96.1	0.82	0.3	7.5	1.8
Sockeye salmon	112	0.67	0.4	7.5	2.5
Rainbow trout	151	1.3	1.1	7.5	1.5
Chinook salmon	99	1.3	1.1	9.7	2.1
Pink salmon	-	0.58	0.5	5.3	2.7

[1] Source: Wan et al. 1987. All bioassays conducted at 46.4 to 50°F, 10 fish/concentration. Static with aeration. LC_{50} based on measured, rather than nominal concentrations. Photoperiod and lighting conditions not specified.

The BEE form of triclopyr is exponentially more toxic to fish when compared to the TEA form. The salmonid LC50 values for triclopyr BEE (technical grade and as formulated Garlon 4) ranged from 0.19 mg a.e./L to 1.9 mg a.e./L (SERA 2011c). The lowest LC50 value was for coho salmon alevins (Mayes et al. 1986). The Wan et al. (1987) study is supported by more recent flow-through toxicity assays on Garlon 4 with reported acute LC50 values for salmonids of 0.79 to 1.76 mg/L (Kreutzweiser et al. 1994) and 0.84 mg/L (Johansen and Geen 1990).

Wan et al. (1987) found that Garlon 3A, a formulation of triclopyr TEA, was about 170 times less toxic (significant at $p<0.01$) to salmonids than the Garlon 4 formulation. Triclopyr TEA LC50 values for salmonids reportedly range from 75.4 mg a.e./L to 273.7 mg a.e./L (SERA 2011c;). The EPA classified triclopyr TEA as practically non-toxic to freshwater fishes (EPA 1998).

Based upon available information, the triclopyr acid appears to be approximately 11 times less toxic to salmonids than the triclopyr BEE. Based upon information in all available literature, the salmonid LC_{50} values for triclopyr acid range from 5.3 mg a.e./L to 117 mg a.e./L (SERA 2011c). Six of the seven LC_{50} values included in this range came from the Wan et al. (1987) study, and they appear to be outliers not only with respect to the higher LC_{50} value from Batchelder (1973), but also with respect to all 17 LC_{50} values on triclopyr TEA. According to SERA, the results from Wan et al. (1987) cannot be attributed to experimental factors or methods, and the study cannot be dismissed as irrelevant. While one would expect the acid form to be more toxic than the salt form, the extreme difference (more than an order of magnitude) noted above is suspect (Patrick Durkin, personal communication). Because of this, neither

SERA (2011c) nor EPA (2009) included the data in their assessments. Giving deference to toxicological experts, this Opinion utilizes 117 mg a.e./L as the lethal concentration for triclopyr acid.

The TCP (an environmental metabolite of triclopyr acid), is substantially more toxic in fish than either triclopyr acid or triclopyr TEA, and is similar to the toxicity of triclopyr BEE. Salmonid TCP LC_{50} values from two separate studies (Wan et al. 1987; Gorzinski et al. 1991) range from 1.5 mg TCP/L to 12.6 mg TCP/L. Six of the seven salmonid LC_{50} values for TCP are from Wan et al. (1987), and all are approximately five times lower than the value obtained by Gorzinski et al. (1991). There is no clear explanation as to why these two experiments had such vastly different results. It may reflect experimental variability or other unknown factors rather than any differences in species sensitivity (SERA 2011c). This Opinion uses the lowest value (i.e., 1.5 mg TCP/L) as the lethal concentration for TCP.

Sublethal Effects. A few acute and chronic studies examining sublethal effects have been performed on triclopyr BEE, triclopyr TEA, and the metabolite TCP. Similar to the lethality studies, results from the sublethal effects studies indicate that triclopyr BEE was the most toxic and triclopyr TEA was the least toxic.

An early life-stage study conducted with triclopyr BEE in rainbow trout yielded a NOEC of 0.017 mg a.e./L and a LOEC (based on larval length and weight) of 0.035 mg a.e./L (Weinberg et al. 1994). Johansen and Geen (1990) studied the sublethal effects of Garlon 4 on rainbow trout using flow-through systems. The authors noted fish were more docile (than the controls) at concentrations of 0.32 to 0.43 mg a.e./L, which are about a factor of 2 below the 96-hour LC50 determined in this study. At levels ≤0.1 mg a.e./L, rainbow trout were hypersensitive to photoperiod changes over 4-day periods of exposure. This is reasonably consistent with the threshold for behavioral changes in rainbow trout for Garlon 4 of 0.26 mg a.e./L reported by Morgan et al. (1991).

For triclopyr TEA, a 28 day egg-to-fry study was performed using fathead minnows (Mayes et al. 1984; Mayes 1990). In these studies, fathead minnow eggs were exposed to concentrations of 26, 43, 65, 104, 162, and 253 mg a.i./L. The survival of fathead minnows (embryo-larval stages) was significantly reduced at 253 mg/L compared with control animals. At 162 mg/L, there was a slight decrease in body length. The authors reported a NOEC of 32.2 mg a.e./L and a LOEC (length) of 50.2 mg a.e./L. Morgan et al. (1991) examined behavior changes in rainbow trout after a 0.5-hour exposure to Garlon 3A. The authors reported a threshold for behavioral changes of 63.6 mg a.e./L and a threshold for avoidance response of 254 mg a.e./L.

Marino et al. (2003) conducted an egg-to-fry study, exposing rainbow trout to TCP. The authors exposed rainbow trout to 0.586, 0.106, 0.178, 0.278, 0.479, and 0.825 mg TCP/L in a flow-through system. Observations were made for 33 days post-hatch of the water control embryos. The authors reported a NOEC for fry weight and growth of 0.178 mg TCP/L, and a LOEC of 0.278 mg TCP/L.

Although TCP is much more toxic than triclopyr TEA, field monitoring cited in SERA (2011c) indicates that TCP residues in soil and water occur at concentrations much lower than the application rate of the active ingredient. Given the high toxicity of TCP and the uncertainty of exposure risk to this metabolite, the potential for adverse effects to listed fish is uncertain. Garlon 4 is not proposed for use in riparian areas or this Opinion.

Toxicity: Other Aquatic Organisms. Based on acute lethality, aquatic invertebrates appear to be about equally or somewhat less sensitive than fish to the various forms of triclopyr. Acute LC_{50} values for triclopyr acid and triclopyr TEA range from about 100 to about 6,400 mg a.e./L. Gersich et al. (1982) conducted a chronic daphnid study and reported a NOEC of 25.95 mg a.e./L. Triclopyr BEE was substantially more toxic to aquatic invertebrates, with LC_{50} values ranging from 0.19 to 20 mg a.e./L (SERA 2011c). Some of the studies reported NOEC (for lethality), and those ranged from 0.12 mg a.e./L to 1.2 mg a.e./L. Increases in invertebrate drift have been documented at triclopyr BEE concentrations of 0.6 to 0.95 mg/L (Kreutzweiser et al. 1995; Thompson et al. 1995), but no other effects such as changes in stream invertebrate abundance were noted. In a chronic study, Chen et al. (2008) reported concentration-related decreases in *Simocephalus vetulus* (a cladoceran) at triclopyr BEE concentration of 0.25 mg a.e./L and 0.5 mg a.e./L. Only two studies examining the toxicity of TCP on aquatic invertebrates were available. One study reported an acute LC_{50} of 10.9 mg TCP/L (EPA 2009). The second study reported a NOEC of 0.058 mg TCP/L, based on a decrease in mean number of young/adult (Machado 2003).

Similar to aquatic organisms, algae are more sensitive to triclopyr BEE than to triclopyr TEA. For triclopyr BEE, the EC_{50} values for growth inhibition in algae range from about 0.073 to 5.9 mg a.e./L. For triclopyr TEA and triclopyr acid, the EC_{50} values for the same endpoint in algae range from about 0.49 to 80 mg a.e./L. The TCP toxicity falls between the other forms, with a reported EC_{50} value of 1.8 mg TCP/L.

For aquatic macrophytes, triclopyr TEA is more toxic to dicots than to monocots, with EC_{50} values ranging from 0.04 to 0.56 mg a.e./L and 6.06 to 15.8 mg a.e./L, respectively. In fact, triclopyr TEA appears to be more toxic to dicots than triclopyr BEE (EC_{50} values ranging from 1.49 to 4.62 mg a.e./L). No studies were available regarding the toxicity of TCP.

NMFS Pesticide Registration Opinion. Chemical concentrations examined in the in the 2011 registration Opinion (NMFS Tracking # 2004/02673) did not vary drastically from those summarized here. The triclopyr registration Opinion used the following rainbow trout LC_{50} values as assessment endpoints for triclopyr: 0.470 mg a.e./L for BEE, 79.2 mg a.e./L for TEA, and 177 mg a.e./L for triclopyr acid. Information presented in the 2011 Opinion for EPAs registration of triclopyr does not suggest a different endpoint as being more appropriate than that which was used in this Opinion.

The registration Opinion concluded there was no overlap between the peak farm pond EECs for forestry uses (at 6 lb a.e./acre) and the fish and invertebrate toxicity endpoints for triclopyr BEE. Floodplain estimates for triclopyr BEE overlapped with all acute assessment endpoints at the application rate of 8 lb a.e./acre. For triclopyr TEA, none of the peak concentrations and assessment endpoints overlapped.

Fluroxypyr

Exposure: Because surface runoff potential is high, and potential for loss on eroded soil is low, Fluroxypyr has the potential to leach to groundwater. Fluroxypyr is moderately mobile in and poorly adsorbed by most soil types. At single point concentration of 0.066 mg/L in soil, fluroxypyr is very mobile in silt loam, sandy loam, loam, and silty clay (Lehmann et al. 1988). In field studies, Bergstrom et al. (1990) found concentrations in soil were either undetectable or at very low levels within three months after the application of fluroxypyr. A typical half-life for fluroxypyr in the soils is 36 days. Fluroxypyr is broken down by microbes and sunlight. Water contamination rates are complex as fluroxypyr is poorly soluble and the upper bound of measured concentrations exceeds the water solubility. SERA (2009) reported peak WCR of 0.08 mg/L per lb/acre applied.

***End Use Products*.** Two formulations of fluroxypyr are specifically considered in the SERA (2009) risk assessment: Vista Specialty Herbicide and Vista XRT. Both of these formulations contain the 1-methylheptyl ester of fluroxypyr as well as two listed inerts: naphthalene and 1 methyl-2-pyrrolidinone. The Vista XRT formulation contains a greater concentration of the fluroxypyr ester and much lower concentrations of the listed inerts. Fluroxypyr is the only active ingredient (26.2 percent) in the herbicide Vista. According to the product label, Vista also contains 73.8 percent other ingredients (unspecified).

***Toxicity Fish*:** Fluroxypyr does not bioconcentrate through the food chain. The SERA Risk Assessment (2009) classifies fluroxypyr-acid as slightly toxic to practically nontoxic to fish, based on acute toxicity. Acute toxicity tests evaluated by the EPA indicate that fluroxypyr is slightly toxic to practically non-toxic to freshwater fish. For bluegill sunfish, a 96-hour LC_{50} >14.3 mg/L was reported. For rainbow trout, 96-hour LC_{50} values ranged from 13.4 mg/L to >100 mg/L. In studies by Wan et al. (1992), the 96-hour LC_{50} for Chinook salmon ranged from 10 to 17 mg/L and sockeye salmon ranged from 10 to 15 mg/L. However, the Wan et al. (1992) study was for unidentified formulations with no relation to proposed formulations. Those results were not applied in the SERA (2009) assessment. The NOEC values for fish used in the 2009 risk assessment are taken as 0.060 mg a.e./L for sensitive species, including salmonids, and 0.49 mg a.e./L for tolerant species. The fluroxypyr literature does not include chronic fish bioassays. The EPA/Office of Pesticide Programs (OPP) waived the requirement for chronic testing because of the low acute toxicity of both fluroxypyr acid and fluroxypyr-MHE to fish. Fluroxypyr has limited solubility in water and SERA (2009) indicated that solvents used in toxicity studies may influence reported toxicity levels. In addition the only LC_{50} values found were for unidentified formulations that were not covered by the Forest Service risk assessment (SERA 2009). They even state, "available fish bioassays submitted to the EPA suggest the unlikelihood of adverse effects resulting from fluroxypyr exposure, and the development of a hazard quotient is unwarranted." This is likely due to nominal concentrations (a product of volume herbicide added to volume water) are always several orders of magnitude higher than measured concentrations of fluroxypyr, because of the solubility properties. SERA (2009) stated that, "it is not clear that fluroxypyr-MHE would cause adverse effects under any plausible set of conditions."

Toxicity Other Aquatic Organisms: Results from toxicity testing conducted on Daphnia magna indicate that fluroxypyr is practically non-toxic to this species of invertebrate. The 48-hour EC_{50} for this toxicity test was >100 mg/L. The EPA did not require a chronic study in aquatic invertebrates because of the low toxicity of fluroxypyr acid to this group of organisms; however. Jones (1984) conducted a standard life cycle study which was submitted to the EPA in support of the registration of fluroxypyr. This study reports an effect on reproduction parameters but does not identify an LOEC based on immobility at 100 mg. The NOEC reported in the study is 56 mg/L. Eastern oysters, however, appear to be more sensitive to fluroxypyr-MHE. Based on the EC_{50} of 0.068 mg ester/L [measured concentration equivalent to 0.042 mg a.e./L] for shell deposition (Boeri et al. 1996), fluroxypyr-MHE is classified as very highly toxic (EPA/OPP 1998). The Forest Service risk assessment elected not to base toxicity values on estimates of an EC_{50} or LOEC. The EPA/OPP (2004), on the other hand, uses EC_{50} values, but interprets risk with levels of concern of 0.5 for acute risk and 0.05 for endangered species. To maintain compatibility with the EPA, the Forest Service risk assessments divided the EC_{50} by a factor of 20 to approximate a NOEC. Using this approach, the EC_{50} of 0.068 mg/L is used to estimate a NOEC of 0.0034 mg/L. This concentration is below the reported LOEC by a factor of about 15 [0.05 mg/L ÷0.0034 mg/L ≈ 14.71]. When the NOEC of 0.0034 mg/L is converted to acid equivalents, the acute toxicity value used for sensitive species of aquatic invertebrates is about 0.002 mg a.e./L [0.0034 mg a.i./L x 0.694 a.e/a.i. = 0.00236].

Fluroxypyr-MHE is much more toxic to aquatic plants than to aquatic animals, as is true for most herbicides. For algae, the available NOEC values range from 0.03 mg a.i./L (*Anabaena flos-aquae*, from Milazzo et al. 1996a) to 0.199 mg a.i./L (*Selenastrum Capricornutum*) from Milazzo et al. (1996b). When converted to acid equivalents (0.694 a.e./a.i.), these concentrations correspond to about 0.021–0.14 mg a.e./L and are used for sensitive and tolerant species, respectively.

For macrophytes, only two studies are available, and both were conducted using *Lemna gibba*, duckweed (Kirk et al. 1996; Kirk et al. 1998). The 7-day NOECs from these studies are 0.412 mg/L (Kirk et al. 1998) and 1.22 mg/L (Kirk et al. 1996). Kirk et al. (1998) also report a 14-day NOEC of 0.437 mg/L. The study by Kirk et al. (1996) is classified as Core by EPA/OPP (1998). The later study by Kirk et al. (1998) is not cited in EPA/OPP (1998) and may not have been available at the time the risk assessment was prepared. For the current risk assessment, the lowest NOEC, 0.412 mg/L reported by Kirk et al. (1998) is used for tolerant species. When adjusted for acid equivalents, the toxicity value is about 0.29 mg a.e./L [0.412 mg a.i./L x 0.694 a.e./a.e. = 0.285928 mg a.e./L]. No dose-response assessment is proposed for sensitive species of aquatic macrophytes.

Rimsulfuron

Exposure: Rimsulfuron is non-persistent in the environment. The reported half-life in soil is 24.3 days. In terrestrial systems, photodegradation and biodegradation appear to be the primary loss mechanisms. The photodegradation half-life in soil is between 11 and 12 days in sandy loam soil. The biodegradation half-life in soil is around 18 days in anaerobic environments, while the half-life ranges from 5 to 40 days in aerobic environments (NYSDEC 2009). As in terrestrial systems, biodegradation and photodegradation appear to be the primary loss mechanisms for rimsulfuron in aquatic environments. An aquatic biodegradation half-life of 10 days was observed in aerobic systems.

All of the risk quotients (RQs) for fish and aquatic invertebrates were below the most conservative level of concern (LOC) of 0.05 (acute endangered species), indicating that direct spray is not likely to pose a risk to these aquatic receptors. Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute endangered species). All chronic RQs were well below the LOC for chronic risk to endangered species (0.5). These results indicate that off-site drift of rimsulfuron is not likely to pose an acute or chronic risk to these aquatic species. Acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05 (acute endangered species) for all pond and stream scenarios. All chronic RQs were well below the LOC for chronic risk to endangered species (0.5). These results indicate that surface runoff is not likely to pose a risk to these aquatic species.

End Use Products: Rimsulfuron is a sulfonylurea herbicide that works via inhibition of acetolactate synthase. Inhibition of the enzyme leads to rapid cessation of growth and visual symptoms such as chlorosis, necrosis, leaf malformation and discoloration. Formulations of rimsulfuron include dry flowable (Laramie 25DF®) and water soluble granules (Matrix SG®). Matrix SG® and Laramie 25DF® are the two formulations currently available. Both Matrix SG® and Laramie 25DF® contain 25 percent active ingredient of Rimsulfuron N-((4,6-dimethoxypyrimidin-2-yl) aninocarbonyl)-3-(ethyksulfonyl)-2-pyridinesulfonamide. According to the product labels both contain 75 percent other ingredients that are not disclosed.

Toxicity: Fish: The toxicity of rimsulfuron to freshwater fish was evaluated by testing both coldwater and warmwater fish species, and the lowest toxicity result was selected as the toxicity reference values (TRV) for fish. One study examined the acute toxic effects of rimsulfuron on rainbow trout, a coldwater species. This study found that no adverse effects occurred after 96 hours of exposure to 390 mg/liter. The LC_{50} from this study was determined to be in excess of 390 mg/L. Acute toxicity tests were also conducted with warmwater fish species, namely the bluegill sunfish. Two studies determined that no adverse effects occurred after 96 hours of exposure to 390 mg/L. The LC_{50}s from these studies were also in excess of 390 mg/L. These results suggest that coldwater and warmwater fish species may have comparable sensitivity to rimsulfuron. No chronic tests were identified. Given that the coldwater and warmwater fish endpoints were the same, it was not possible to select the lower of the two as the TRV for fish. The LC_{50} of >390 mg a.i./L was selected as the acute TRV. In the absence of chronic data, the acute no observable adverse effect level (NOAEL) of 390 mg a.i./L was divided by an uncertainty factor of 3 to extrapolate to a chronic NOAEL of 130 mg a.i./L and this value was used as the NOAEL TRV for chronic effects. Based on rimsulfuron's octanol-water coefficient (Kow) and regression equations, rimsulfuron is not likely to bioconcentrate in fish tissue (CalEPA 1997).

Toxicity: Other Aquatic Organisms: Freshwater invertebrate toxicity tests are required for the EPA pesticide registration process. Two core acute toxicity tests using water fleas were reviewed. In these acute studies, the statistical endpoint (the EC_{50}) is the concentration that causes an effect in 50 percent of the test organisms after 48 hours. The lowest EC_{50} reported from these studies was >50 mg/L using a 99.5 percent rimsulfuron product (Martins et al. 2001). The second test reported an EC_{50} value of >360 mg/L using a 98.8 percent rimsulfuron product. A supplemental acute study using water fleas was also identified during the literature review. This study reported an EC_{50} value of 1,000 mg/L, but no adverse effects were observed at a concentration of 800 mg/L. A Daphnia life-cycle test to assess chronic toxicity to aquatic invertebrates was not found in the literature. The lowest EC_{50} >50 mg a.i./L) was selected as the invertebrate acute TRV. In the absence of chronic data, the acute NOAEL value of 50 mg a.i./L was divided by an uncertainty factor of 3 to extrapolate to a chronic NOAEL of 16.7 mg a.i./L, and this value was used as the NOAEL TRV for chronic effects.

Standard toxicity tests were conducted on aquatic plants, including aquatic macrophytes and algae. Rimsulfuron was most toxic to aquatic macrophytes, particularly duckweed (Lemna gibba). In the duckweed study, plants were adversely affected (based on reduced growth) by concentrations as low as 0.0116 mg/L after 14 days of exposure (MRID 42471308). The NOAEL for duckweed in this same study was 0.00009 mg/L. The no adverse effect concentrations for green algae (*Selenastrum capricornutum*) and the freshwater diatom (*Navicula pelliculosa*) were 0.029 and <0.030 mg/L, respectively, after 5 days of exposure.

No chronic tests using aquatic plants were found in the available literature. Since the 14-day duckweed test is considered to be an acute test, the EC50 (0.0116 mg a.i./L) was selected as the aquatic plant acute TRV. In the absence of a chronic NOAEL, the acute NOAEL from this study was divided by an uncertainty factor of 3 to extrapolate to a chronic NOAEL of 0.00003 mg a.i./L, which was selected as the chronic TRV.

References

Abdel-Hamid, M.I. 1996. Development and application of a simple procedure for toxicity testing using immobilized algae. Water Sci Technol. 33(6):129-138. (Cited in SERA 2004a).

Alexander, H.C., F.M. Gersich, and M.A. Mayes. 1985. Acute toxicity of four phenoxy herbicides to aquatic organisms. Bulletin of Environmental Contamination and Toxicology 35:314-321.

Baarschers, W.H., J.G. Donnelly, and H.S. Heitland. 1988. Microbial toxicity of triclopyr and related herbicides. Environmental Toxicology 3(2):127-136.

Baer, K. 1990. Chronic Toxicity of IN T5648-40 to *Daphnia magna*. Lab Project Number: 614-90: MR-4581-804. Unpublished study prepared by Haskell Laboratory. 260 pages. MRID 41672806. (Cited in SERA 2004f).

Baloch-Haq, R., M. Snel, R. Jackson, et al. 1993. Comparison of the dissipation characteristics of clopyralid as determined by laboratory, field and lysimeter studies, Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, United Kingdom, pp. 783-788. (Cited in SERA 2004b).

Barker, C., K. Drottar, and H. Krueger. 1998. Toxicity of AC 263222 during the early life-stages of the fathead minnow (*Pimephelas promelas)*: Lab Project Number: 2CO 98-134: 954-98-134:130A-120. Unpublished study prepared by Wildlife International, Ltd. 93 pages. MRID No. 44728202. (Cited in SERA 2004d).

Batchelder, T.L. 1973. Acute Fish toxicity of Dowco 233 (3,5,6- Trichloro-2-pyridyloxyacetic acid) and two derivatives. Report WCL-73014. Submitted by Dow Chemical U.S.A., Midland, Michigan. MRID 49637. (Cited in SERA 2011c).

Batchelder, T. 1974. Acute fish toxicity of picloram (dry TORDON acid). Waste Control Department, The Dow Chemical Company, Midland, MI. No. File: 005101-016.pdf. DER for MRID 00112016 dated 7/16/82. (Cited in SERA 2011b).

Bergstrom, L.F., A.S. Mcgibbon, S.R. Day, and M. Snel. 1990. Leaching Potential and Decomposition of Fluroxypyr in Swedish Soils Under Field Conditions. Pestic Sci. 29 (4): 405-418.

Bergstrom, L., A. McGibbon, S. Day, and M. Snel. 1991. Leaching potential and decomposition of clopyralid in Swedish soils under field conditions. Environmental Toxicology and Chemistry 10(5):563-571.

Blasberg, J., S. Hicks, and J. Stratton. 1991. Acute Toxicity of Chlorsulfuron to *Selenastrum capricornutum Printz*: Final Report. Lab Project Number: AMR-2081-91: 39427. Unpublished study prepared by ABC Laboratories, Inc. 33 p. MRID 42186801. (Cited in SERA 2004a).

Boeri, R., P. Kowalski, and T. Ward. 1996. Fluroxypyr 1-Methylheptyl Ester: Acute Flow-Through Mollusc Shell Deposition Test. Laboratory Report ID:646-DO. Unpublished study prepared by T. R. Wilbury Labs., Inc. 13 p. MRID No. 44080310.

Boeri, R., D. Wyskiel, and T. Ward. 2002. Picloram acid: life cycle study in the Daphnid, *Daphnia magna*: Lab Project number 2391-DO: 021029. Unpublished study prepared by T.R. Wilbury Laboratories, Inc. 46 pages. MRID 45760301. (Cited in SERA 2011b).

Bond, C.E., J.D. Fortune, and F. Young. 1965. Results of preliminary bioassays with kurosal-SL and dicamba. Progressive Fish Culturalist 27(1):49-51.

Bovey, R.W. and C.W. Richardson. 1991. Dissipation of clopyralid and picloram in soil and seep flow in the Blacklands of Texas. Journal of Environmental Quality 20(3):528-531.

Brown, M.R. 1994. Static, acute, 96-hour LC_{50} of DPX-T5648-42 (sulfometuron methyl) to rainbow trout, *Oncorhynchus mykiss*: (Limit test). Laboratory Report No. 589-94. Unpublished study prepared by E.I. du Pont de Nemours and Co., Haskell Laboratory for Toxicology and Industrial Medicine, Newark, DE. 28 pages. MRID 43501802. (Cited in SERA 2004f).

California Environmental Protection Agency (CalEPA). 1997. Assessment of the Tolerances for Section 3 Registration of ShadeoutTM (Rimsulfuron) on Tomatoes. Department of Pesticide Regulation. October 21, 1997.

Chen, C.Y., K. M. Hathaway, D.G. Thompson, and C.L. Folt. 2008. Multiple stressor effects of herbicide, pH, and food on wetland zooplankton and a larval amphibian. Ecotoxicology and Environmental Safety 71(1):209-218.

Concha, M. and K. Shepler. 1994. Photodegradation of (carbon 14) - clopyralid in buffered aqueous solution at ph 7 by natural sunlight: Lab Project Number: 451W: ENV94048 (Unpublished study prepared by PTRL West, Inc.). 65 pp. MRID No.43891401. (Cited in SERA 2004b).

Coyner, A., G. Gupta, and T. Jones. 2001. Effect of chlorsulfuron on growth of submerged aquatic macrophyte *Potamogeton pectinatus* (sago pondweed). Environmental Pollution 111(3):453-455. (Cited in SERA 2004a).

Extoxnet. 1996. Pesticide Information Profiles: Metsulfuron-methyl. Extension Technology Network. Available: http://extoxnet.orst.edu/. (May 2012).

Fairchild, J. F., D. S. Ruessler, P. S. Haverland, and A. R. Carlson. 1997. Comparative sensitivity of *Selenastrum capricornutum* and *Lemna minor* to sixteen herbicides. Archive of Environmental Contamination and Toxicology 32(4):353-457. (Cited in SERA 2004a, c).

Fairchild, J. F., A. Allert, L.S. Sappington, K. J. Nelson, and J. Valle. 2008. Using accelerated life testing procedures to compare the relative sensitivity of rainbow trout and the federally listed threatened bull trout to three commonly used rangeland herbicides (picloram, 2,4-D, and clopyralid). Environmental Toxicology and Chemistry 27(3):623-630.

Fairchild, J. F., A. Allert, K. P. Feltz, K. J. Nelson, and J. A. Valle. 2009a. An ecological risk assessment of the acute and chronic effects of the herbicide clopyralid to rainbow trout (*Oncorhynchus mykiss*). Archives of Environmental Contamination and Toxicology 57:725-731.

Fairchild, J. F., K. P. Feltz, L. C. Sappington, A. L. Allert, K. J. Nelson, and J. Valle. 2009b. An ecological risk assessment of the acute and chronic toxicity of the herbicide picloram to the threatened bull trout (*Salvelinus confluentus*) and the rainbow trout (*Oncorhynchus mykiss*). Archives of Environmental Contamination and Toxicology 56(4):761-769.

Folmar L. C. 1978. Avoidance chamber responses of mayfly nymphs exposed to eight herbicides. Bulletin of Environmental Contamination and Toxicology 19(3):312-318.

Forbis, A., D. Burgess, and L. Georgie. 1985. Acute toxicity of CN 10-6471 [(Banvel herbicide)] to Daphnia magna: Report No. 33173. Unpublished study prepared by Analytical Biochemistry Laboratories, Inc. 37 pages. MRID 001513152. (Cited in SERA 2004c).

Forsyth D. J., P. A. Martin, G. G. Shaw. 1997. Effects of herbicides on two submersed aquatic macrophytes, *Potamogeton pectinatus* L. and *Myriophyllum sibiricum* Komarov, in a prairie wetland. Environmental Pollution 95(2):259–268.

Gardner S. C., C. E. Grue, J. M. Grassley, L. A. Lenz, J. M. Lindenauer, and M. E. Seeley. 1997. Single species algal (*Ankistrodesmus*) toxicity tests with Rodeo and Garlon 3a. Bulletin of Environmental Contamination and Toxicology 59(3):492-499.

Gersich, F., D. Hopkins, and D. Milazzo. 1984. The acute and chronic toxicity of technical picloram (4-Amino-3,5,6-trichloropicolinic acid) to *Daphnia magna* Straus: ES-690. Unpublished study prepared by Dow Chemical USA. 16 pages. MRID 00151783. (Cited in SERA 2011b).

Gersich, F., C. Mandoza, and D. Hopkins. 1982. The acute and chronic toxicity of triclopyr triethylamine salt solution to *Daphnia magna* Straus: ES-583. Unpublished study prepared by Environmental Sciences Research, Dow Chemical U.S.A. 19 pages. MRID 00151959. (Cited in SERA 2011c).

Gomez, L., J. Masot, S. Martinez, E. Duran, F. Soler, and V. Roncero. 1998. Acute 2,4-D poisoning in tench (*Tinca* L.): Lesions in the hematopoietic portion of the kidney. Archive of Environmental Contamination and Toxicology 35:479-483.

Goodman, N. C. 1979. 48-Hour LC50 to *Daphnia magna*. Haskell Laboratory Report No. 152-79. (Unpublished study received Jun 16, 1980 under 352-105; submitted by E.I. du Pont de Nemours & Co., Wilmington, Del.; CDL:099462-H). MRID 00035262. (Cited in SERA 2004a).

Gorzinski, S., K. Lehr, and D. Piasecki. 1991. Garlon 4 herbicide: static acute 96-hour toxicity to the rainbow trout, *Oncorhynchus mykiss* Walbaum: Lab Project Number: ES-DR-022406168-4. Unpublished study prepared by DowElanco. 33 pages. MRID 41971603. (Cited in SERA 2011c).

Grande M., S. Andersen, and D. Berge. 1994. Effects of pesticides on fish: experimental and field studies. Norwegian Journal of Agricultural Sciences Suppl. 13:195-209. MRID 45202909. (Cited in SERA 2004a).

Grover, R. and A. E. Smith. 1974. Adsorption studies with the acid and dimethylamine forms of 2,4-D and dicamba. Canadian Journal of Soil Science 54:179-786.

Hall, C. 1984. 96-hour LC_{50} to rainbow trout: benzoic acid, 2-N-(4-Methoxy-6-methyl- 1,3,5-triazin-2-yl)-N-methylamino-carbonyl-amino-sulfonyl, methyl ester. Laboratory Report No. 545-84. Unpublished study prepared by Haskell Laboratory for Toxicology and Industrial Medicine. 5 pages. MRID No. 00149672. (Cited in SERA 2004e).

Hawes, K. and S. Erhardt-Zabik. 1995. The anaerobic aquatic metabolism of clopyralid. Lab Project Number: ENV93076, Unpublished study prepared by DowElanco North American Environmental Chemistry Lab. MRID No.43891404. 42 pp. (Cited in SERA 2004a).

Henry, C.J., K. F. Higgins, and K. J. Buhl. 1994. Acute toxicity and hazard assessment of Rodeo, X-77 Spreader, and Chem-Trol to aquatic invertebrates. Archives of Environmental Contamination and Toxicology 27:392-399.

Hessen, D. O., T. Kallqvist, M. I. Abdel-Hamid, and D. Berge. 1994. Effects of pesticides on different zooplankton taxa in mesocosm experiments. Norwegian Journal of Agriculture Science Suppl. 0(13):153-161 (Cited in SERA 2004a).

Hildebrand L. D., D. S. Sullivan, and T. P. Sullivan. 1980. Effects of Roundup herbicide on populations of *Daphnia magna* in a forest pond. Bulletin of Environmental Contamination and Toxicology 25(3):353-357.

Hoberg, J. 1990. Sulfometuron methyl - toxicity to the freshwater green alga *Selenastrum capricornutum*. Lab Project No. AMR- 1893-90. Unpublished study prepared by Springborn Laboratories, Inc. 24 pages. MRID 41680102. (Cited in SERA 2004f).

Hoberg, J. 1993a. Dicamba technical: toxicity to the freshwater alga, *Anabaena flos-aquae*: Final Report: Lab Project Number: 93-3-4702: 10828.0892.6139.420: 100/92/02. Unpublished study prepared by Springborn Labs, Inc. 605 pages. MRID 42774109. (Cited in SERA 2004c).

Hoberg, J. 1993b. Dicamba technical: toxicity to the duckweed, *Lemna Gibba*: Final Report: Lab Project Number: 93-3-4665: 10828.0892.6140.410: 100/92/06. Unpublished study prepared
by Springborn Labs, Inc. 61 pages. MRID 42774111. (Cited in SERA 2004c).

Hubbard, R. K., R. G. Williams, M. D. Erdman, and L. R. Marti. 1989. Chemical transport from coastal plain soils under simulated rainfall. II. Movement of cyanizine, sulfometruon-methyl, and bromide. Transactions of the American Society of Agricultural Engineers 32(4):1250-1257.

Hurlbert, S. H. 1975. Secondary effects of pesticides on aquatic ecosystems. Residue Review 57:81-148.

Hutton, D. 1989. Chronic toxicity of DPX-T6376-74 to *Daphnia magna*: Lab Project Number: 4581-654: 833-88: HLR 833-88. Unpublished study prepared by DuPont Haskell Lab for Toxicology and Industrial Medicine. 39 pages. MRID No. 43490601. (Cited in SERA 2004e).

Ismail, B. S. and K. Kalithasan. 1997. Effects of repeated application on persistence and downward movement of four herbicides in soil. Australian Journal of Soil Research 35(3):503-513.

Johansen, J. A. and G. H. Geen. 1990. Sublethal and acute toxicity of the ethylene glycol butyl ether ester formulation of triclopyr to juvenile Coho salmon (*Oncorhynchus kisutch*). Archives of Environmental Contamination and Toxicology 19(4):610-616.

Johnson, W. W. and M. T. Finley. 1980. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication 137. U.S.FWS, Washington, D.C. 98 pages.

Johnson, R. M. and J. T. Sims. 1993. Influence of surface and subsoil properties on herbicide sorption by Atlantic coastal plain soils. Soil Science 155(5):339-348.

Jones, N. 1984. Prolonged Toxicity of Dowco 433 Acid to Daphnia magna: LSR/Aquatox Schedule No. AFT/84/010. Unpublished study prepared by Aquatox Limited. 38 p. MRID No. 40244521.

Kallqvist, T. and R. Romstad. 1994. Effects of agricultural pesticides on planktonic algae and cyanobacteria examples of interspecies sensitivity variations. Norwegian Journal of Agricultural Sciences Suppl. 0(13):117-131. (Cited in SERA 2004a)

Kallqvist, T., M. I. Abdel-Hamid, and D. Berge. 1994. Effects of agricultural pesticides on freshwater plankton communities in enclosures. Norwegian Journal of Agricultural Sciences Suppl. 0(13):133-152. (Cited in SERA 2004a)

Kannuck, R. and T. Sloman. 1995. Sulfometuron methyl (DPX-T5648): Influence on growth and reproduction of *Lemna gibba* G3. Lab Project No. AMR 2902-94. Unpublished study prepared by Stine-Haskell Research Center, E.I. du Pont de Nemours and Co, Newark, DE. 41pages. MRID 43538503. (Cited in SERA 2004f).

Kirk, H., D. Milazzo, and L. Humbert. 1994. The toxicity of tordon K herbicide formulation to the aquatic plant, duckweed, *Lemna gibba* L.G-3: Lab Project Number: DECO/ES/2764. Unpublished study prepared by The Environmental Toxicology and Chemistry Research Lab. 35 pages. MRID 43230311. (Cited in SERA 2011b).

Kirk, H. D., D. P. Milazzo, J. M. Hugo, and M. D. Martin. 1996. Fluroxypyr 1-Methylheptyl Ester: The Toxicity to the Aquatic Plant, Duckweed Lerona gibba L. G-3. Unpublished Study. Environmental Toxicology & Chemistry Research Laboratory, The Dow Chemical Company, Midland, MI. DowElanco, Indianapolis, IN. MRID No. 44080338.

Kirk, H., M. Gilles, and D. Rick et al. 1998. Phytotoxicological Evaluation of Starane 180 Emulsifiable Herbicide Concentrate (Formulation EF-1463) Exposed Aquatic Plant, Duckweed, Lemna gibba L. G-3: Lab Project Number: 981132. Unpublished study prepared by Dow Chemical Company. 75 p. MRID No. 44744001.

Knuteson, J. 1999. Review of Environmental Fate of 3,5,6-Trichloro-2-pyridinol. (TCP): Laboratory, Terrestrial and Aquatic Field Studies: Lab Project Number: GH-C 4875. Unpublished study prepared by Dow AgroSciences LLC. 75 pages. MRID 44766301. (Cited in SERA 2011c).

Kreamer, G. 1996. Early life-stage toxicity of DPX-T6376-141 (Metsulfuron Methyl) to rainbow trout, (*Oncorhynchus mykiss*): Lab Project Number: HLR 182-96: 10352: 182-96. Unpublished study prepared by DuPont Haskell Lab for Toxicology and Industrial Medicine. 400 pp. MRID No. 44122801. (Cited in SERA 2004e).

Kreutzweiser, D. P., S. B. Holmes, and D. C. Eichenberg. 1994. Influence of exposure duration on the toxicity of triclopyr ester to fish and aquatic insects. Archives of Environmental Contamination and Toxicology 26(1):124-129.

Kreutzweiser, D. P, D. G. Thompson, S. S. Capell, D. R. Thomas, and B. Staznik. 1995. Field evaluation of triclopyr ester toxicity to fish. Archives of Environmental Contamination and Toxicology 28 (1):18-26.

Krzyszowska, A. J., R. D. Allen and G. F. Vance. 1994. Assessment of the fate of two herbicides in Wyoming rangeland soil: column studies. Journal of Environmental Quality 23(5):1051-1058.

Landstein, D., S. Arad, Z. Barak, and D.M. Chipman. 1993. Relationships among the herbicide and functional sites of acetohydroxy acid synthase from *Chlorella emersonii*. Planta 191(1):1-6.

Lehmann, R. 1988. Formation of Fluroxypyr from Fluroxypyr-MHE by Soil Catalysis: Lab Project Number: GH-C 2068. Unpublished study prepared by Dow Chemical U.S.A. 26p. MRID No. 42137316.

Leitch, C. and P. Fagg. 1985. Clopyralid herbicide residues in streamwater after aerial spraying of a *Pinus radiata* plantation. New Zealand Journal of Forestry Science 15(2):195-206.

Little, E. E., R. D. Archeski, B. A. Flerov, and V. I. Kozlovskaya. 1990. Behavioral indicators of sublethal toxicity in rainbow trout. Archive of Environmental Contamination and Toxicology 19(3):380-385.

Lorz, H. W., S. W. Glenn, R. H. Williams, C. M. Kunkel, L. A. Norris, and B. R. Loper. 1979. Effects of selected herbicides on smolting of coho salmon. EPA-600/3-79-071. EPA, Environmental Research Laboratory, Corvallis, Oregon.

Machado, M. 2003. Triclopyr metabolite 3,5,6-TCP -- Full life-cycle toxicity test with water fleas, *Daphnia magna*, under static-renewal conditions: Lab Project Number: 12550.6286: 021300. Unpublished study prepared by Springborn Smithers Laboratories. 66 pages. MRID 45861301. (Cited in SERA 2011c).

Marino, T., E. McClymont, and C. Hales. 2003. Revised report for 3,5,6-Trichloro-2-Pyridinol (TCP): evaluation of the toxicity to the early life stages of the rainbow trout, *Oncorhynchus mykiss* Walbaum. Project Number: 011150, 011150R. Unpublished study prepared by The Dow Chemical Co. 69 pages. MRID 46033201. (Cited in SERA 2011c).

Martinez-Tabche, L., E. Madrigal-Bujaidar, and T. Negrete. 2004. Genotoxicity and lipoperoxidation produced by paraquat and 2,4-Dischlorophenoxyacetic acid in the gills of rainbow trout (*Oncorhynchus mikiss*). Bulletin of Environmental Contamination and Toxicology 73:146-152.

Martins, J. M. F., N. Chevre, L. Spack, J. Tarradellas, and A. Mermoud. 2001. Degradation in Soil and Water and Ecotoxicity of Rimsulfuron and its Metabolites. Chemosphere 45:515-522.

Mayer, F. L. and M. R. Ellersieck. 1986. Manual of acute toxicity: interpretation and data base for 410 chemicals and 66 species of freshwater animals. Resource Publication Number 160. U.S. FWS, Washington, DC. 505 pages.

Mayes, M. A. 1984. The acute toxicity of picloram potassium salt and picloram triisopzopanolamine salt to aquatic organisms. Environmental Toxicology and Chemistry 3(2):263-269.

Mayes, M. 1990. Dow Chemical USA phase 3 summary of MRID 00151958. The acute and chronic toxicity of triclopyr [(3,5,6-Trichloro-2-Pyridinyl)oxy) acetic acid] triethylamine salt solution to the fathead (*Pimephales promelas* Rafinesque): minnow. Project ID: ES-582. Prepared by Dow Chemical CO. 11 pages. MRID 92189012. (Cited in SERA 2011c).

Mayes, M. A., P. G. Murphy, D. L. Hopkins, F. M. Gersich, and F. A. Blanchard. 1986. The toxicity and metabolism of triclopyr butoxyethyl ester: coho salmon. Toxicologist 6:26 (Abstract Only). (Cited in SERA 2011c).

Mayes, M. A., D. L. Hopkins, and D. C. Dill. 1987. Toxicity of picloram (4-amino-3,5,6-trichloropicolinic acid) to life stages of the rainbow trout. Bulletin of Environmental Contamination and Toxicology 38:653-600.

McAllister, W., J. Bowman, and P. Cohle. 1985a. Aucte toxicity of CN 10-6471 [(Banvel herbicide)] to bluefill sunfish. (*Lepomis macrochirus*): Report No. 33171. Unpublished study prepared by Analytical Biochemistry Laboratories, Inc. 53 pages. MRID 00153150. (cited in SERA 2004c).

McAllister W., J. Bowman, and P. Cohle. 1985b. Acute Toxicity of CN 10-6471 [(Banvel Herbicide)] to Rainbow Trout. (*Salmo gairdneri*): Report No. 33172. Unpublished study prepared by Analytical Biochemistry Laboratories, Inc. 58 pages. MRID 00153151. (cited in SERA 2004c).

McLaren/Hart Environmental Engineering Corporation. 1995. Use of the Registered Aquatic Herbicide Fluridone (Sonar) and the Use of the Registered Aquatic Herbicide Glyphosate (Rodeo and Accord) in the State of New York - Final Generic Environmental Impact Statement. (prepared for Dow- Elanco and Monsanto).

Milazzo, D. P., J. A. Miller, J. M. Hugo, and M. D. Martin. 1996a. Fluroxypyr 1-Methylheptyl Ester: The Toxicity to the Blue-Green Alga, Anabaena flos-aquae. Unpublished Study. Environmental Toxicology & Chemistry Research Laboratory, The Dow Chemical Company, Midland, MI DowElanco, Indianapolis, IN. Laboratory Report ID: ES-3073. MRID No. 44080336.

Milazzo, D. P., J. M. Hugo, and M. D. Martin. 1996b. Fluroxypyr 1-Methylheptyl Ester: The Toxicity to the Freshwater Green Alga, Selenastrum capricornutum Printz. Unpublished Study. Environmental Toxicology & Chemistry Research Laboratory, The Dow Chemical Company, Midland, MI. DowElanco, Indianapolis, IN. MRID No. 44803340.

Mitchell, D. G., P. M. Chapman, and T. J. Long. 1987. Acute toxicity of Roundup and Rodeo herbicides to rainbow trout, chinook, and coho salmon. Bulletin of Environmental Contamination and Toxicology 39(6):1028-1035.

Morgan, M. J. and J. W. Kiceniuk. 1992. Response of rainbow trout to a two month exposure to vision a glyphosate herbicide. Bulletin of Environmental Contamination and Toxicology 48(5):772-780.

Morgan J. D., G. A. Vigers, A. P Farrell, D. M. Janz, and J. F. Maville. 1991. Acute avoidance reactions and behavioral responses of juvenile rainbow trout (*Oncorhynchus mykiss*) to Garlon 4, Garlon 3A and Vision Herbicides. Environmental Toxicology and Chemistry 10(1):73-79.

Muska, C. and R. Driscoll. 1982. Early life stage toxicity of INT-5648-18 to fathead minnow. Haskell Laboratory Report No. 765-82. Unpublished study received March 28, 1983, under 352-401; submitted by Haskell Laboratory for Toxicology and Industrial Medicine, E.I. du Pont de Nemours and Co. Inc., Newark, DE. MRID 00126600. (Cited in SERA 2004f).

Muska, C. and C. Hall. 1982. 96-hour LC_{50} to rainbow trout: Laboratory Report No. 515-82. Unpublished study received Feb 14, 1983 under 352-EX-111. CDL:071434-B. Submitted by E.I. du Pont de Nemours & Co., Inc., Wilmington, Delaware. MRID No. 00125816. (Cited in SERA 2004e).

National Library of Medicine (NLM). 2012. Data Query of the Hazardous Substances Database. National Library of Medicine, Toxnet. Available: http://toxnet.nlm.nih.gov/. (May 2012).

Neary, D. G. and J. L. Michael. 1989. Herbicides - protecting long-term sustainability and water quality in forest ecosystems. New Zealand Journal of Forestry Science 26:241-264.

New York State Department of Environmental Conservation (NYSDEC). 2009. Division of Solid and Hazardous Materials Bureau of Pesticides Management. Registration of a Major Change in Labeling for DuPont Matrix FNV Herbicide (EPA Registration Number 352-671) Containing the Active Ingredient Rimsulfuron (Active Ingredient Code 129009). Memorandum Dated May 15, 2009.

Nystrom B., B. Bjornsater, and H. Blanck. 1999. Effects of sulfonylurea herbicides on non-target aquatic micro-organisms: Growth inhibition of micro-algae and short-term inhibition of adenine and thymidine incorporation in periphyton communities. Aquatic Toxicology 47(1):9-22.

Pereira, J. L., S. C. Antunes, B. B. Castro, C. R. Marques, A. M. M. Goncalves, F. Goncalves, and R. Pereira. 2009. Toxicity evaluation of three pesticides on non-target aquatic and soil organisms: commercial formulation versus active ingredient. Ecotoxicology 18:455-463.

Perkins, M. J. 1997. Effects of two formulations of glyphosate and triclopyr on four non-target aquatic species: *Xenopus laevis*, *Myriophyllum sibiricum*, *Lemna gibba* and *Tubifex*. MS Thesis, University of Guelph, Canada. 110 pages. (Cited in SERA 2011a).

Peterson, H. G., C. Boutin, P. A. Martin, K. E. Freemark, N. J. Ruecker, and M. J. Moody. 1994. Aquatic phyto-toxicity of 23 pesticides applied at expected environmental concentrations. Aquatic Toxicology 28(3-4):275-292.

Petty, D. G., K. D. Getsinger, and K. B. Woodburn. 2003. A review of the aquatic environmental fate of triclopyr and its major metabolites. Journal of Aquatic Plant Management 41:69-75.

Pierson, K. 1991. Flow-Through 77 Day Toxicity of DPX-W4189-170 to Embryo and Larval Rainbow Trout, Oncorhynchus mykiss. Lab Project Number: 494-91: MR-4581-866. Unpublished study prepared by E.I. du Pont de Nemours and Co. MRID 41976405. (Cited in SERA 2004a).

Rashin, E. and C. Graber. 1993. Effectiveness of Best Management Practicess for aerial application of forest practices. Ecology Publication No. 93-81, Prepared for the Timber/Fish/Wildlife Cooperative Monitoring Evaluation and Research Committee. Olympia, Washington.

Rice, P. M., J. C. Toney, D. J. Bedunah, and C. E. Carlson. 1997. Plant community diversity and growth form responses to herbicide applications for control of *Centaurea maculosa*. Journal of Applied Ecology 34(6):1397-1412.

Roshon, R. D., J. H. Mccann, D. G. Thompson, and G. R. Stephenson. 1999. Effects of seven forestry management herbicides on *Myriophyllum sibiricum*, as compared with other nontarget aquatic organisms. Canadian Journal of Forest Research 29(7):1158-1169.

Sanders, H. O. 1969. Toxicity of pesticides to the crustacean *Gammarus lacustris*. USDI Technical Paper 25. Bureau of Sport Fisheries and Wildlife, U.S. FWS, Columbia, MO.

Scifres, C. J. and T. J. Allen. 1973. Dissipation of dicamba from grassland soils of Texas. Weed Science 21(5):393-396.

Simenstad, C. A., J. R. Cordell, L. Tear, L. A. Weitkamp, F. L. Paveglio, K. M. Kilbride, K. L. Fresh, and C. E. Grue. 1996. Use of Rodeo and X-77 spreader to control smooth cordgrass (*Spartina alterniflora*) in a southwestern Washington estuary: 2. Effects on benthic microflora and invertebrates. Environmental Toxicology and Chemistry 15(6):969-978.

Smith, E. J. 1979. 96-Hour LC50 to Rainbow Trout. Haskell Laboratory Report No. 386-79. (Unpublished study received Jun 16, 1980 under 352-105; submitted by E.I. du Pont de Nemours & Co., Wilmington, Del.; CDL:099462-E). MRID 00035259. (Cited in SERA 2004a).

Smith, B. C., C. A. Curran, K. W. Brown, J. L. Cabarrus, J. B. Gown, J. K. Mcintyre, E. E. Moreland, V. L. Wong, J. M. Grassley, and C. E. Grue. 2004. Toxicity of Four Surfactants to juvenile rainbow trout: Implications for use over water. Bulletin of Environmental Contamination and Toxicology 72:647-654.

Sprecher, S. L., K. D. Getsinger, and A. B. Stewart. 1998. Selective effects of aquatic herbicides on sago pondweed. Journal of Aquatic Plant Management 36: 64-68.

Syracuse Environmental Research Associates, Inc. (SERA). 2004a. Chlorsulfuron – Human Health and Ecological Risk Assessment – Final Report. SERA TR 04-43-18-01c. Fayetteville, New York. Prepared for: USFS Forest Health Protection, Arlington, VA. Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/112104_chlorsulf.pdf. (May 2012).

SERA. 2004b. Clopyralid – Human Health and Ecological Risk Assessment - Final Report. SERA TR 04-43-17-03c. Fayetteville, New York. Prepared for: USFS Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/120504_clopyralid.pdf. (May 2012).

SERA. 2004c. Dicamba – Human Health and Ecological Risk Assessment – Final Report. SERA TR 04-43-17-06d. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/112404_dicamba.pdf. (May 2012).

SERA. 2004d. Imazapic – human health and ecological risk assessment – final report. SERA TR 04-43-17-04b. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/122304_Imazapic.pdf. (May 2012).

SERA. 2004e. Metsulfuron methyl – human health and ecological risk assessment – final report. SERA TR 04-43-17-01b. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: www.fs.fed.us/foresthealth/pesticide/pdfs/120904_Metsulfuron.pdf. (May 2012).

SERA. 2004f. Sulfometuron methyl – human health and ecological risk assessment – final report. SERA TR 03-43-17-02c. Fayetteville, New York. Prepared for: USFS, Forest Health Protection, Arlington, VA. Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/121404_Sulfometuron.pdf. (May 2012).

SERA. 2006a. 2,4-D – human health and ecological risk assessment – final report. Fayetteville, New York. Prepared for USDA Forest Service, Forest Health Protection, Arlington, VA. Available: https://www.fs.fed.us/foresthealth/pesticide/pdfs/093006_24d.pdf. (March 2012).

SERA. 2007. Aminopyralid – human health and ecological risk assessment – final report. SERA TR 052-04 Manlius, NY. Prepared for: USDA USFS, Forest Health Protection, http://www.fs.fed.us/foresthealth/pesticide/pdfs/062807_Aminopyralid.pdf (June 2007).

SERA. 2009. Fluroxypyr - Human Health and Ecological Risk Assessment FINAL REPORT. SERA TR-052-12-03a. Prepared for: USDA USFS. Available at: https://www.fs.fed.us/foresthealth/pesticide/pdfs/0521303a_fluroxypyr.pdf

SERA. 2011a. Glyphosate – human health and ecological risk assessment – final report. SERA TR-052-22-03b. Manlius, New York. Prepared for: USFS, Southern Region, Atlanta, Georgia. Available: https://www.fs.fed.us/foresthealth/pesticide/pdfs/Glyphosate_SERA_TR-052-22-03b.pdf. (May 2012).

SERA. 2011b. Picloram – human health and ecological risk assessment – final report. SERA TR 052-27-03a. Fayetteville, New York. Prepared for USFS, Southern Region, Atlanta, Georgia. Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/Picloram_SERA_TR-052-27-03a.pdf. (May 2012).

SERA. 2011c. Triclopyr – human health and ecological risk assessment – final report. SERA TR 052-25-03a. Fayetteville, New York. Prepared for: USFS, Southern Region, Atlanta, Georgia. Available: https://www.fs.fed.us/foresthealth/pesticide/pdfs/052-25-03aTriclopyr.pdf. (May 2012).

SERA. 2011d. Imazapyr – human health and ecological risk assessment – final report. SERA TR 052-29-03a. Manlius, NY. Prepared for: USDA USFS, Forest Health Protection, Available: http://www.fs.fed.us/foresthealth/pesticide/pdfs/Imazapyr_TR-052-29-03a.pdf (December 2011).

Thompson, S. 1994. Sulfometuron methyl (DPX-T5648): Influence on growth and reproduction of three select algal species: Lab Project Number: AMR 2892-93: 112A-121. Unpublished study prepared by Wildlife International Ltd, Easton, MD and Haskell Laboratory for Toxicology and Industrial Medicine, E.I. du Pont de Nemours and Co, Inc., Newark, DE. 58 pages. MRID 43538502. (Cited in SERA 2004f).

Thompson, D. G., D. P. Kreutzweiser, S. S. Capell, D. R. Thomas, B. Staznik and T. Viinikka. 1995. Journal of Environmental Toxicology and Chemistry 14(8):1307-1317.

Tierney, K. B., P. S. Ross, H. E. Jarrard, K. R. Delaney, and C. J. Kennedy. 2006. Changes in juvenile coho salmon electro-olfactogram during and after short-term exposure to current-use pesticides. Environmental Toxicology and Chemistry 25(10):2809-2817.

Tierney, K. B., C. R. Singh, P. S. Ross, and C. J. Kennedy. 2007. Relating olfactory neurotoxicity to altered olfactory-mediated behaviors in rainbow trout exposed to three currently-used pesticides. Aquatic Toxicology 81(1):55-64.

Tu, M., C. Hurd, and J. M. Randall. 2001. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Nature Conservancy. Version: April 2001. Available: http://www.invasive.org/gist/products/handbook/methods-handbook.pdf. (May 2012).

U.S. Environmental Protection Agency (EPA). 1993. Registration Eligibility Decision for Glyphosate. EPA 738-R-93-014. Office of Prevention, Pesticides, and Toxic Substances. 291 pages.

EPA. 1995. Registration Eligibility Decision for Picloram. EPA 738-R95-019. Office of Prevention, Pesticides, and Toxic Substances. 301 pages.

EPA. 1998. Registration Eligibility Decision for Trichlopyr. EPA 738-R-98-011. Office of Prevention, Pesticides, and Toxic Substances. 285 pages.

EPA. 2005a. Reregistration Eligibility Decision for 2,4-D. EPA 738-R-05-002. Office of Prevention, Pesticides, and Toxic Substances. 304 pages.

EPA. 2005b. Reregistration Eligibility Decision for Chlorsulfuron. EPA Office of Prevention, Pesticides, and Toxic Substances. 90 pages.

EPA. 2009. Risks of Triclopyr Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*). Including Appendices A through Q. Available: http://www.epa.gov/espp/litstatus/effects/redleg-frog/. (May 2012).

EPA. 2012. Environmental Fate Effects Division Problem Formulation for the Environmental Fate, Ecological Risk, Endangered Species, and Human Health Drinking Water Exposure Assessments in Support of the Registration Review of Rimsulfuron. Office of Prevention, Pesticides, and Toxic Substances. Washington, DC. September 13, 2012. 53 pgs.

U.S. Environmental Protection Agency/Office of Pesticide Programs (EPA/OPP). 1998. Review for Section 3 Registration of Fluroxypyr Acid (Chemical # 128959) and Fluroxypyr MHE (Chemical # 128968-5). Report dated June 8, 1998.

EPA/OPP. 2004. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, Endangered and Threatened Species Effects Determinations. Available at https://www3.epa.gov/pesticides/endanger/consultation/ecorisk-overview.pdf

U.S. Forest Service (USFS). 2000a. Glyphosate: herbicide information profile. USFS, Pacific Northwest Region. Available: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev2_025810.pdf. (May 2012).

USFS. 2000b. Picloram: Herbicide Information Profile. Pacific Northwest Region Forest Service. Available at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev2_025812.pdf. Accessed March 26, 2012.

U.S. Geological Survey (USGS). 1998. Data on pesticides in surface and ground water of the United States. Revised October 23, 1998. Results of the National Water Quality Assessment Program (NAWQA).

Vilkas, A. 1977a. The acute toxicity of banvel technical to the bluegill sunfish. Union Carbide Environmental Services. November 21, 1977. Review. 2 pages. Accession No. 232965. (Cited in SERA 2004c).

Vilkas, A. 1977b. The acute toxicity of banvel technical to the sheepshead minnow. Union Carbide Environmental Services. December 14, 1977. Review. 1 page. Accession No. 232965. (Cited in SERA 2004c).

Waite, D. T., R. Grover, N. D. Westcott, H. Sommerstad, and L. Kerr. 1992. Pesticides in groundwater, surface water, and spring runoff in a small Saskatchewan watershed. Environmental Toxicology and Chemistry 11(6):741-748.

Wan, M. T., D. J. Moul, and R. G. Watts. 1987. Acute toxicity to juvenile Pacific salmonids of Garlon 3A, Garlon 4, triclopyr, triclopyr ester, and their transformation products 3,5,6-trichloro-2-pyridinol and 2-methoxy-3,5,6-trichloropyridine. Bulletin of Environmental Contamination and Toxicology 39(4):721-728.

Wan, M. T., R. G. Watts, and D. J. Moul. 1989. Effects of different dilution water types on the acute toxicity to juvenile pacific salmonids and rainbow trout of glyphosate and its formulated products. Bulletin of Environmental Contamination and Toxicology 43(3):378-385.

Wan, M. T.; R. G. Watts; D. J. Moul. 1992. Effects of Different Dilution Water Types on the Acute Toxicity to Juvenile Pacific Salmon and Rainbow Trout of Fluroxypyr Formulated Product XRM-5084. Bull Environ Contam Toxicol. 49 (6): 914-921.

Ward, G. 1991. 2,4-D, Dimethylamine Salt: Chronic Toxicity to the Water Flea, *Daphnia magna*, Under Flow-through Test Conditions: Lab Project Number: J9002003D. Unpublished study prepared by Toxikon Environmental Sciences. 45 p. MRID 41835210. (Cited in SERA 2006).

Ward, T. and R. Boeri. 1989. Chronic Toxicity of DPX-W4189-94 to Daphnia magna. Lab Project Number: 4581-655: 87-89. Unpublished study prepared by E.I. du Pont de Nemours and Co. 27 p. MRID 41976404. (Cited in SERA 2004a).

Ward, T. and R. Boeri. 1991. Static Acute Toxicity of DPX-W4189-165 (Chlorsulfuron) to the Mysid, Mysidopsis bahia. Lab Project Number: MR-4581-866: 523-91: 9131-DU.

Unpublished study prepared by EnviroSystems Division. 31 p. MRID 41976402. (Cited in SERA 2004a).

Washington State Department of Transportation (WSDOT). 2006. WSDOT Chlorsulfuron Roadside Vegetation Management Herbicide Factsheet. Available: https://www.wsdot.wa.gov/NR/rdonlyres/51B16438-C6D6-42E4-8F8D-0825E04E4B09/0/HerbicidesfactsheetChlorsulfuron.pdf. (May 2012).

Wauchope, R. D., R. G. Williams, and L. R. Marti. 1990. Runoff of sulfometuron-methyl and cyanazine from small plots: Effects of formulation and grass cover. Journal of Environmental Quality 19(1):119-125.

Wei, L., H. Yu, Y. Sun, J. Fen, and L. Wang. 1998. The effects of three sulfonylurea herbicides and their degradation products on the green algae *Chlorella pyrenoidosa*. Chemosphere 37(4):747-751. (Cited in SERA 2004a, e).

Wei, L., H. Yu, J. Cao, Y. Sun, J. Fen, and L. Wang. 1999. Determination and prediction of partition coefficient and toxicity for sulfonylurea herbicides and their degradation products. Chemosphere 38(7):1713-1719. (Cited in SERA 2004e).

Weinberg, J.J. Hugo and M. Martin. 1994. Evaluation of the toxicity of triclopyr butoxyethyl ester to the early life stages of the rainbow trout, *Oncorhynchus mykiss* Walbaum: Lab Project Number: DR/0133/7242: DECO/ES/2699. Unpublished study prepared by The Environmental Toxicology & Chemistry Research Lab. 47 pages. MRID 43230201. (Cited in SERA 2011c).

Woodburn, K. 1987. Clopyralid – The hydrolysis of clopyralid in sterile, buffered water: lab Project Number: LEH060893. (Unpublished study prepared by DowElanco). MRID No. 41971101. (Cited in SERA 2004b).

Woodward, D. F. 1976. Toxicity of the herbicides dinoseb and picloram to cutthroat (*Salmo clarki*) and lake trout (*Salvelinus namaycush*). Journal of the Fisheries Research Board of Canada 33:1671-1676.

Woodward, D. F. 1979. Assessing the hazard of picloram to cutthroat trout. Journal of Range Management 32(3):230-232.

Woodward, D. F. 1982. Acute toxicity of mixtures of range management herbicides to cutthroat trout. Journal of Range Management 35(4):539-540.

Xie, L., K. Thrippleton, M. A. Irwin, G. S. Siemering, A. Mekebri, D. Crane, K. Berry, and D. Schlenk. 2005. Evaluation of estrogenic activities of aquatic herbicides and surfactants using an rainbow trout vitellogenin assay. Toxicological Sciences 87(2):391-8.