SMALL-SCALE MINERAL PROSPECTING WHITE PAPER

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List of Abbreviations and Acronyms

7Q10	7-day consecutive 10-year
BMP	best management practice
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
HCP	Habitat Conservation Plan
HPA	Hydraulic Project Approval
IDWR	Idaho Department of Water Resources
ITP	Incidental Take Permit
LWD	large woody debris
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OHWL	ordinary high water line
RCW	Revised Code of Washington
RPM	reasonable and prudent measure
SaSI	Salmonid Stock Inventory
SWD	small woody debris
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area

List of Units of Measure

cfs	cubic feet per second
ft	foot/feet
ft^2	square feet
ft^3	cubic feet
Mg/L	milligrams per liter
Mm	millimeter
NTU	nephelometric turbidity unit

Note: In general, English measurement units (e.g., feet, inches, miles) are used in this white paper; when the source material expresses a value in metric units, that measurement is also provided in parentheses. However, measurements that by convention are typically made only in metric units are reported in those units (e.g., mg/L). Temperatures are reported in both Fahrenheit and Celsius, regardless of the scale used in the source material.

EXECUTIVE SUMMARY

In Washington State, activities that use, divert, obstruct, or change the natural bed or flow of state waters require a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) (Revised Code of Washington [RCW] 77.55). The purpose of the HPA program is to ensure that such activities do not damage public fish and shellfish resources and their habitats. To ensure that the activities conducted under the HPA authority comply with the ESA and to facilitate ESA compliance for citizens conducting work under an HPA, WDFW is preparing a programmatic, multispecies Habitat Conservation Plan (HCP) to obtain an Incidental Take Permit (ITP) from the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA) Fisheries Service (known as NOAA Fisheries or National Marine Fisheries Service). WDFW's objective is to avoid, minimize, or compensate for the incidental take of species potentially covered under the HCP resulting from the implementation of permits issued under the HPA authority. In this context, to "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct (16 U.S.C. 1532(19)).

To evaluate the feasibility of and develop a scientific foundation for the possible HCP, WDFW has commissioned a series of white papers to review and summarize the best available science for up to 21 HPA activities that could be included in the HCP. This white paper addresses the availability of scientific information on one such HPA activity, small-scale mineral prospecting.

The literature review conducted for this white paper identified seven impact mechanisms associated with the operation of small-scale mineral prospecting activities that could potentially affect aquatic species being considered for coverage under the HCP ("potentially covered species"). These mechanisms describe activities and modifications to habitat arising from activities that can be temporary or permanent in duration. The impact mechanisms evaluated in this white paper are:

- Excavation/entrainment
- Wading
- Substrate modifications/channel hydraulics
- Water quality modifications
- Channel dewatering/obstructions to passage
- Prey base alterations

- Human disturbance

Following a brief description of small-scale mineral prospecting activities and potential impact mechanisms, the 52 aquatic species being considered for coverage under the HCP are described. Based on this information, the risk of direct and indirect impacts to the potentially covered species or their habitats are discussed. In addition, the potential for cumulative impacts is discussed, and the risk for incidental take of potentially covered species is qualitatively estimated. The white paper then identifies data gaps (i.e., instances in which the data or literature are insufficient to allow conclusions on the risk of take). The white paper concludes by providing habitat protection, conservation, mitigation, and management strategies consisting of actions that could be taken to avoid or minimize the impacts of small-scale mineral prospecting. Key elements of the white paper are summarized below.

Activity Description

In 1997, the Washington State Legislature passed Substitute House Bill (SHB) 1565, which defined small-scale mining and prospecting and prohibited any requirement to obtain a written HPA before conducting small-scale mining and prospecting (WDFW 1999). The *Gold and Fish Rules and Regulations for Mineral Prospecting and Placer Mining in Washington State* (Gold and Fish pamphlet; WDFW 1999) serves as the HPA for mining and prospecting activities that comply with the guidelines of the pamphlet. However, small-scale mineral prospecting activities that do not meet all of the requirements of the Gold and Fish pamphlet can be authorized under other HPA types (e.g., individual HPA or supplemental approval).

Small-scale mineral prospecting and mining was defined as the use of pans, non-motorized sluice boxes, concentrators, and mini-rocker boxes to discover and recover minerals. SHB 1565 also refers to any mining activity that complies with the most current version of the Gold and Fish pamphlet, such as suction dredging. Small-scale mining is defined only by the type of equipment used, without reference to the volume of material sorted. Small-scale mining does not include chemical mining or dredge sizes greater than 4 inches.

Species and Habitat Use

This white paper considers potential impacts on 52 potentially covered species and summarizes the geographic distribution and habitat requirements of those species. That information was used to assess potential impacts on the potentially covered species.

Direct and Indirect Impacts

The available literature, including several specific small-scale mining studies, was reviewed to determine the current state of knowledge regarding direct and indirect impacts on the potentially covered species. Direct impacts can include: (1) mortality from the physical effects of wading or entrainment of early life history stages or eggs; and (2) lower productivity resulting from habitat modifications (e.g., altered streambeds or water quality). Indirect impacts can include changes in food resources and human disturbances.

The various studies documented several types of impacts related to the distance between mining activities, turbidity levels near and downstream of the mining activities, the use of unstable mine tailings by fish for spawning locations, changes in channel morphology, and alterations to prey resources related to suction dredging and sedimentation. This information provided a basis for comparison to current HPA and Gold and Fish pamphlet requirements for small-scale mineral prospecting.

The seven identified impact mechanisms associated with the operation of small-scale mineral prospecting activities that could affect potentially covered species are evaluated in this white paper. Each of the impact mechanisms is briefly described below.

Table ES-1
Principal Impact Mechanisms Evaluated

Impact Mechanism	Description
Excavation/Entrainment	All physical disruption of the streambed and removal of organisms from their natural environment. This mechanism includes organism displacement.
Wading	Physical abrasion and crushing of organisms underfoot.
Substrate Modifications/Channel Hydraulics	Changes in substrate composition (grain size) or morphology that result when channel processes are altered by artificial means (e.g., excavation or deposition). This mechanism includes stranding.
Water Quality Modifications	Changes in water quality, primarily in turbidity but also in metallic and hydrocarbon toxins.
Channel Dewatering/Obstructions to Passage	Changes that result from altered flow, principally dewatering that occurs due to stream diversion during mining activities; or stranding of organisms due to dewatering, excavation, or placement of spoils. Influence of equipment, dams, or diversion obstructions on migrating species.
Prey Base Alterations	Changes to food sources that impact aquatic organisms by altering their prey base.
Human Disturbance	The potential for human disturbances (e.g., noise) along the channel during mineral prospecting activities to indirectly displace or disrupt the behavior of potentially covered species.

Cumulative Impacts of Small-Scale Mineral Prospecting

Cumulative impacts can result from small-scale mining in the same location for multiple years or from multiple mining operations occurring within an area. The geographic concentration of the individual HPAs reviewed for this white paper (i.e., a review of a subset of those operations not conducted using the Gold and Fish pamphlet guidelines) demonstrates the potential for significant portions of creeks to be mined and therefore highlights the importance of understanding or recognizing the potential for cumulative impacts to potentially covered species and their habitats.

Data Gaps

The majority of literature focuses on fisheries, water quality, or non-covered species of aquatic invertebrates. Little information was found regarding the direct impacts of small-scale mining on some of the other potentially covered species, including mussels, snails, limpets, and non-salmonid fishes. Additional research is underway concerning the influence of small-scale mineral prospecting on freshwater mussel species, but the information was not available for this review. Additional research needs to enhance the evaluation of the potential for take via direct, indirect, and cumulative impacts of potentially covered species are presented.

Recommended Habitat Protection, Conservation, Mitigation, and Management Strategies

The impacts of small-scale mineral prospecting can be minimized primarily through operational restrictions, including the type of mining equipment, limitations on excavation zones within streams, and allowable work windows. Such restrictions are included in the Gold and Fish pamphlet, which allows only specific types of mining equipment and restricts its use to authorized excavation zones based on the wetted perimeter and the ordinary high water line (OHWL). In addition, all mineral prospecting activities in Washington streams are subject to specifically designated work windows. Some streams require an individual HPA permit for mining activity. These restrictions, and others outlined in the Gold and Fish pamphlet, help avoid and minimize the impacts of small-scale mining. However, based on our review of the pamphlet and the available scientific literature, additional measures and management strategies could be implemented to further reduce the impacts of small-scale mining and the potential for take of potentially covered freshwater species. Fourteen mitigation/conservation measures and four management recommendations are offered to address these issues. Most of the recommendations address the allowed timing of the activity, the allowed location of the activity, and enhanced database tracking of the activity.

1 INTRODUCTION

In Washington State, construction or performance of work that will use, divert, obstruct, or change the natural bed[1] or flow of state waters requires a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) (Revised Code of Washington [RCW] 77.55). The purpose of the HPA program is to ensure that such activities are completed in a manner that prevents damage to public fish and shellfish resources and their habitats. Because several fish and aquatic species in the state are listed as threatened or endangered under the federal Endangered Species Act (ESA), many of the activities requiring an HPA may also require approvals from the National Oceanic and Atmospheric Administration's Fisheries Service (known as NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS). Such approvals can be in the form of an ESA Section 7 Incidental Take Statement or an ESA Section 10 Incidental Take Permit (ITP). As authorized in Section 10 of the ESA, ITPs may be issued for otherwise lawful activities that could result in the "take" of ESA-listed species or their habitats. In this context, to take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct (16 United States Code 1532(19)).

To ensure that the activities conducted under the HPA authority comply with the ESA and to facilitate ESA compliance for citizens conducting work under an HPA, WDFW is preparing a programmatic, multispecies Habitat Conservation Plan (HCP) to obtain an ITP from the USFWS and NOAA Fisheries. An HCP must outline conservation measures for avoiding, minimizing, and mitigating, to the maximum extent practicable, the impacts of the permitted take on the potentially covered species.[2] The federal agencies must also find in their biological opinion that any permitted incidental take will not jeopardize continued existence of the species, i.e., the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.

To develop a scientific foundation for the HCP, WDFW has commissioned a series of white papers that will review and summarize the best available science for up to 21 HPA activities that could be included in the HCP.

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[1] Bed is defined as the land below the ordinary high water line of the state waters, but does not include irrigation ditches, canals, the outflow from stormwater runoff devices, or other artificial watercourses except where they exist in a natural watercourse that has been altered by humans.

[2] In this white paper, "potentially covered species" refers to species that could be covered in the HCP under consideration; however, that determination would be made at the time the HCP is finalized between the WDFW and the federal agencies.

This white paper addresses the availability of scientific information on one such HPA activity, small-scale mineral prospecting. This white paper compiles and synthesizes existing information, describes potential take mechanisms, and makes recommendations for measures to avoid or minimize the impacts of small-scale mineral prospecting. In addition, WDFW can use this white paper to help assess whether changes are warranted in the existing programmatic HPA pamphlet titled *Gold and Fish Rules and Regulations for Mineral Prospecting and Placer Mining in Washington State* (Gold and Fish pamphlet; WDFW 1999).

The remainder of this white paper is organized as follows:

- Section 2 – Objectives
- Section 3 – Methodology
- Section 4 – Types of small-scale mining activities and relevant regulations
- Section 5 – Distributions and habitat use of the potentially covered species
- Section 6 – Conceptual framework for assessing impacts
- Section 7 – Analysis of direct and indirect impacts
- Section 8 – Analysis of cumulative impacts
- Section 9 – Analysis of the potential risk of take
- Section 10 – Identified data gaps
- Section 11 – Strategies and management recommendations to offset potential impacts
- Section 12 – Publication details for the references cited

2 OBJECTIVE

The objectives of this white paper are:

- To compile and synthesize the best available scientific information related to the potential impacts of small-scale mining on potentially covered species, their habitats, and associated ecological processes
- To use this scientific information to estimate the circumstances, mechanisms, and risk of incidental take potentially or likely resulting from small-scale mining activities
- To identify appropriate and practicable measures, including policy directives, conservation measures, and best management practices (BMPs), for avoiding, minimizing, or mitigating for the risk of incidental take of potentially covered species

3 METHODOLOGY

A literature review was conducted to determine the current state of knowledge regarding the impacts of small-scale mining and its potential to directly and indirectly affect the 29 freshwater or anadromous species among the 52 potentially covered fish and shellfish species identified by WDFW (Table 1; refer to Appendix B for the complete list of potentially covered species). The compiled literature set included: (a) relevant previous white papers prepared for WDFW; (b) copies of individual HPAs for small-scale mining in 2006 as provided by WDFW; (c) documents secured as a result of keyword searches on the Internet and in other literature databases; (d) a review of general biological opinions prepared by NOAA Fisheries and USFWS, addressing similar issues as small-scale mineral prospecting; (e) review of a specific biological opinion addressing the effects of recreational suction dredge mining in Idaho prepared by the NMFS; and (e) scientific research papers on small-scale mineral prospecting and associated environmental impacts provided by the WDFW and the small-scale mining community. The principal keyword search strategy was to look for documents linking terms describing the species (i.e., common and scientific names of all potentially covered species) with terms describing mineral prospecting or mechanisms of impact associated with the operation of such activities. The Gold and Fish pamphlet was reviewed to evaluate whether existing rules and regulations provide enough detail to allow identification of impacts and potential for take. In addition, 57 individual HPAs for small-scale mining granted in 2006 by WDFW were also reviewed.

The compiled documents were reviewed to determine which potential mechanisms of impact were addressed in each document. The majority of references considered impacts to salmonid fishes or to physical habitat features. Documents that evaluated impacts to potentially covered species other than salmonids were also identified during the literature review. The literature review results were entered into a matrix, which allowed easy identification of literature relevant to each impact mechanism. Documents located during the literature review were in turn used in Internet searches (mostly conducted using the Google® search tool) to locate additional relevant literature addressing specific impact pathways.

Table 1
Potentially Covered Freshwater and Anadromous Fish and Wildlife Species

Common Name	Scientific Name	Status	Habitat
California floater (mussel)	*Anodonta californiensis*	FSC/SC	Freshwater
Mountain sucker	*Catostomus platyrhynchus*	SC	Freshwater
Margined sculpin	*Cottus marginatus*	FSC/SS	Freshwater
Lake chub	*Couesius plumbeus*	SC	Freshwater
Giant Columbia River limpet	*Fisherola nuttalli*	SC	Freshwater
Great Columbia River spire snail	*Fluminicola columbiana*	FSC/SC	Freshwater
Western ridged mussel	*Gonidea angulata*	(none)	Freshwater
Western brook lamprey	*Lampetra richardsoni*	FSC	Freshwater
Olympic mudminnow	*Novumbra hubbsi*	SS	Freshwater
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	FSC	Freshwater
Redband trout	*Oncorhynchus mykiss*	FSC	Freshwater
Pygmy whitefish	*Prosopium coulteri*	FSC/SS	Freshwater
Leopard dace	*Rhinichthys falcatus*	SC	Freshwater
Umatilla dace	*Rhinichthys umatilla*	SC	Freshwater
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	FSC	Freshwater & Anadromous
Sockeye salmon	*Oncorhynchus nerka*	FE/FT/SC	Freshwater (kokanee) & Anadromous
Bull trout	*Salvelinus confluentus*	FT/SC	Freshwater & Anadromous
Green sturgeon	*Acipenser medirostris*	SPHS	Anadromous
White sturgeon	*Acipenser transmontanus*	SPHS	Anadromous
River lamprey	*Lampetra ayresi*	FSC/SC	Anadromous
Pacific lamprey	*Lampetra tridentata*	FSC	Anadromous
Pink salmon	*Oncorhynchus gorbuscha*	SPHS	Anadromous
Chum salmon	*Oncorhynchus keta*	FT/SC	Anadromous
Coho salmon	*Oncorhynchus kisutch*	FC/FSC	Anadromous
Steelhead	*Oncorhynchus mykiss*	FE/FT/SC	Anadromous
Chinook salmon	*Oncorhynchus tschawytscha*	FE/FT/SC	Anadromous
Dolly Varden	*Salvelinus malma*	FP	Anadromous
Longfin smelt	*Spirinchus thaleichthys*	SPHS	Anadromous
Eulachon	*Thaleichthys pacificus*	FC/SC	Anadromous

Notes:

FE = Federal Endangered
FP = Federal Protected
FT = Federal Threatened
FC = Federal Candidate
FSC = Federal Species of Concern
SC = State Candidate
SS = State Sensitive
SPHS = State Priority Habitat Species

Source: The list of species being considered for coverage under the HCP was provided in "WDFW Hydraulic Project Approval HCP Exhibit B HPA Final Grant Proposal," which was distributed with the Request for Proposal for this analysis.

Note: Species listed by habitat type; within habitat type, species listed in alphabetical order by scientific name.

Although numerous articles were compiled from print and Internet sources as a result of the literature search, only some of the sources contained information on small-scale mining and the impacts on fisheries and other ecological resources. Many of the relevant articles investigated the use of small-scale suction dredges and the associated impacts on water quality, channel morphology, benthic macroinvertebrates, and fish. Most studies measured water quality parameters—commonly turbidity and total suspended solids (TSS) and occasionally heavy metals—and counted the number of macroinvertebrates upstream and downstream of suction dredge operations. Other impacts of small-scale mining, such as entrainment, stranding, impacts on spawning, substrate embeddedness[3], and changes in channel morphology, were also investigated.

Impact mechanism analyses were prepared using the compiled scientific information. A draft version of this white paper was reviewed by technical specialists on the consultant team, and submitted to WDFW for comments. The white paper was amended based on the comments provided by WDFW and the white paper was finalized.

[3] Embeddedness is the degree to which fine sediments surround coarse substrates on the surface of a stream bed.

4 ACTIVITY DESCRIPTION

In 1997, the Washington State Legislature passed Substitute House Bill 1565, which defined small-scale mining and prospecting and prohibited any requirement to obtain a written HPA before conducting small-scale mining and prospecting (WDFW 1999). The 1999 Gold and Fish pamphlet serves as the HPA permit for mining and prospecting activities that comply with the guidelines of the pamphlet. However, as described below, small-scale mineral prospecting activities that do not meet all of the requirements of the Gold and Fish pamphlet can be authorized under other HPA types (e.g., individual HPA or supplemental approval).

4.1 Definition of Small-Scale Mineral Prospecting

Small-scale mineral prospecting was defined in Substitute House Bill 1565 as the use of pans, non-motorized sluice boxes, concentrators, and mini-rocker boxes to discover and recover minerals. The bill also refers to any mining activity that complies with the most current version of the Gold and Fish pamphlet, such as suction dredging. Small-scale mining was defined in the bill only by the type of equipment used, without reference to the volume of material sorted, although the Gold and Fish pamphlet restricts operations of non-motorized sluice boxes, concentrators, and mini-rocker boxes to half of the wetted channel width during any one excavation. Specific mining techniques allowed by the 1999 edition of the Gold and Fish pamphlet include the use of small-scale mineral prospecting equipment, and additional equipment such as suction dredges, highbankers, and concentrators. These activities are defined below. In the context of this paper, all of the methods and equipment authorized by the Gold and Fish pamphlet are considered small-scale mineral prospecting.

Panning: The use of a handheld or motorized open, metal, or plastic dish to wash aggregate (WDFW 1999).

Sluice box: A trough equipped with riffles across its bottom that is used to recover gold and other minerals with the use of water (WDFW 1999).

Suction dredge: A machine equipped with an internal combustion engine or electric motor powering a water pump, which is used to move submerged bed materials by means of hydraulic suction (WDFW 1999). The bed materials are processed through an attached sluice box for the recovery of gold and other minerals.

Highbankers: A stationary concentrator capable of being operated outside the wetted perimeter of the water body from which water is removed, and which is used to separate gold and other minerals from aggregate with the use of water supplied by hand or pumping, and consisting of a sluice box, hopper, and water supply (WDFW 1999). Aggregate is supplied to the highbanker by means other than suction dredging. Highbankers exclude mini-rocker boxes.

Concentrator: A device used to physically or mechanically separate and enrich the valuable mineral content of aggregate. Examples include pans, sluice boxes, and mini-rocker boxes.

The Washington Administrative Code (WAC) establishes four classes of small-scale mineral prospecting based on the location and type of equipment used. These classes are defined in Table 2 per WAC 220-110-020.

4.2 Gold and Fish Pamphlet

The Gold and Fish pamphlet (attached for reference in Appendix A) provides an abundance of information, including:

- When the pamphlet qualifies as an HPA permit
- When an additional written permit is necessary
- A brief description of the impacts of small-scale mining on fish habitat
- Other agency requirements
- A glossary of terms
- Specific small-scale mining rules and regulations

The Gold and Fish pamphlet also provides directives to assist in minimizing effects, such as:

- Avoid disturbing fish eggs, fry, or freshwater mussels.
- Safely collect and return any fish entrapped in pools created during excavation.
- Cease operations when fish are observed in distress, a fish kill occurs, or water quality problems arise.
- Screen pump intakes.
- Do not conduct mining activities in streams and tributaries closed for spawning.

The Gold and Fish pamphlet provides additional guidance for conducting activities in a manner that is intended to minimize indirect effects, such as:

- Limiting excavations between the ordinary high water line (OHWL) and 200 feet landward.
- Maintaining 200 feet between excavations.
- Maintaining a 400-foot distance between excavations and fishways or fish hatchery intakes.

Each stream in Washington State has an allowable work window during which mining can occur. During the allowable period, specific mining techniques are restricted depending on the location within the stream channel (WDFW 1999). As summarized in Table 2, mining techniques are categorized by class, and the classes are restricted to different stream zones. Class 0 can be conducted above the water surface line, but below the OHWL; Classes I and II can be conducted anywhere below the OHWL; Class I can also be conducted 200 feet landward of the OHWL; and Class III can only be conducted 200 feet landward of the OHWL. Figure 1 (taken from the 1999 Gold and Fish pamphlet) illustrates the stream zones where various classes of mineral prospecting activities can occur.

Table 2
WDFW Classification of Small-scale Mineral Prospecting Activities

Classification	Authorized Mining Activities	Allowable Location of Activities	Allowable Timing of Activities
Class 0	Non-motorized pans	Above the water surface line, but below the OHWL	Jan 1 – Dec 31, unless designated as "submit application" or "closed"
Class I	Pans, non-motorized sluice boxes, concentrators, mini-rocker boxes	Below the OHWL; 200 feet landward of the OHWL	Restricted based on spawning and incubation timing, organized by county, stream, and tributary[1]
Special Class I	Pans, non-motorized sluice boxes, concentrators, mini-rocker boxes	200 feet landward of the OHWL	Generally, 2 to 3 months earlier than Class I, since it precludes in-channel work activity.
Class II	Suction dredges, highbankers	Below the OHWL	Restricted based on spawning and incubation timing, organized by county, stream, and tributary[1]
Class III	Highbankers, suction dredge/highbanker combinations, other concentrators	200 feet landward of the OHWL	Jan 1 – Dec 31, unless designated as "closed"

Source: WDFW 1999
OHWL – Ordinary high water line
1) See Table 5 for a listing of work windows by county

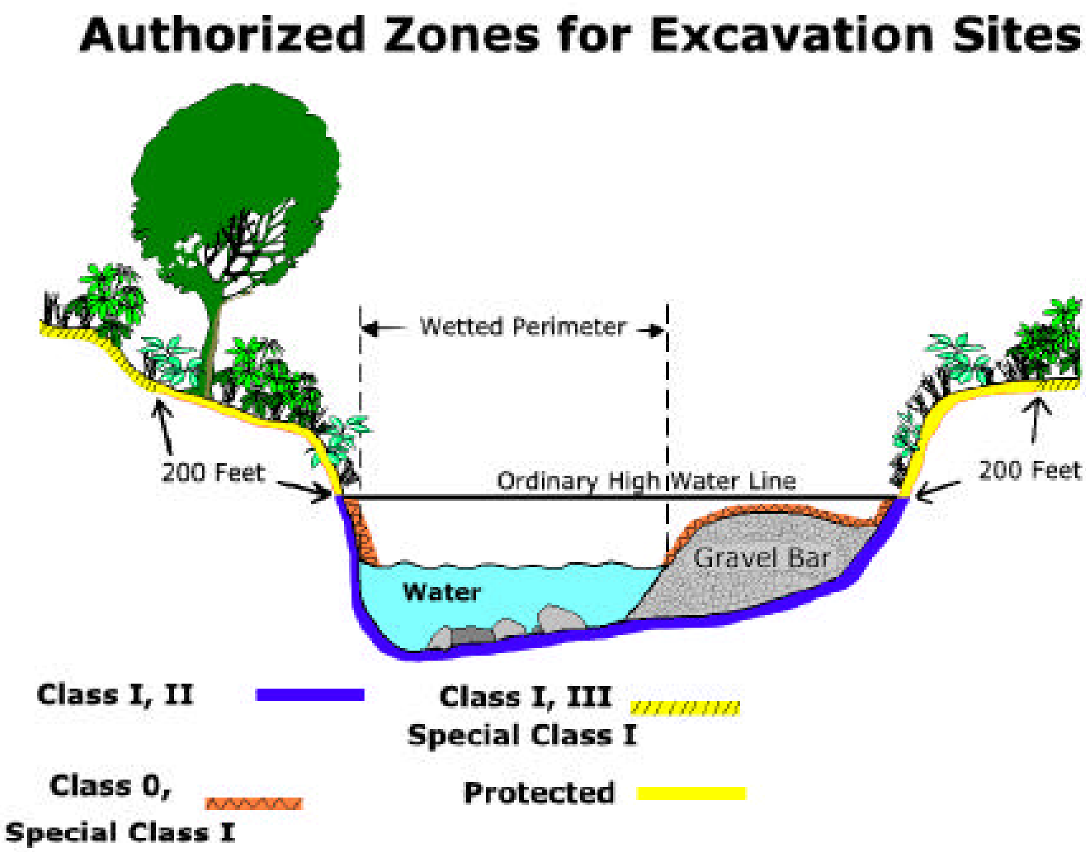

Figure 1 Stream Zone Locations of Various Classes of Small-Scale Mineral Prospecting Activities (Source: WDFW 1999)

4.3 Other HPA Permitting Options

When an applicant wishes to make a deviation from the Gold and Fish pamphlet HPA in location, method, timing, or work period, alternative approaches for obtaining HPA approval are available. At certain locations in the state, applications for site-specific, individual HPAs occur since use of the Gold and Fish pamphlet is precluded. Applicants may also apply for individual HPAs if the methods of prospecting, timing, or duration of the activity vary from the programmatic Gold and Fish pamphlet. For some areas, a supplemental approval to the Gold and Fish pamphlet can be obtained, rather than an individual HPA, for timing and location deviations associated with Class I and Class II mining activities. A supplemental approval can also be used in some areas for location deviations from the pamphlet for Class III mineral prospecting equipment.

4.4 Environmental Setting and Geographic Location of Small-Scale Mineral Prospecting Activities

Mineral prospecting activities conducted in compliance with the Gold and Fish pamphlet are not tracked by WDFW; therefore, there is incomplete documentation of the location and frequency of small-scale mineral prospecting activities. According to The Claim Post (http://www.theclaimpost.com), a website for mining enthusiasts, streams most likely to contain gold should exhibit the following four characteristics:

- The stream should be unregulated (free flowing/not dammed).
- The stream should be in a mineral-rich area.
- The stream should fall through enough elevation to cause sufficient churning in the spring flood.
- The stream path and rock formations should facilitate the deposition of dense minerals such as gold, platinum, lead, and iron.

Individual HPAs for mineral prospecting are tracked in WDFW's Hydraulic Project Management System and provide information on the location of small-scale mining activities that were authorized outside of the Gold and Fish pamphlet. Fifty-seven individual HPA permits granted in 2006 for activities not covered under the Gold and Fish pamphlet were reviewed. The 57 permits were applicable to 16 rivers or creeks in nine Water Resource Inventory Areas (WRIAs) in Washington State, as summarized in Table 3. Table C-1 (Appendix C) summarizes these permits by permit number, location, work period, work description, and number of work locations. Of the 57 permits, 36 were granted for extended work windows, 18 were granted for streams requiring an application as specified in the Gold and Fish pamphlet, two were granted for "other reasons,"[4] and it is unclear why one application was submitted.

[4] The "other reasons" were for an educational rally on the Similkameen River and to allow a suction dredge with a 5-inch nozzle instead of the 4-inch nozzle specified in the Gold and Fish pamphlet

Table 3
Distribution of Small-Scale Mineral Prospecting Activity in 2006

WRIA	No. of HPAs	Percent (%)
01 – Nooksack	7	12
04 – Upper Skagit	37	65
11 – Nisqually	1	2
17/18 – Dungeness/Elwha	2	3
27 – Lewis	6	11
39 – Yakima	2	3
49 – Okanogan	1	2
61 – Columbia River (Lake Roosevelt)	1	2
Total	**57**	**100**

Source: 57 individual HPA permits provided by WDFW.

It is interesting to note 37 of the 57 individual HPAs (65 percent) granted through September 18, 2006, were located in the upper Skagit watershed in the Ruby Creek drainage upstream of Ross Lake, along Slate, Bonita, Park, and Canyon creeks. These HPAs were related to 20 mineral claims (Oregon Mining Claim[5] Serial Numbers between 08340 and 158848). Each individual mining claim is a minimum of 20 acres and multiple-party claims can extend to a maximum of eight individuals, or 160 acres (The Claim Post 2006).

The majority of individual HPAs authorize the use of equipment in Classes 0, I, and II. Relatively few applications are for Class III methods of aggregate extraction (Table 4). It is assumed the distribution of equipment use is similar for activities conducted under the Gold and Fish pamphlet.

Table 4
Frequency of Authorized Equipment-Use Classes Based on WDFW Individual HPAs in 2006

Equipment	Class 0	Class I	Class II	Class III
No. Authorized	52	54	46	16
Percent of 57 HPAs	91%	95%	81%	28%

Note: HPAs often authorize more than one equipment-use class.

[5] This terminology is used by the Bureau of Land Management to refer to claims in both Washington and Oregon.

5 SPECIES AND HABITAT USE

The Gold and Fish pamphlet specifies work windows when small-scale mineral prospecting is allowed in each stream in Washington State. In general, small-scale mining is allowed between June 1 and September 30; specific work windows vary county by county and for specific streams. Table 5 summarizes each county's general work window and the WRIAs or watersheds included in each county. Appendix D provides a map of the WRIAs in Washington State. Potentially covered species present in each WRIA are listed in Table 6. The general work window applies to the majority of streams in the county except for those specifically excluded in the Gold and Fish pamphlet (Appendix A), which lists the stream-specific work windows. In addition, all tributaries within the boundaries of a national park are closed to mining activity year-round, and some rivers or creeks used by sensitive species may require an individual HPA.

Table 5
Classes I and II Small-Scale Mineral Prospecting General Work Windows and Potentially Covered Species by County

County	General Mineral Prospecting Work Windows[6]	Associated Water Resource Inventory Areas (WRIAs)
Adams	July 1 – Oct 31	34, 36, 41, 43
Asotin	July 1 – Oct 31	35
Benton	June 1 – Sept 30	31, 33, 36, 37, 40
Chelan	July 1 – Aug 15	4, 7, 39, 40, 44-50
Clallam	July 15 – Sept 30	17-20
Clark	July 1 – Sept 30	27, 28
Columbia	July 15 – Oct 31	32, 33, 35
Cowlitz	July 1 – Sept 30	23, 25-27
Douglas	July 1 – Oct 31	40-42, 44, 46, 47, 49, 50
Ferry	July 1 – Aug 31	51-53, 58-61
Franklin	June 1 – Sept 30	31, 33-36
Garfield	July 15 – Oct 31	35
Grant	July 1 – Oct 31	36, 41-44, 53
Grays Harbor	July 15 – Oct 31	14, 16, 21-24
Island	June 15 – Sept 15	2, 3, 5-8, 15
Jefferson	July 15 – Oct 31	6, 15-18, 20-22
King	July 1 – Sept 30	7-10, 12, 15, 38, 39, 45
Kitsap	July 15 – Oct 31	6, 8, 9, 15-17
Kittitas	June 1 – Sept 30	7, 36, 38-41, 45
Klickitat	Jul 1 – Sep 30	29-31, 37
Lewis	Jul 1 – Sep 30	11, 13, 23-26, 30, 38
Lincoln	Jun 15 – Oct 15	34, 41-43, 52-54, 58
Mason	Jul 15 – Oct 31	13-16, 21, 22
Okanogan	Jul 1 – Aug 15	4, 42, 47-53, 60
Pacific	Jul 1 – Sep 30	22-25
Pend Oreille	Jul 1 – Aug 31	55, 57, 59, 61, 62
Pierce	Jul 15 – Aug 31	10-13, 15, 26, 38
San Juan	June 1 – Aug 31	2
Skagit	July 1 – Sept 30	1,3-5, 47, 48
Skamania	July 1 – Sept 30	26-29
Snohomish	July 1 – Sept 30	3-8, 15, 45
Spokane	June 15 – Aug 31	34, 43, 54-57
Stevens	July 1 – Aug 31	54, 55, 58-62
Thurston	July 15 – Sept 15	11, 13-15, 22, 23
Wahkiakum	July 15 – Sept 15	23-25
Walla Walla	July 15 – Oct 31	31-33
Whatcom	July 1 – Sept 30	1, 3, 4, 48
Whitman	June 15 – Oct 15	34, 35, 56
Yakima	June 1 – Sept 30	10, 26, 27, 29-31, 37-40

[6] See Appendix A for a more complete description of work windows, including stream-specific work windows in each county.

Table 6
Range of Potentially Covered Freshwater and Anadromous Species

Common Name	Scientific Name	Water Resource Inventory Area*
Green sturgeon	*Acipenser medirostris*	22, 24, 25, 26, 27, 28
White sturgeon	*Acipenser transmontanus*	3, 22, 24-37, 40-42, 44-61 (Columbia and Snake rivers)
California floater (mussel)	*Anodonta californiensis*	30, 36, 37, 40, 47-49, 58, 59
Mountain sucker	*Catostomus platyrhynchus*	23, 26-33, 35-41, 44-46 (Columbia, Snake, and Yakima rivers)
Margined sculpin	*Cottus marginatus*	32, 35
Lake chub	*Couesius plumbeus*	48, 61; other locations unknown
Giant Columbia River limpet	*Fisherola nuttalli*	35, 36, 40, 47-49, 54, 57; other locations unknown
Great Columbia River spire snail	*Fluminicola columbiana*	35, 45, 48, 49; other locations unknown
Western ridged mussel	*Gonidea angulata*	1, 3-5, 7-11, 13, 21-42, 44-55, 57-62
River lamprey	*Lampetra ayresi*	1, 3, 5, 7-16, 20-40
Western brook lamprey	*Lampetra richardsoni*	1, 3, 5, 7-14, 16, 20-40
Pacific lamprey	*Lampetra tridentata*	1, 3, 5, 7-42, 44-46, 58, 61
Olympic mudminnow	*Novumbra hubbsi*	5, 7-14, 20-24, 26
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	1-5, 7-30
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	37-39, 44-55, 58-62
Pink salmon	*Oncorhynchus gorbuscha*	1, 3-5, 7-13, 16-19, 21
Chum salmon	*Oncorhynchus keta*	1, 3-5, 7--29
Coho salmon	*Oncorhynchus kisutch*	1-42, 44-48, 50
Redband trout	*Oncorhynchus mykiss*	37-40, 45-49, 54-57
Steelhead Trout	*Oncorhynchus mykiss*	1, 3-5, 7-12, 14, 15, 17-41, 44-50
Sockeye salmon	*Oncorhynchus nerka*	1, 3-5, 7-12, 16, 19-22, 25-33, 35-37, 40, 41, 44-50
Chinook salmon	*Oncorhynchus tschawytscha*	1-41, 44-50
Pygmy whitefish	*Prosopium coulteri*	7, 8, 19, 39, 47, 49, 53, 55, 58, 59, 62
Leopard dace	*Rhinichthys falcatus*	21, 26-41, 44-50
Umatilla dace	*Rhinichthys umatilla*	31, 36-41, 44-50, 59-61
Bull trout	*Salvelinus confluentus*	1-23, 26, 27, 29-41, 44-55 57-62
Dolly Varden	*Salvelinus malma*	1, 3, 5, 7, 17-22, 24
Longfin smelt	*Spirinchus thaleichthys*	Reported in 1 and 8; assumed in 3, 5-15, 22, 24 at mouths of rivers and streams
Eulachon	*Thaleichthys pacificus*	20-29 (mouths of major rivers)

* The distribution of all fish species in this table is based on WDFW GIS data submitted on CDs, WDNR (2006a) descriptions and visual examination of range maps published by Wydoski and Whitney (2003) with comparison to published maps showing WRIA boundaries. The distribution of all invertebrate species is based on narrative descriptions presented by the Washington Department of Natural Resources (WDNR 2006b). Please refer to Appendix D for a figure showing WRIA locations.

Note: Species listed in alphabetical order by scientific name.

Bull trout, spring and summer Chinook, and pink and sockeye salmon are the potentially covered fish species most likely to be influenced by small-scale mining activities during their spawning and incubation periods, if they are distributed in the areas where the Gold and Fish pamphlet allows small-scale mineral prospecting. The tail end of the fry emergence period from species spawning in the spring, such as steelhead, resident rainbow, westslope cutthroat trout, lamprey, sturgeon, and dace species, could also be exposed to small-scale mineral prospecting activities. Juvenile rearing life-history stages of fish species present during the summer could also be affected. Due to their lack of mobility, resident populations of the potentially covered shellfish species would similarly be exposed to such activities. Table 7 summarizes the habitat requirements of various life-history stages of the potentially covered species.

Table 7
Habitat Requirements of Potentially Covered Species

Common Name	Scientific Name	Habitat and Life Requirements[1]	Reproductive Timing[2]: Spawning, Egg Incubation, Emergence
Green sturgeon	*Acipenser medirostris*	Habits and life history not well known; found in all marine waters in Washington and in estuaries; spend much of life in marine nearshore waters and estuaries, returning to rivers to spawn; spawn in deep pools, substrate preferences unclear but are likely large cobbles, although range from sand to bedrock; reside in lower reaches of fresh water for up to 3 years; age at sexual maturity uncertain; feed on fishes and invertebrates (Wydoski and Whitney 2003; Nakamoto and Kisanuki 1995; Adams et al. 2002; Emmett et al. 1991)	Spawning: Spring Incubation and Emergence: Large eggs sink to bottom, weak swimmers (Kynard et al. 2005)
White sturgeon	*Acipenser transmontanus*	Found in marine waters and major rivers in Washington; in marine settings, adults and subadults use estuarine and marine nearshore, including some movement into intertidal flats to feed at high tide; some landlocked populations behind dams; seasonally use main channels and sloughs; juveniles also occupy boulder and bedrock substrate; prefers swift (2.6 to 9.2 feet per second) and deep (13 to 66 feet) water on bedrock substrate for spawning; juveniles feed on mysid shrimp and amphipods; large fish feed on variety of crustaceans, annelid worms, mollusks, and fish (Parsley et al. 1993; Wydoski and Whitney 2003; Emmett et al. 1991)	Spawning: April to July Incubation: Approx. 7 days Emergence: Approx. 7 days
California floater (mussel)	*Anodonta californiensis*	Freshwater filter feeder requiring clean, well-oxygenated water; declining through much of historical range; known to occur in Columbia and Okanogan rivers and several lakes; intolerant of habitats with shifting substrates, excessive water flow fluctuations, or seasonal hypoxia; fertilization takes place within the brood chambers of the female mussel; the fertilized eggs develop into a parasitic stage called glochidia; released glochidia attach to species-specific host fish; juvenile and adult mussels attach to gravel and rocks (Nedeau et al. 2005; Larsen et al. 1995; Box et al. 2003; Frest and Johannes 1995, In: WDNR 2006b)	Spawning: Spring Incubation: In brood pouch, duration unknown; glochidia attach to host fish during metamorphosis
Mountain sucker	*Catostomus platyrhynchus*	Distribution restricted to Columbia River system; found in clear, cold mountain streams less than 40 feet wide and in some lakes; prefer deep pools in summer with moderate current; juveniles prefer slower side channels or weedy backwaters; food consists of algae and diatoms (Wydoski and Whitney 2003)	Spawning: June and July
Margined sculpin	*Cottus marginatus*	Endemic to southeastern Washington; habitat is in deeper pools and slow-moving glides in headwater tributaries with silt and small gravel substrate; spawn under rocks in pools; prefer cool water less than 68 degrees Fahrenheit (F) (20 degrees Celsius [C]); avoid high-velocity areas; food is unknown (Wydoski and Whitney 2003; Mongillo and Hallock 1998)	Spawning: May to June Incubation and Emergence: Unknown
Lake chub	*Couesius plumbeus*	Bottom dwellers inhabiting a variety of habitats in lakes and streams; prefer small, slow streams; spawn on rocky and gravelly substrate in tributary streams to lakes; juveniles feed on zooplankton and phytoplankton; adults feed on insects (Wydoski and Whitney 2003)	Spawning: April to June, broadcast spawn

Common Name	Scientific Name	Habitat and Life Requirements[1]	Reproductive Timing[2]: Spawning, Egg Incubation, Emergence
Giant Columbia River limpet	*Fisherola nuttalli*	Also known as the shortface lanx; occupies fast-moving and well-oxygenated streams, specifically the Hanford Reach, Wenatchee and Methow rivers; found in shallow, rocky areas of cobble to boulder substrate; species feeds by grazing on algae and small crustaceans attached to rocks (Neitzel and Frest 1990, In: WDNR 2006b)	Unknown
Great Columbia River spire snail	*Fluminicola columbiana*	Also known as the Columbia pebblesnail and ashy pebblesnail; current range is restricted to rivers, streams, and creeks of the Columbia River basin; require clear, cold streams with highly oxygenated water; found in riffle pool on substrates ranging from sand to gravel or rock; graze on algae and small crustaceans (Neitzel and Frest 1990; Neitzel and Frest 1989, In: WDNR 2006b)	Unknown
Western ridged mussel	*Gonidea angulata*	Specific information on this species is generally lacking; reside on substrates ranging from dense mud to coarse gravel in creeks, streams, and rivers; found in a variety of flow regimes; species may tolerate seasonal turbidity but is absent from areas with continuous turbidity (WDNR 2006b)	Larvae generally attach to the gills of fish for 1 to 6 weeks; post-larval mussels "hatch" from cysts as free living juveniles to settle and bury in the substrate
River lamprey	*Lampetra ayresi*	Detailed distribution records not available for Washington; occupy fine silt substrates in backwaters of cold-water streams; larvae (ammocoetes) are filter feeders in mud substrates of cold-water streams; juveniles believed to migrate to Pacific Ocean several years after hatching; adults spend May to September in ocean before migrating to fresh water; adults attach to and feed on fish (Wydoski and Whitney 2003)	Spawning: April to July Incubation: April to July Emergence: 2 to 3 weeks after spawning
Western brook lamprey	*Lampetra richardsoni*	Found in small coastal and Puget Sound rivers and lower Columbia and Yakima river basins; spend entire life in fresh water; adults found in cool water (52 to 64 degrees F; 11 to 17.8 degrees C) on pebble/rocky substrate; ammocoetes inhabit silty stream bottoms in quiet backwaters; ammocoetes are filter feeders; mature adults do not feed (Wydoski and Whitney 2003)	Spawning: April to July Incubation and Emergence: Adhesive eggs hatch in 10 days
Pacific lamprey	*Lampetra tridentata*	Found in most large coastal and Puget Sound rivers and Columbia, Snake, and Yakima river basins; larvae (ammocoetes) are filter feeders in mud substrates of cold-water streams; juveniles migrate to Pacific Ocean 4 to 7 years after hatching; attach to fish in ocean for 20 to 40 months before returning to rivers to spawn (Wydoski and Whitney 2003)	Spawning: April to July Incubation: April to July Emergence: 2 to 3 weeks after spawning
Olympic mudminnow	*Novumbra hubbsi*	Occur in the southern and western lowlands of the Olympic Peninsula, the Chehalis River drainage, lower Deschutes River drainage, and south Puget Sound lowlands west of the Nisqually River and in King County; found in quiet water with mud substrate, preferring bogs and swamps with dense aquatic vegetation; feed on annelids, insects, and crustaceans (Harris 1974; Mongillo and Hallock 1999, In: WDNR 2006a; Wydoski and Whitney 2003)	Spawning: Late November to December Early March to mid-June Incubation: 9 days Emergence: 7 days after hatching

Common Name	Scientific Name	Habitat and Life Requirements[1]	Reproductive Timing[2]: Spawning, Egg Incubation, Emergence
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	NOAA Fisheries recognizes three Evolutionarily Significant Units (ESUs) in Washington: (1) Puget Sound; (2) Olympic Peninsula; (3) Southwestern Washington; coastal cutthroat trout exhibit resident (stays in streams), fluvial (migrates to rivers), adfluvial (migrates to lakes), and anadromous life-history forms; resident coastal cutthroat trout utilize small headwater streams for all of their life stages; coastal cutthroat trout are repeat spawners; typically rear in the natal streams for up to 2 years; juveniles feed primarily on aquatic invertebrates but are opportunistic feeders; utilize estuaries and nearshore habitat but has been caught offshore (Johnson et al. 1999; Pauley et al. 1988, In: WDNR 2006a)	Spawning: Late December to February Incubation: 2 to 4 months Emergence: 4 months
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	Subspecies of cutthroat trout; three possible life forms: adfluvial, fluvial, or resident; all three life forms spawn in tributary streams in the spring when water temperature is about 50 degrees F (10 degrees C); fry spend 1 to 4 years in their natal streams; cutthroat trout tend to thrive in streams with more pool habitat and cover; fry feed on zooplankton, fingerlings feed on aquatic insect larvae, and adults feed on terrestrial and aquatic insects (Liknes and Graham 1988; Shepard et al. 1984; Wydoski and Whitney 2003)	Spawning: March to July Incubation: April to August Emergence: May to August
Pink salmon	*Oncorhynchus gorbuscha*	Pink salmon is the most abundant species of salmon, with 13 stocks identified in Washington; pink salmon, the smallest of the Pacific salmon, mature and spawn on a 2-year cycle; opportunistic feeder in marine habitat, foraging on a variety of forage fish, crustaceans, ichthyoplankton, and zooplankton; will spawn in rivers with substantial amounts of silt; migrate downstream almost immediately after emergence, moving quickly to marine nearshore habitats where they grow rapidly, feeding on small crustaceans, such as euphausiids, amphipods, and cladocerans (Hard et al. 1996; Heard 1991, In: WDNR 2006a)	Spawning: August to October Incubation: 3 to 5 months Emergence: 3 to 5 months
Chum salmon	*Oncorhynchus keta*	NOAA Fisheries recognizes four ESUs in Washington: (1) Hood Canal summer run; (2) Columbia; (3) Puget Sound/Strait of Georgia; (4) Pacific Coast; little is known regarding their ocean distribution; maturing individuals that return to Washington streams have primarily been found in the Gulf of Alaska; usually found in the rivers and streams of the Washington coast, Hood Canal, Strait of Juan de Fuca, and Puget Sound; in the Columbia River basin, their range does not extend above the Dalles Dam; chum salmon rear in the ocean for the majority of their adult lives; at maturity, adults migrate homeward between May and June, entering coastal streams from June to November; chum fry feed on chironomid and mayfly larvae, as well as other aquatic insects; chum fry arrive in estuaries earlier than most salmon; juvenile chum reside in estuaries longer than most other anadromous species (Quinn 2005; Salo 1991; Healey 1982, In: Wydoski and Whitney 2003 and WDNR 2006a)	Spawning: October to December Incubation: 0.5 to 4.5 months Emergence: 6 months

Common Name	Scientific Name	Habitat and Life Requirements[1]	Reproductive Timing[2]: Spawning, Egg Incubation, Emergence
Coho salmon	*Oncorhynchus kisutch*	NOAA Fisheries recognizes three ESUs in Washington: (1) Lower Columbia River/SW Washington; (2) Puget Sound and Strait of Georgia; and (3) Olympic Peninsula; this species is found in a broader diversity of habitats than any of the other native anadromous salmonids; coho spend between 1 and 2 years in the ocean before returning to spawn; adult coho feed on invertebrates but become more piscivorous as they grow larger; spawning occurs in gravel free of heavy sedimentation; developing young remain in gravel for up to 3 months after hatching; coho fry feed primarily on aquatic insects and prefer pools and undercut banks with woody debris; coho rear in fresh water for 12 to 18 months before moving downstream to the ocean in the spring (Meehan 1991; Groot and Margolis 1991, In: WDNR 2006a; Wydoski and Whitney 2003)	Spawning: September to late January Incubation: 1.5 to 2 months Emergence: 2 to 3 weeks
Redband trout	*Oncorhynchus mykiss gairdneri*	Redband trout is a subspecies of rainbow trout found east of the Cascade Mountains; prefer cool water, less than 70 degrees F (21 degrees C), and occupy streams and lakes containing high amounts of dissolved oxygen; spawn in streams; food consists of Daphnia and chironomids as well as fish eggs, fish, and insect larvae and pupae (Busby et al. 1996; Wydoski and Whitney 2003).	Spawning: March to April Incubation: 1 to 3 months Emergence: 3 months
Steelhead	*Oncorhynchus mykiss*	NOAA Fisheries recognizes 15 ESUs of steelhead, seven of which occur in Washington; during their ocean phase of life, steelhead are generally found within 10 to 25 miles of the shore; steelhead remain in the marine environment 2 to 4 years; most steelhead spawn at least twice in their lifetimes; a summer spawning run enters fresh water in August and September, and a winter run occurs from December through February; escape cover, such as logs, undercut banks, and deep pools, is important for adult and young steelhead; after hatching and emergence, juveniles establish territories feeding on microscopic aquatic organisms and then larger organisms such as isopods, amphipods, and aquatic and terrestrial insects; steelhead rear in fresh water for up to 4 years before migrating to sea (McKinnell et al. 1997, In: WDNR 2006a; Wydoski and Whitney 2003)	Spawning: March to April Incubation: 1 to 3 months Emergence: 3 months
Sockeye salmon	*Oncorhynchus nerka*	WDFW recognizes nine sockeye salmon stocks in the state; of these, three are in Lake Washington and two in the Columbia River. Sockeye are found in the Snake and Okanogan, Lake Wenatchee, Lake Quinault, Lake Ozette, Baker River, Lake Pleasant, and Big Bear Creek drainages. Kokanee (landlocked sockeye) occur in many lakes, with the larger populations in Banks and Loon Lakes and Lake Whatcom and Lake Washington-Sammamish; spawn in shallow gravelly habitat in rivers and lakes and live in lakes 1 to 2 years before migrating to ocean; juveniles feed on zooplankton, adults feed on fishes, euphausiids, and copepods (Wydoski and Whitney 2003)	Spawning: August to October Incubation: 3 to 5 months Emergence: 3 to 5 months

Common Name	Scientific Name	Habitat and Life Requirements[1]	Reproductive Timing[2]: Spawning, Egg Incubation, Emergence
Chinook salmon (spring)	*Oncorhynchus tschawytscha*	NOAA Fisheries recognizes eight ESUs in Washington, of which three are spring runs; found in the rivers and streams of Puget Sound, including Hood Canal and the Strait of Juan de Fuca, the Pacific coast, and the Columbia River and its tributaries; some landlocked populations occur in Lake Washington, Lake Cushman, and Lake Roosevelt; spring-run Chinook return to fresh water between March and May and spawn first in headwater streams; Chinook exhibit one of two life-history types, or races: the stream-type and the ocean-type; stream-type Chinook tend to spend 1 or more years in freshwater environments as juveniles prior to migrating to salt water as smolts; ocean-type Chinook spend 3 months to 1 year in fresh water before smolting and migrating to estuarine or nearshore areas; spring Chinook are especially dependent on high water quality and good access to spawning areas as they move upstream during periods of lower flow and hold in rivers for extended periods of time before spawning; ocean-type Chinook are more dependent on estuarine habitats to complete their life history than any other species of salmon; Chinook generally feed on invertebrates, but become more piscivorous with age (Wydoski and Whitney 2003; Myers et al. 1998, In: WDNR 2006a)	Spawning: August to mid-September Incubation: 6 to 8 months Emergence: 6 to 9 months
Chinook salmon (fall)	*Oncorhynchus tschawytscha*	NOAA Fisheries recognizes eight ESUs in Washington, of which two are fall runs; fall types spawn in mainstem tributaries; see life history for spring-run Chinook salmon above (Wydoski and Whitney 2003)	Spawning: Late October to early December Incubation: 1 to 6 months Emergence: 6 months
Pygmy whitefish	*Prosopium coulteri*	In Washington, pygmy whitefish occur at the extreme southern edge of their natural range; pygmy whitefish were once found in at least 15 Washington lakes but have a current distribution in nine; most often occur in deep, oligotrophic lakes with temperatures less than 50 degrees F (10 degrees C); use shallow water or tributary streams during the spawning season; feed on zooplankton, such as cladocerans, copepods, and midge larvae (Hallock and Mongillo 1998, In: WDNR 2006a; Wydoski and Whitney 2003)	Spawning: July to November Incubation and Emergence: Unknown
Leopard dace	*Rhinicthys falcatus*	Within Washington, leopard dace currently inhabit the lower, mid, and upper reaches of the Columbia, Snake, Yakima and Similikameen rivers; utilize habitat on or near the bottom of streams and small to mid-sized rivers with velocities less than 1.6 feet/sec (0.5 meters/second); prefers gravel and small cobble substrate covered by fine sediment with summer water temperatures ranging between 59 and 64 degrees F (15 and 18 degrees C); juveniles feed primarily on aquatic insects, adult leopard dace consume terrestrial insects; little is known about leopard dace spawning habitat or behavior (Wydoski and Whitney 2003)	Spawning: May to July Incubation and Emergence: Unknown
Umatilla dace	*Rhinicthys umatilla*	Umatilla dace are benthic fish found in relatively productive, low-elevation streams; inhabit streams with clean substrates of rock, boulders, and cobbles in reaches where water velocity is less than 1.5 feet/second; juveniles occupy streams with cobble and rubble substrates; adults occupy deeper water habitats; food habits are unknown (Wydoski and Whitney 2003)	Little known of reproduction Spawning: Early to mid-July Incubation and Emergence: Unknown

Common Name	Scientific Name	Habitat and Life Requirements[1]	Reproductive Timing[2]: Spawning, Egg Incubation, Emergence
Bull trout	*Salvelinus confluentus*	Widely distributed in Washington; exhibits four life-history types – anadromous, adfluvial, fluvial, and resident; bull trout typically rear in their natal streams for 2 to 4 years, although resident fish may remain in these streams for their entire lives; multiple life-history forms occur together in the same water; young-of-the-year occupy side channels, with juveniles in pools, runs, and riffles; adults occupy deep pools; diet of juveniles includes larval and adult aquatic insects; subadults and adults feed on fish; bull trout in the nearshore ecosystem rely on estuarine wetlands and favor irregular shorelines with unconsolidated substrates (Wydoski and Whitney 2003; Goetz et al. 2004, In: WDNR 2006a)	Spawning: Late August to late December Incubation and Emergence: 4 to 6 months
Dolly Varden	*Salvelinus malma*	Species restricted to coastal areas and rivers that empty into them; species occurs sympatrically in streams in Olympic Peninsula; prefer pool areas and cool temperatures; spawn and rear in streams, may feed and winter in lakes; juveniles extensively use instream cover; ages 1 to 13 utilize beaches composed of sand and gravel; opportunistic feeders on aquatic insects, crustaceans, salmon eggs, fish (Leary and Allendorf 1997, In: Wydoski and Whitney 2003)	Spawn mid-September to November; hatch 129 days after fertilization
Longfin smelt	*Spirinchus thaleichthys*	Marine species that spawns in streams not far from marine waters; juveniles utilize nearshore habitats of a variety of substrates; juveniles feed on small Neomysis; adults feed on copepods and euphausiids; most adults die after spawning (Wydoski and Whitney 2003; Lee et al. 1980, In: Alaska Natural Heritage Program 2006)	Spawning: October to December Incubation and Emergence: Hatch in 40 days; larvae drift downstream to salt water
Eulachon	*Thaleichthys pacificus*	Eulachon occur from northern California to southwestern Alaska; occur in offshore marine waters and spawn in tidal portions of rivers; spawn in variety of substrates but sand most common; juveniles rear in nearshore marine areas; plankton-feeders eating crustaceans such as copepods and euphausiids; larvae and post-larvae eat phytoplankton, copepods; important prey species for fishes, marine mammals, and birds (Langer et al. 1977; Howell et al. 2001; Lewis et al. 2002; WDFW and ODFW 2001, In: Willson et al. 2006)	Spawning: During spring when water temperature is 40 to 50 degrees F (4 to 10 degrees C); eggs stick to substrate Incubation: Temperature-dependent, range 20 to 40 days Emergence: Larvae drift downstream to salt water

Note: Species listed in alphabetical order by scientific name.

[1]Comments related to distribution pertain only to the Washington portion of species distribution.

[2]Spawning is given as seasonal timing, when information is available. Incubation is the time elapsed between spawning and hatching. Emergence is the time elapsed between hatching and when juveniles enter the water column; as noted above where relevant, some hatchlings enter the water column immediately.

6 CONCEPTUAL FRAMEWORK FOR ASSESSING IMPACTS

The conceptual model developed by Williams and Thom (2001), and presented below as Figure 2, provides a simple but effective characterization of the link between potential impacts associated with small-scale mineral prospecting activities and the ecological functions supported by the habitat.

Figure 2
Conceptual Framework for Assessment

The process begins with an impact, which in this case would consist of activities authorized under a pamphlet HPA (i.e., Gold and Fish Pamphlet) or individual HPA for small-scale mineral prospecting. The impact will exert varying degrees of effect on the ecosystem's controlling factors (Williams and Thom 2001). Controlling factors are the physical processes or environmental conditions (e.g., flow conditions or wave energy) that control local habitat structure (e.g., substrate or vegetation). Habitat structure is linked to habitat processes (e.g., shading or cover), which are linked to ecological functions (e.g., refuge and prey production). These linkages form the "impact pathway" in which alterations to the environment associated with small-scale mineral prospecting can lead to impacts to the ecological function of the habitat for potentially covered species. Impact mechanisms are the alternations to any of the conceptual framework components along the impact pathway that can result in an impact to ecological function and therefore to potentially covered species.

The literature review conducted for this white paper identified seven impact mechanisms associated with the operation of small-scale mineral prospecting activities that could affect potentially covered species. Table 8 lists and describes the impact mechanisms evaluated in this white paper.

Table 8
Principal Impact Mechanisms Evaluated

Impact Mechanism	Description
Excavation/Entrainment	All physical disruption of the streambed and removal of organisms from their natural environment. This mechanism includes organism displacement.
Wading	Physical abrasion and crushing of organisms underfoot.
Substrate Modifications/Channel Hydraulics	Changes in substrate composition (grain size) or morphology that result when channel processes are altered by artificial means (e.g., excavation, deposition). This mechanism includes stranding.
Water Quality Modifications	Changes in water quality, primarily in turbidity but also in metallic and hydrocarbon toxins.
Channel Dewatering/Obstructions to Passage	Changes that result from altered flow, principally dewatering that occurs due to stream diversion during mining activities; or stranding of organisms due to dewatering, excavation, or placement of spoils. Influence of equipment, dams or diversion obstructions on migrating species.
Prey Base Alterations	Changes to food sources that impact aquatic organisms by altering their prey base
Human Disturbance	The potential for human disturbances (e.g., noise) along the channel during mineral prospecting activities to indirectly displace or disrupt the behavior of potentially covered fish species

7 DIRECT AND INDIRECT IMPACTS

Potentially covered species are vulnerable to adverse influences of mineral prospecting via certain impact mechanisms, as identified in Section 6. The following discussion describes the impact mechanisms and how each mechanism is linked to essential life-history traits or particular habitat requirements of potentially covered species.

The potential direct impacts of small-scale mining include both detrimental and beneficial impacts on spawning, plus impacts related to entrainment, wading, excavation and stranding, fish passage barriers, as well as habitat modifications affecting water quality, and channel morphology. Potential indirect impacts of small-scale mining include changes in macroinvertebrate communities, which may alter the food base for potentially covered species and the effects of human disturbances like noise on such species. Each of these mechanisms is addressed below.

There is an element of overlap among some impact mechanisms. For instance, aggregate excavation necessarily includes some elements of substrate modification and channel hydraulics. In the following impact analysis, such areas of overlap are identified by cross references.

A methodical review of the available scientific literature was conducted as described in Section 3. Literature sources reviewed and cited for each pathway are listed in Table 9. The majority of research concerning small-scale mineral prospecting and biological resources address various life histories of salmonid fishes. In cases where specific literature concerning the effects of small-scale mineral prospecting on potentially covered species was not located, research conducted either with other, similar species or by associated mechanisms was used as a surrogate. The text includes information when assumptions or extrapolations of this nature are used in the white paper.

Table 9
Summary of Small-Scale Mining Impact Citations Reviewed and Referenced

Impacts	References Reviewed	References Cited
Direct Impacts		
Excavation/Entrainment	North 1993; Griffith and Andrews 1981; Harvey and Lisle 1998; Hall 1988; Bernell et al. 2003	Griffith and Andrews 1981; Harvey and Lisle 1998
Channel Morphology	North 1993; Hassler et al. 1986; Harvey and Lisle 1998; Somer and Hassler 1992; Thomas 1985; Stern 1988; Konopacky Environmental 1996; Hall 1988; USFS 2004; USFS 2001	Stern 1988; Hassler et al. 1986; Hall 1988; Harvey 1986; North 1993; Thomas 1985;
Spawning Habitat	Hassler et al. 1986; Stern 1988; Harvey and Lisle 1999; Harvey and Lisle 1998; Hall 1988; Campbell 1979; Somer and Hassler 1992; Bernell et al. 2003; USFS 2000	Somer and Hassler 1992; Harvey and Lisle 1998; Harvey and Lisle 1999; Spence et al. 1996; Roberts and White 1992; Thomas 1985
Wading	Roberts and White 1992	Roberts and White 1992
Stranding		
Water Quality		
Turbidity	Prussian et al. 1999; North 1993; Hassler et al. 1986; Madej 2004; Ecology 2005; USGS 1997; Harvey 1986; Stern 1988; Konopacky Environmental 1996; Lloyd et al. 1987; Sigler et al. 1984; Campbell 1979; USFS 2004; Bernell et al. 2003; USFS 2001; Wagener and LaPerriere 1985; Harvey et al. 1982	Prussian et al. 1999; Ecology 2005; Stern 1988; Hassler et al. 1986; Bash et al. 2001; USFWS 2006; Harvey et al. 1982
Total Suspended Solids	Prussian et al. 1999; North 1993; Hassler et al. 1986; Ecology 2005; Somer and Hassler 1992; Thomas 1985; Stern 1988; Konopacky Environmental 1996; USFS 2004; Watters 1999; Bernell et al. 2003; USFS 2001; Wagener and LaPerriere 1985	Stern 1988; Hassler et al. 1986; Bash et al. 2001; USFWS 2006; Watters 1999
Metals	Prussian et al. 1999; North 1993; Ecology 2005; USGS 1997; Ecology 2004; Hall 1988	Prussian et al. 1999; Ecology 2005; USACE 1985; North 1993; USGS 1997
Fuel Spills	NMFS 2006o	NMFS 2006o
Indirect Impacts		
Prey Base Alterations	Prussian et al. 1999; North 1993; Hassler et al. 1986; Griffith and Andrews 1981; Harvey 1986; Harvey and Lisle 1998; Somer and Hassler 1992; Thomas 1985; Stern 1988; Konopacky Environmental 1996; USFS 2004; Bernell et al. 2003; Wagener and LaPerriere 1985; Harvey et al. 1982	Griffith and Andrews 1981; Prussian et al. 1999; Harvey 1986; Thomas 1985; Somer and Hassler 1992; Hassler et al. 1986; Spence et al. 1996; Harvey et al. 1982
Human Disturbance	NMFS 2006o	NMFS 2006o
Cumulative Effects	Harvey and Lisle 1998; Bayley 2003; Bernell et al. 2003; Harvey et al. 1982	Hassler et al. 1986; Harvey 1986; Prussian et al. 1999; Ecology 2005; Stern 1988; Harvey et al. 1982; Nelson et al. 1991

7.1 Excavation/Entrainment

All techniques used for small-scale mining (e.g., pans, sluice boxes, suction dredges, highbankers) involve excavating aggregate from the channel bed and sorting the materials to separate valuable minerals. Regardless of the method, such organisms as invertebrates, fish eggs, fry and larvae can become entrained during the process of excavating and sorting aggregate substrate. Entrainment of biological resources is likely a greater issue with suction dredging than with other techniques. Eggs, fry and larvae represent sensitive life stages and may be harmed through direct impact with the mining device during excavation or entrainment or indirectly affected by increased susceptibility to other stressors because of the physical displacement that results from entrainment in pumps, dredges, or shovels. As such, the manner, timing, duration, and extent of aggregate excavation are important factors in the magnitude of the impact.

Griffith and Andrews (1981) found 100 percent mortality of uneyed eggs and approximately 30 percent mortality of eyed cutthroat trout (*Salmo clarki*) eggs after their experimental entrainment through a dredge. This same study found 83 percent mortality of rainbow trout (*Oncorhynchus mykiss*) sac-fry after passage through a dredge. However, once the sac-fry "button up," they are less vulnerable to entrainment mortality. The authors found no mortality in underyearling brook trout (*Salvelinus fontinalis*) between approximately 1.5 and 2.5 inches (42 and 59 millimeters [mm]) in size and yearling brook trout and rainbow trout approximately 3.0 to 5.5 inches (80 to 140 mm) in size that were put through a dredge and observed for 48 hours. The authors concluded that fingerling trout (4 inches; ≥100 mm) would not normally be entrained since they can easily avoid a dredge intake velocity of 1 foot per second (30 centimeters per second). If fingerlings enter a dredge, Griffith and Andrews (1981) expected the fish would survive based on their study results.

Mortality can also result from the excavation and subsequent displacement of invertebrates, eggs, fry and larvae and the subsequent predation or unfavorable physiochemical conditions (Harvey and Lisle 1998). However, the impact has not been widely studied and may be difficult to research.

Excavation and entrainment of other potentially covered species have not been addressed in the scientific literature. It is possible any small organism or juvenile life-history stage residing in or on the streambed that lacks mobility and strong swimming capabilities could be entrained or displaced from its habitat. Surveys of invertebrate populations upstream and downstream of pre-and post mining activities offer an indirect assessment of entrainment and displacement losses. Refer to Section 7.6, *Prey Base Alterations*.

7.2 Wading

Mortality of sensitive life-history stages of potentially covered species such as eggs, fry, and larvae can also increase through the impacts of wading associated with mining operations. Mortality of salmonid eggs and fry increased as a result of wading associated with mining operations (Roberts and White 1992). The authors found that stepping on redds twice a day throughout the period of egg fertilization to fry emergence killed 83 percent of cutthroat trout eggs and pre-emergent fry. This study also found wading-related mortality was greatest during the eyed-egg and pre-emergent fry stages. When wading occurred during these stages, mortality was as high as 43 percent during a single wading experiment. However, if small-scale mining activities are avoided in spawning and incubation locations, then there would be little potential for impact from wading associated with small-scale mining.

The effect of wading on other potentially covered species has not been addressed in the scientific literature. It is possible adult shellfish that lack mobility or a juvenile life-history stage residing in or on the streambed that lacks strong swimming capabilities could be abraded or crushed during wading.

7.3 Substrate Modification / Channel Hydraulics

Small-scale mineral prospecting typically involves excavating stream bed sediments, often down to the bedrock, by lifting the alluvial (i.e., material previously transported by the stream) substrate out of the channel, putting it through the mining device, and discharging the material downstream. Dredging results in the sorting of substrates as mine tailings (the waste materials left after minerals are removed from the aggregate) are returned to the channel. Cobbles and boulders too large for the extraction method or dredge nozzle are often piled alongside the hole or on the bank; coarse sediments (mixture of small cobbles, large gravel, and sands) are deposited closest to the dredge; and fine sediments settle some distance downstream of the dredge (Stern 1988). As a consequence, suction dredging creates a pattern of holes and piles in and along stream channels. Dredged materials can also change channel morphology by filling pools downstream with tailings. The hole-and-pile patterns and filled pools may persist until the next high-flow event. Stream bed alterations are probably more long-lived on streams with controlled flows than on those with flushing flows (Harvey 1986; Stern 1988) and may have more of an impact in small tributaries where flows are not large enough to redistribute gravel (North 1993). WDFW anticipated such substrate modifications under the current Gold and Fish pamphlet, which does not allow the deposition of tailings in existing pools and requires that holes be filled and piles be leveled when a collection site is abandoned.

7.3.1 Excavation Holes

In a study of suction dredging impacts in Canyon Creek, California, mean dredge hole depth was 4 feet (1.2 meters) in 1984 and 5 feet (1.5 meters) in 1985 (Stern 1988). Approximately 9 percent of the holes and tailings observed in 1984 were still visible at the beginning of the next season. A study in Victoria, Canada, found similar hole sizes, with depths ranging from 2 feet (0.6 meter) to more than 6 feet (2 meters) (Hall 1998). Substrate changes in two California streams, as a result of small-scale mining activities, influenced macroinvertebrate density and diversity (Harvey 1986). The potential for stranding of juvenile and adult fish can occur when stream flows recede. The fish could become trapped either in depressions or along sloped tailing piles at or adjacent to the water's edge, where a potential exists for these zones to become dewatered and the fish exposed to predators. Limited scientific information is available regarding the effect of mineral prospecting on stranding, and no observations of stranding have been reported in the literature to date. The Gold and Fish pamphlet's requirement that all working pits and tailing piles be filled and leveled if a collection site is abandoned for more than 16 hours following in-channel work minimizes the potential for stranding and for subsequent substrate modifications.

7.3.2 Deposition of Tailings

Returning unused aggregate to the stream presents two potential pathways for changes in channel morphology: suspension and deposition. Fine sediment light enough to remain suspended in the water column can increase TSS concentrations and turbidity levels in the vicinity of the mining activity. These factors are addressed in the water quality summary in Section 7.4. Substrates heavy enough to settle on the streambed will gradually fall out of the water column depending on local changes in stream velocity patterns. Tailing deposits in and near the channel will be reworked by the stream flow and bed materials will be sorted from sequentially larger to smaller particle sizes in the downstream direction. The lens of material lying on the channel bed associated with tailing deposits also becomes thinner in the downstream direction as a function of grain size distribution. The benefit or impact of this material in the stream channel will depend upon the particle size and the depth of deposition.

The deposition of mine tailings can both enhance and interfere with spawning success. In some cases, mine tailings can benefit fish. The process of suction dredging generates piles of gravel that pass through the suction dredge. The piles are often composed of gravel-size fractions that are suitable for salmonid fish and lamprey spawning and can create additional spawning habitat in local sections of streams. Salmonid fishes have been documented to spawn in previously dredged areas (Hassler et al. 1986; Somer and Hassler 1992) and have been found to selectively spawn in tailings, even where sufficient natural substrate exists (Harvey and Lisle 1998). Given the loosely consolidated nature of these gravels, it is presumed fish find the digging and cleaning of tailing deposits easier than surrounding spawning habitat.

Although fish are known to use these materials for spawning, research has not been conducted on the subsequent recruitment of fry to the population from these redds. Given the loosely consolidated nature of the tailings, it has been postulated that spawning may be less productive and the tailings less stable than natural substrates, since they could be subject to scour before incubation is complete (Thomas 1985; Harvey and Lisle 1999). Harvey and Lisle (1999) found the net and maximum scour of Chinook salmon redds located on dredge tailings were significantly greater than the scour of redds on natural substrates. Dredge tailings may disproportionately influence fall spawners (salmon and native char[7]), because tailings are likely to be scoured, displaced, removed, or resorted as a result of ascending stream flows before the end of the incubation or emergence periods. Late fall-, winter-, or spring-spawning species may have fewer tailing deposits available for spawning as a result of freshets that rework and

[7] Bull trout; Dolly Varden

redistribute the deposits (Harvey and Lisle 1998). More information about the relative stability of tailings and their use for spawning is needed, and this aspect is identified in Section 10 as a data gap.

Whether natural or previously dredged sites are used for spawning, the successful incubation of embryos and development of fry can be influenced by small-scale mineral prospecting activities by means of fine sediment deposition within or over completed spawning sites. The movement of fine sediment can increase substrate embeddedness. By filling gravel interstices, fine sediments reduce intergravel water velocities and dissolved oxygen levels (Stern 1988). If sediment deposition occurs after spawning, this process can harm eggs and pre-emergent fry.

Fine sediment deposition can clog interstitial substrates, restrict water flow through the spawning nest and thereby reduce oxygen transfer and the flushing of metabolic waste products (e.g., ammonia). A lack of water exchange through a spawning nest has the potential to reduce survival and production of juvenile year-classes (Spence et al. 1996).

The likelihood that small-scale mineral prospecting will generate sufficient levels of sediment deposition to reduce survival and production of potentially covered species is a factor of the type of equipment used, timing and duration of the activity, location of the spawning area, grain size of the bed materials, and the concentration of activities. The National Marine Fisheries Service (NMFS) (2006o) reported that the anticipated average surface area of an excavation site for 18 permits in Lolo Creek, Idaho, averaged slightly more than 1,000 square feet (ft^2). At an excavation depth of 6 feet, the volume of material removed from the stream could lie in the range of 6,000 cubic feet (ft^3) per site. Distributed along a plume 350 feet in length,[8] this volume of material could provide a lens of sediment ranging from a couple of feet immediately below the collection site to less than an inch 350 feet downstream. Although local site and sediment conditions will vary widely, this approximation provides a conceptual view of potential downstream deposits. Excavations and subsequent deposition of aggregate spoils in a small tributary stream have a greater potential to influence local biological communities than on a large mainstem river simply based on the higher percentage of the channel influenced and the

[8] the maximum distance of observable sediment deposits in Big East Fork Creek, CA (Somer and Kassler 1992)

lower power of small channels to transport sediment compared to large streams (Thomas 1985; North 1993).

WDFW anticipated such substrate modifications and the current Gold and Fish pamphlet requests that small-scale mineral prospecting avoid disturbing fish eggs and fry and avoid streams closed for spawning purposes. The work windows identified in the pamphlet were designed to avoid prospecting activities during specific spawning and incubation periods in each watershed. Restricting activities to a distance of 200 feet from each other also assists in minimizing the influence of concentrated activities.

The dredging process can also change substrate embeddedness by filling interstitial spaces and pools with fine sediments downstream of the mining activities and reducing rearing habitat quality and quantity. Pools tend to accumulate sediment transported as bedload during low flows, when mining typically occurs (Harvey and Lisle 1998). Stern (1988) found that substrate embeddedness increased significantly from pre- to post-mining (using the Mann-Whitney U-test at a p-value of less than 0.05) in a study of suction dredge mining in Canyon Creek, California. Fine sediment filled gravel interstices and stream bottom roughness declined downstream of dredge areas (Hassler et al. 1986). Canyon Creek lacks aquatic vegetation, large organic debris, and riparian cover, and a change in the streambed substrate resulted in diminished quality of fish rearing habitat due to instream cover losses (Hassler et al. 1986). Harvey et al. (1982) found suction dredging changed the substrate in the American River, California, between 100 and 200 feet (30 and 60 meters) downstream of dredging operations. Sand composed approximately 25 to 40 percent of the substrate for a distance of 100 feet (30 meters) below the dredge where virtually no sand was present prior to dredging. Sand embedded the cobble, thereby reducing or eliminating habitat of some insect and fish species. In Butte Creek, California, the amount of sand at one location increased from less than 10 percent to greater than 60 percent after the occurrence of suction dredge mining (Harvey et al. 1982). The sand deposits in either of these cases were not observable the subsequent year, suggesting winter and spring runoff had mobilized and redistributed the sand. Although fine sediment layers increased along the bed in a Montana stream, Thomas (1985) found no significant changes in intergravel permeability. These results suggest the effects of substrate embeddedness on oxygen exchange, and therefore species viability, may vary. At least in some streams, the subsequent influence of the sediment on intergravel flow and gas exchange may be minimal. In all cases, the effects appear to be short in duration.

7.3.3 Channel Morphology

In this section, potential alterations to channel morphology resulting from mineral prospecting activities are explored with respect to stream bank modifications, removal of bed structure to channels, and channelization. Miller et al. (2001), a WDFW white paper, provides an overview of the geomorphic basis for and the principles of channel configurations and is incorporated herein by reference. Bolton and Shellberg (2001), also a WDFW white paper, provides a literature review of geomorphic controls on streams and the ecological effects of stream modifications. The Bolton and Shellberg (2001) review is also incorporated herein by reference.

Mining activities have the capability to influence stream banks, causing changes in channel morphometry that include loss of riparian vegetation and cover and discharge of fine sediments into the stream (North 1993). Stern (1988) found that mining of the stream bank, although not a permitted activity, occurred along some permitted excavation sites in California. Associated channel changes were evaluated in a study of 20 suction dredging operations in Canyon Creek, California, in 1984 and 15 operations in 1985 (Stern 1988). The results, shown in Table 10, suggest suction dredging operations have the potential to alter stream morphology and result in a risk of impacts to habitat for aquatic organisms.

The removal of rocks, stones, or wood debris too large to pass through the intake nozzle of a suction dredge results in the loss of habitat for instream organisms (Hall 1988). Removal of structure within the stream channel can have the following potential effects on the channel (Brookes 1988, in Bolton and Shellberg 2001):

- Channel shortened and steepened by straightening
- Increased stream power; more erosive scour forces
- Altered channel morphology to plane-bedded channel
- Channel loses the ability to meander over time

Channel roughness elements affect stream velocity by increasing boundary shear stress, thereby increasing resistance to flow (Leopold et al. 1964). The principal in-channel bed elements that provide roughness are large woody debris (LWD), rocks, boulders, and shoreline intrusions. Channel structures like wood and boulders increase channel roughness in a variety of ways that alter habitat, such as changes in roughness elements both in-channel and along the channel perimeter, or changes in the relationship between channel area and wetted perimeter.

Although not permitted activities, cutting and removing LWD from stream channels have the potential to occur during small-scale mining. Removal of channel structure, especially large key pieces embedded in the stream, can alter channel morphology and reduce the abundance of pool features (Montogomery and Buffington 1993; Fox 2001; WFPB 1997). Placement of wood debris, boulder clusters, and other structure to trap gravels, scour pools, and add complexity to channels is frequently used as a stream habitat enhancement technique (Abbe and Montgomery 1996). Removal of such structures would have a corollary effect of simplifying channels and reducing pool frequencies (Montgomery and Buffington 1993, 1997). The productivity and abundance of potentially covered species could be adversely influenced with such changes in channel morphology. Habitat complexity (opposite of uniformity) increases the density-independent survival in freshwater salmonid fishes (Lestelle et al. 1996).

Table 10
Unintended Channel Morphological Changes Associated with Small-Scale Suction Dredging in Canyon Creek, California

Year	Surveyed Dredging Operations	Undercut Banks	Channelized Waters	Riparian Vegetation Damage	Sluiced Upper Banks
1984	20 (100%)	5 (25%)	3 (15%)	5 (25%)	0 (0%)
1985	15 (100%)	7 (47%)	2 (13%)	2 (13%)	1 (7%)

Source: Stern 1988

Woody debris contributes to habitat conditions within freshwater environments (Naiman et al. 2002). Woody debris is important in controlling channel morphology, regulating the storage and transport of sediment and particulate organic matter, and creating and maintaining fish habitat (Murphy and Meehan 1991). Within streams, approximately 70 percent of structural diversity is derived from root wads, trees, and limbs that fall into the stream (Knutson and Naef 1997).

In small streams, LWD is a major factor influencing pool formation in plane-bed and step-pool channels. Bilby (1984, in Naiman et al. 2002) and Sedell et al. (1985, in Naiman et al. 2002) found approximately 80 percent of the pools in several small streams in southwest Washington and Idaho are associated with wood. Additionally, juvenile salmonid abundance in winter, particularly juvenile coho salmon, is positively correlated to abundance of LWD and pools (Nickelson et al. 1992a,b, 1993; Hicks et al. 1991). In large streams, the position of LWD strongly influences the size and location of pools (Naiman et al. 2002). LWD is typically oriented downstream in large streams, due to powerful streamflow, which favors formation of backwater pools along margins of the mainstem (Naiman et al. 2002).

Large woody debris provides cover and foraging opportunities for fish (Quinn 2005). The removal of woody debris in the aquatic environment can limit habitat complexity, foraging opportunities, and predator avoidance (Quinn 2005), thus reducing productivity and survival of potentially covered fish species (Lestelle et al. 1996).

Mining activities can also result in stream channelization (i.e., deepening and narrowing of the natural channel). Channelization can alter fish habitat by reducing channel complexity, increasing water velocity, removing cover, and changing riffle habitat in meandering stream reach morphologies to plane-bedded stream channels and runs (North 1993). Simplification of channels can reduce potentially covered species abundance in the stream network (Lestelle et al. 1996).

The effect of substrate modification on other potentially covered species has not been specifically addressed in the scientific literature. Lamprey species use channels in a similar fashion as salmonid fishes for spawning and incubation and are assumed to respond in a like manner to changes in substrate composition or channel morphologies. Shellfish vary with respect to their susceptibility to sediment deposition. Freshwater mussels, including the Western ridged mussel (*Gonidea angulata*) and the California floater (*Anodonta californiensis*), are different with respect to their attachment points in a stream, their fertilization and incubation processes, and, thus, their susceptibility to substrate changes. Adult and juvenile Western ridged mussels bury into substrate of mud to coarse gravel and tolerate seasonal deposition of small amounts of sediment (WDNR 2006a). Conversely, the California floater attaches to coarse gravel and rocks and requires clean, well-oxygenated water to prosper (Nedeau et al. 2005; Larsen et al. 1995; Box et al. 2003). It is assumed the California floater is less tolerant of sediment deposition than the Western ridged mussel. The Great Columbia River spire snail (*Fluminocola columbiana*) and the Columbia River limpet (*Fisherola nuttali*) feed by scraping algae and periphyton off rocks (Neitzel and Frest 1990). Based on their feeding strategy, these species are assumed to be sensitive to sediment deposition that would adversely influence productivity of algal communities. The following literature sources describe potential effects of sediment on similar mollusc and macroinvertebrate species. The effects on potentially covered invertebrate species are inferred based on similar life histories, feeding strategies, or habitat preferences as the species reported in the literature.

Modification of the stream bed by means of sediment deposits may have a profound effect on the benthic invertebrate community living on or within the stream bed (Waters 1995). Sediment deposits can potentially smother individual mussels and beds of mussels. Increased sediment can affect macroinvertebrate habitat by filling interstitial space and rendering attachment sites unsuitable. Sediment deposition may cause invertebrates to seek a more favorable habitat (Rosenberg and Snow 1975, in Henley et al. 2000). According to Birtwell (1999), macroinvertebrate abundance and composition have been strongly correlated with substrate embeddedness (the degree that stream bed particles are surrounded by fine material). At an embeddedness level of one-third, insect abundance can decline by about 50 percent, especially for riffle-inhabiting taxa (Waters 1995).

Freshwater mussels like the California floater and the Western ridged mussel are found in creeks and rivers in the Columbia River basin and have the potential to be exposed to mining activities. Mussel species living in flowing water usually prefer mud, sand, gravel, and cobble substrates (USFWS 2005). Changes in sediment bedloads can potentially harm mussel species. Sediment deposition can shift the bed characteristics from a sand/gravel/cobble bottom to a bottom overlain with silt, changing the relative abundance or types of mussel species (Ellis 1936; Watters 1999). In a laboratory study of the impacts of silt and sediment on 18 mussel species common to the Midwestern basins of North America, Ellis (1936) found up to 90 percent of the mussels perished when a layer of silt 0.25 to 1.0 inch (0.6 to 2.5 centimeters) deep was allowed to accumulate along the surface of an artificial stream. This experiment was monitored for more than one year. The study results demonstrated that the silt layer induced the observed mortality, as mussels were unable to maintain themselves under these conditions.

Species of freshwater mussels commonly thought to be tolerant of sediment conditions also showed depressed growth rates in muddy substrates (Box and Mossa 1999). It is possible the decline of sensitive mussel species across North America is due to the loss and degradation of clean riffle and run habitats (Henley et al. 2000).

Siltation is also detrimental to young mussels and reduces their survival (Scruggs 1960, cited in Tucker and Theiling 1998). Juvenile survival (even of hardy species) may be reduced in silt-impacted mussel beds, which can limit recruitment in the entire bed (Tucker and Theiling 1998). It is also understood that different mussel species show varying responses to fine sediment inputs (Box and Mossa 1999).

In summary, the available scientific literature suggests native mussels are particularly vulnerable to increased sediment deposition. Siltation and subsequent shifting and smothering of habitat are often cited as major factors in the decline of mussel biota. Therefore, small-scale mining activities that increase suspended sediment and silt deposits along stream channels can potentially impact the abundance of mussel species. Mussels may be at risk of poorly managed dredged sites if sediment deposits persist for extended periods (6 months to a year). The data from various suction dredge sites in the western U.S. vary with respect to the length of observed sediment deposits from sediments that are redistributed during first major freshet (Harvey and Lisle 1998) to silt layers that remain observable a year following suction dredging (Harvey 1986; Stern 1988).

7.4 Water Quality Modifications

Several studies document changes in turbidity or suspended solids concentrations resulting from mining activities. In a study that reviewed the impacts of large suction dredges in Fortymile River (Alaska) and small suction dredges in Resurrection Creek and Chatanika River (Alaska), turbidity increased downstream of dredge operations from 1 nephelometric turbidity unit (NTU) to 25 NTUs (Prussian et al. 1999). However, turbidity and total filterable solids declined rapidly downstream and returned to ambient values at a distance of 525 feet (160 meters).

Another study conducted by the Washington State Department of Ecology (Ecology) at three sites on the Similkameen River in Washington found that turbidity increased from background levels ranging between 0.8 and 4.3 NTUs to levels ranging from 10.0 to 12.0 NTUs at a distance 10 feet (3 meters) downstream of dredge operations (Ecology 2005). After 200 feet (61 meters), which is the minimum distance between dredge operations required by the Gold and Fish pamphlet, turbidity levels ranged between 1.4 and 5.2 NTUs, just slightly higher than background conditions at each site (Ecology 2005).

A study on Canyon Creek in California showed an increase in turbidity and TSS of two to three times the control values at 164 feet (50 meters) downstream of dredge operations, but documented a return to control values at 328 feet (100 meters) downstream (Stern 1988). Although suspended sediment and turbidity levels were higher than ambient levels immediately below the suction dredges, they did not approach levels that would damage gill surfaces of fish (Hassler et al. 1986). This study also noted improper mining practices, such as sluicing mine tailings into the stream, can raise turbidity up to 4 to 5 miles downstream.

Washington State water quality standards specify that turbidity: (1) shall not exceed 5 NTUs over background when the background turbidity is 50 NTUs or less or (2) shall not increase by more than 10 percent when the background turbidity is more than 50 NTUs (WAC 1997). Based on these criteria, the studies cited above have documented the potential for localized impacts of in-channel mining activities on the ability to meet water quality standards for turbidity. Based on the longitudinal turbidity profile information presented from the Similkameen River, Washington (Ecology 2005) and from Canyon Creek, California (Stern

1988; Hassler et al. 1986), turbidity exceedances of the water quality standards should be limited to a zone 30 feet downstream from the dredging operations. Very few of the turbidity samples exceeded 18 NTUs, the lowest observable level reported by Bash et al. (2001) as a sublethal influence on salmonid fish populations.

The literature results differ with respect to the magnitude and extent of turbidity plumes downstream of small-scale mining operations based primarily on the type of material dredged. Most suction dredge operations focus on locations where minerals would settle, which are often in shallow lenses over bedrock or in pockets of gravel and cobble. Harvey et al. (1982) observed that dredging bedrock pockets containing only sand and gravel caused virtually no change in turbidity, whereas dredging clay deposits and stream banks caused very noticeable turbidity increases. Excavations for mineral prospecting rarely occur in silt, which when disturbed can increase turbidity levels substantially compared to excavating in sands and gravels (NMFS 2006o).

7.4.1 Suspended Solids Impacts on Fish

Fish species have the ability to cope with some levels of suspended sediments and turbidity, as evidenced by the presence of juvenile and adult fish in local streams characterized by high natural levels of glacial silt, TSS, turbidity, and substrate embeddedness. Although quite high levels of turbidity are usually needed to induce acute fish mortality, researchers have determined that low levels of TSS and turbidity can cause chronic, sublethal effects such as "loss or reduction of foraging capability, reduced growth, resistance to disease, increased stress, and interference with cues necessary for orientation in homing and migration" (Bash et al. 2001).

Fine sediment has been recognized as detrimental to the reproductive success of salmonid fishes since the early 1920s (Harrison 1923). Bash et al. (2001) exhaustively reviews 40 years of research on the physiological and behavioral effects of turbidity and suspended solids on salmonids, with findings as briefly summarized below.

Physiological effects of suspended sediment on salmonid fish include gill trauma and altered osmoregulation[9], blood chemistry, reproduction, and growth. Most of the

[9] The act of regulating osmotic pressure to maintain water and mineral salt content in body fluids.

research we reviewed entailed laboratory studies. Stress response in fish was determined to be a result of the combination of duration, frequency, and magnitude of exposure and other environmental factors. Stress responses vary between salmonid species and life stages. Gills may become irritated by abrasive suspended sediments. Several laboratory studies have shown gill trauma and increased coughing frequency with increased turbidity. Other studies have shown impacts on osmoregulation during smolting in association with increases in suspended sediment (Bash et al. 2001).

The behavioral effects of suspended sediments on salmonid fishes are described by laboratory and field studies in the categories of avoidance and changes in territoriality, foraging, predation, homing, and migration. Salmonids appear to avoid areas of increased turbidity in laboratory and field studies. Some laboratory studies have shown a negative impact of increased turbidity on foraging, possibly due to reduced visibility, while other studies have shown a positive effect of increased turbidity on foraging, possibly due to reduced risk of predation. Laboratory and field studies have shown a link between increased turbidity and reduced primary production and prey availability. Field studies have indicated that while increased turbidity may delay migration, it does not seem to alter homing ability (Bash et al. 2001).

Additional studies support the assertion that water clarity affects fish behavior. Avoidance responses, changes in territorial behavior, feeding patterns and homing ability have been observed in association with increased turbidity levels (Sigler 1988). Avoidance responses of rainbow trout to suspended sediment have been observed at concentrations between 10 and 20 milligrams per liter (mg/L) (Wildish and Power 1985). Juvenile chum salmon, considered a species more tolerant of suspended sediment (Nightingale and Simenstad 2001), have also exhibited avoidance behavior in response to elevated turbidity levels (Salo et al. 1979). However, turbidity plumes that do not extend from bank to bank are not expected to significantly impact the behavior of migrating fish (Nightingale and Simenstad 2001).

Several NMFS biological opinions have been reviewed for their conclusions on potential water quality impacts to listed fish species. In all cases, sediment- and turbidity-related impacts comprised the overwhelming majority of discussion on water quality effects. In most of the cases reviewed, the magnitude, frequency, and duration of sediment pulses were expected to be similar to naturally occurring conditions during natural fluctuations in flow conditions, and few actively spawning fish species were predicted to be present during in-water work windows (NMFS 2006a, 2006f, 2006h, 2006i, 2006j, 2006k, 2006m, 2006n). NMFS found that elevated turbidity can cause direct mortality (NMFS 2006g), while sublethal threats include harassment since feeding patterns may be affected and fish are likely to avoid areas of increased turbidity (NMFS 2006d). Specific to small-scale mining, NMFS concluded potential increases in turbidity as a result of suction dredge activities in Lolo Creek, Idaho, would have negligible impacts on listed steelhead trout and their habitats (NMFS 2006o).

Based on the reviews of previous biological opinions described above, activities that allow considerable increases in suspended sediment have a high risk of incidental take of potentially covered fish species exposed to this condition. The risk of take increases in proportion to:

- The magnitude and duration of the impact
- The vulnerability of the affected life-history stage
- The inability of the organism to avoid the impact through avoidance behavior
- The physiological, developmental, and behavioral impairments suffered by the fish
- Indirect mechanisms such as exposure to predation

Conversely, low duration and magnitude increases in turbidity or suspended solids that fall within a range of naturally occurring ambient levels likely pose little risk for the potential of incidental take determinations.

In a review of the available literature on the topic, Bash et al. (2001) found some salmonid populations or life-history stages may be affected by relatively low levels of turbidity (18 to 70 NTUs). Bash et al. (2001) placed the effects of turbidity on fish into three categories: physiological, behavioral, and habitat-related, as follows:

- Physiological
    - Gill trauma

  - Osmoregulation[10]
  - Blood chemistry
  - Reproduction and growth
- Behavioral
  - Avoidance
  - Territoriality
  - Foraging and predation
  - Homing and migration
- Habitat
  - Reduction in spawning habitat
  - Effect on hyporheic[11] upwelling
  - Reduction in benthic invertebrate habitat
  - Damage to spawning sites

Monitored turbidity data downstream from suction dredging operations suggest suspended sediment levels could reach sublethal effect levels reported by Bash et al. (2001) between 18 and 70 NTUs. Usually, the zone of influence is small and the duration short, such that the effects might simulate the levels achieved during a natural precipitation event.

Information from the literature review also describes environmental factors that may modify the effects of sediment on fish, as listed below:

- Duration of exposure
- Frequency of exposure
- Toxicity
- Temperature
- Life stage of fish
- Type, size, and angularity of particles
- Severity/magnitude of plume
- Natural background turbidity
- Time of occurrence

[10] The act of regulating osmotic pressure to maintain water and mineral salt content in body fluids.
[11] The zone of hydrologic interchange between groundwater and surface water in stream channels.

- Other stressors and general conditions of biota
- Availability and access to refugia
- Size and gradient of stream

Refer to Bash et al. (2001) and USFWS (2006) for comprehensive discussions of the effects of fine sediment on salmonid fish species.

7.4.2 Suspended Solids Impacts on Invertebrates

Changes in suspended sediment conditions can also influence other organisms, such as invertebrate species like the potentially covered freshwater mussels, limpets, and snails. The limited mobility of many invertebrate species prevents avoidance from temporary pulses of increased suspended sediment loads. Deposition of the suspended sediment load can also alter streambed characteristics and, therefore, the type and abundance of invertebrates living in a channel. These effects have been addressed in Section 7.3, Substrate Modification / Channel Hydraulics.

Turbidity and suspended solids can affect macroinvertebrates in multiple ways through increased invertebrate drift, feeding impacts, respiratory problems, and loss of habitat (Cederholm and Reid 1987). In this section, the effects of suspended sediment on potentially covered invertebrate species like the sensitive molluscs (mussel, snail, and limpet species) are discussed. General effects of sediment on invertebrates important as prey items for fish and shellfish are addressed in Section 7.6, *Prey Base Alterations*, below.

Direct evidence of water quality effects of small-scale mining on mussel, limpet, and snail species is lacking. However, WDFW is conducting site-specific research on the influence of small-scale mineral prospecting activities on local mussel species. The results of the study effort will not be available prior to completion of this white paper (M. Daily, pers. comm., 2006). Given a direct lack of evidence, inference of potential effects based either on the life history characteristics of the potentially covered invertebrate species or other similar shellfish species is used for the balance of this section.

The potentially covered mussel species are filter feeders and are sensitive to inorganic particle sizes suspended in the water column. The Western ridged mussel may tolerate seasonal turbidity but is absent from areas with continuous turbidity (WDNR 2006b). Conversely, the California floater may be more sensitive to suspended sediment than the Western ridged mussel since the floater requires clean, well-oxygenated water. The Giant Columbia River limpet occupies fast-moving and well-oxygenated rivers. It is found in shallow, rocky areas of cobble to boulder substrate and feeds by grazing on algae and small crustaceans attached to rocks. The Great Columbia River spire snail requires clear, cold streams with highly oxygenated water. It is found in riffle pool on substrates ranging from sand to gravel or rock while grazing on algae and small crustaceans. These two gastropods might be sensitive to changes in primary productivity due to increased turbidity and depth of fine sediment accumulations in the substrate.

7.4.2.1 Feeding and Respiration Impacts

Increased suspended sediment can abrade the respiratory surface of macroinvertebrates and interfere with food uptake for filter-feeders (Birtwell 1999). Increased suspended sediment levels tend to clog feeding structures and reduce feeding efficiencies, which results in reduced growth rates, increased stress, or death of the invertebrates (Ellis 1936; Newcombe and MacDonald 1991). Invertebrates living in the substrate are also subject to scouring or abrasion, which can damage respiratory organs (Bash et al. 2001). Sediment can clog gills of mussels as well as host fish species (Bequart and Miller 1973).

Rivers with chronically high suspended solids concentrations were found to inhibit mussel growth. In laboratory experiments with 18 common species of Midwestern U.S. freshwater mussels, Ellis (1936) showed heavy silt loads interfered with feeding. Mussels remained tightly closed for 75 to 90 percent of the time in moderately silt-laden waters (light penetration of 2 to 4 feet) compared to mussels in silt-free water (light penetration unknown[12]) that were closed less than 50 percent of the time. In an attempt to determine the mechanism by which sediment exposure leads to mussel mortality, Aldridge et al. (1987) showed that exposure to TSS concentrations of 600

[12] Unreported; but the light penetration was likely between 20 and 100 feet, based on silt-free opacity of local rivers

to 750 mg/L[13] reduced rates of sediment clearance and nitrogen excretion and increased oxygen : nitrogen ratios in mussel species. The authors hypothesized that the effect of increased sediment exposure on mussels was starvation due to decreased filtration rates. This finding is consistent with the observation of extended periods where mussels maintain closed shells in turbid waters (Ellis 1936).

Suspended solids have a negative effect on the survival of freshwater mussels, reducing their ability to filter plankton and organic material from flowing waters. Increased levels of TSS/turbidity impair ingestion rates of freshwater mussels in laboratory studies. However, it has been suggested that survival may be species-specific (Box and Mossa 1999). Mussels compensate for increased levels of suspended sediment by increasing filtration rates, increasing the proportion of filtered material that is rejected and, under chronic turbidity loads, increasing the selection efficiency for organic matter (U.S. Environmental Protection Agency [USEPA] 2003). Many of the freshwater mussels have evolved in fast-flowing streams with historically low levels of TSS. These species may have difficulty actively selecting between organic and inorganic particles in the water column. Therefore, low levels of sediment may reduce feeding and, in turn, reduce growth and reproduction (USEPA 2003).

Respiration rates in mussels were inversely affected by turbidity levels up to approximately 20 NTUs, where they leveled off (Alexander et al. 1994). The authors concluded that increased turbidity levels may depress growth rates of mussels by increasing maintenance costs. Overall oxygen consumption rates declined significantly with increasing turbidity levels, but the relationship was not linear (Alexander et al. 1994). Oxygen consumption declined sharply in water with turbidity as little as 5 NTUs. By 20 NTUs, oxygen consumption was in the range of two-thirds to half the oxygen consumption of control mussels. At levels higher than 20 NTUs, further oxygen consumption declined only slightly and leveled completely beyond 80 NTUs. High concentrations of suspended materials can depress growth

[13] If site-specific ratios cannot be determined, the USFWS (2006) recommends using worst-case ratios of 4:1 or 5:1 to convert TSS to turbidity. As such, one could assume the referenced TSS levels would fall in the range of 120 to 190 NTUs.

rates by overloading the gut and gills with inorganic solids (Morton 1971, in Alexander et al. 1994).

Under chronic conditions, mussels may adapt to turbid water conditions by becoming more efficient in filtering undigestible inorganic particles from the gills (USEPA 2003). Thus, mussels may maintain a higher-than-normal metabolic rate in response to turbidity stress.

Evidence of physiological responses to increased turbidity among shellfish appears to be ambiguous. Some researchers have hypothesized that at low turbidity levels, resuspended chlorophyll may act as a food supplement, enhancing growth, while at high levels, food resources are masked by fine inorganic particles to the point of inhibiting growth (Nightingale and Simenstad 2001).

Although the feeding mechanism is different from the filter-feeding mussels, turbid waters also have an adverse influence on the feeding and respiration of gastropod snail and limpet species. Snails and limpets are grazers that feed by scraping algae, periphyton, diatoms, and organic detritus from the streambed surface. These algal communities form a nutritious biofilm on the rocks and cobble stream substrate. Low turbidity is essential for gastropod habitat, not only for available sunlight to reach the bed to stimulate primary productivity, but also because sediment-laden water will abrade and erode the biofilm (Stafford and Horne 2004). Sedimentation can inhibit algal growth and adversely influence snail grazing (Neves et al. 1997) and affect survival of eggs (Hart and Fuller 1974). Streams suitable for snails with gills must be relatively pristine, since high turbidity levels may injure or clog the snails' fragile gill tissue (ODEQ 2003). Due to these requirements, the Columbia pebblesnail is found only in the cold, clear streams of the Snake-Columbia River system (Hershler and Frest 1996; Neitzel and Frest 1990).

These snails are quite short-lived, usually reaching sexual maturity within a year, at which time they breed and die. Because about 90 percent of the population turns over annually, a disruption or disturbance can have long-lasting detrimental effects (ODEQ 2003).

The giant Columbia River limpet (*Fisherola nuttalli*) occurs in stream reaches that are relatively fast moving, clear, cold, and well oxygenated. This species feeds on algal cells and plant matter that are found among the rocks and pebbles underlying these streams. Because of these habitat requirements, the giant Columbia River limpet has been markedly affected by the shift in habitat in the Snake and Columbia rivers brought on with hydroelectric power development (Neitzel and Frest 1990). They are currently known to inhabit the Hanford Reach and Wenatchee and Methow rivers. No information was located in the available literature searches related to sediment effects on this species. Any approximation of effects for the limpet herein is therefore based on results from similar species, habitat characteristics, and our professional opinion.

Based on these studies, it appears likely that potentially covered mollusc species (including the Western ridged mussel, California floater, Columbia pebblesnail, and giant Columbia River limpet) are vulnerable to the effects of suspended sediment and have some risk from chronic exposure to suspended sediments. Thus, there is a risk that potentially covered shellfish and gastropod species could experience some level of incidental take due to increased turbidity downstream of suction dredge operations. However, minimization measures commonly required under the Gold and Fish pamphlet should limit the dispersion of sediment, and most small-scale mining activities will normally result in only temporary increases in turbidity commensurate with a natural precipitation event.

In their biological opinion, NMFS (2006o) expected both turbidity and suspended sediment to increase during suction dredge operations, but such increases were expected to be brief (i.e., only while the dredge engine is operating). Measured turbidities downstream of the dredges did not exceed 50 NTUs (D. Stewart, IDEQ, pers. comm., cited in NMFS 2006o). According to Waters (1995), brief low levels of elevated turbidity are likely to have little or no measurable effect on primary production. Suction dredges usually operate in areas with cobble substrate or bedrock seams, where high density, ore-bearing deposits are typically found. Consequently, particles typically suspended by suction dredges tend to settle rapidly, and sediment plumes typically do not extend far. NMFS concluded that the effects of habitat alteration should be minor, localized, and brief but could be of greater magnitude depending upon site conditions (NMFS 2006o). There is greater potential for higher levels of sediment inputs at some locations, such as dredging at the toe of unstable slopes.

Metal concentrations have also been found to increase during mining operations. Remobilization of metals entrained in the streambed can occur during dredging operations. In the study of Alaska rivers cited above, copper increased by five-fold and zinc increased by nine-fold downstream of the dredge; concentrations of these metals also declined at a distance of 260 feet (80 meters) downstream (Prussian et al. 1999). The Similkameen River study (Ecology 2005) also found increased concentrations of heavy metals downstream of small-scale dredge operations; both zinc and lead concentrations increased approximately 10 times above ambient levels. However, this study also calculated that at the 7-day consecutive 10-year (7Q10) low flow, it would take 50 or more continuously operating dredges to double the concentrations of heavy metals. This increase was not shown to result in exceedances of aquatic life criteria for the metals. As a result, the study concluded that small-scale gold dredges are not a significant toxicity concern for aquatic life in the Similkameen River (Ecology 2005).

A study in Colorado on the Arkansas River found that the fate of metals followed the pattern observed for sediments. As divalent cations, metals are typically adsorbed to the fine sediment particles. Concentrations of zinc and lead in excess of Colorado water quality standards were detected immediately downstream of small-scale dredge operations and continued to exceed water quality standards at 50 feet (15 meters) downstream (U.S. Army Corps of Engineers [USACE] 1985, in North 1993). It is important to note that this study was conducted in a hardrock mining area, which may help explain the high concentrations of metals.

A U.S. Geological Survey (USGS) study measured trace metal concentrations in Fortymile River, Alaska, downstream of suction dredge operations to investigate the potential additions of toxic elements (USGS 1997). This study found metal concentrations (arsenic, iron, chromium, cadmium, cobalt, zinc, and lead) equal to or lower than the regional average, suggesting suction dredging has no measurable effect on chemistry in the Fortymile River system. The Gold and Fish pamphlet requires that any mercury, lead, or other hazardous material collected during mining cannot be returned to waters of the state. Small-scale mining therefore has the potential to help reduce toxic contamination in the streams of Washington.

Based on the available research, it appears most of the recoverable metal concentrations are bound to the sediment and dissipate quickly when the fine sediment settles. Thus, peaks in metal concentrations in the streams are short in duration and the metals are generally unavailable to biological uptake. There is little evidence in the literature that changes in metal concentrations due to small-scale mineral prospecting are of sufficient magnitude or duration to have an adverse influence on aquatic life.

Water temperature has not been found to be affected by small-scale gold mining operations (Stern 1988; Hassler et al. 1986). Other water quality parameters such as alkalinity, hardness, or specific conductivity have also not been found to be affected by suction dredge operations (Prussian et al. 1999).

Mineral prospecting can also affect individual covered species and their habitat through potential water quality effects including increased risk of petroleum chemical contamination. Operations that include mechanized panning, water pumping for sluice boxes and concentrators, suction dredging, and highbanking have the potential risk of gasoline spills and equipment leaks, that can introduce hydrocarbons to the channel and adjacent riparian area. We have not performed an exhaustive literature search concerning the effects of petroleum products on potentially covered species for this white paper since the NMFS views any increase in hydrocarbon levels as a potential take of listed species or their habitats. The NMFS biological opinion for small-scale mining in the Lolo Creek drainage of Idaho includes provisions for minimizing the influence of petroleum products (NMFS 2006o). The purpose of these provisions is to control the potential discharge of contaminants resulting from fuel spills from finding a pathway to receiving waters. Similarly, the U.S. Environmental Protection Agency includes provisions for fueling, fuel storage, spill control planning and cleanup in their NPDES permit for medium-sized suction dredges in Alaska (USEPA 2005).

7.5 Channel Dewatering/ Obstructions

Temporary dams or water diversions can result in altered stream flows including dewatering a portion of the channel during water withdrawals when conducting small-scale mining operations. Channel dewatering is typically associated with an occasional preference to concentrate stream flow for water withdrawal operations. The impacts associated with channel dewatering include:

- Alteration of flow
- Disturbance of the stream bed
- Loss of habitat for some invertebrate and fish species
- Stranding and desiccation of organisms

Channel obstructions related to temporary diversion dams or mining equipment can also delay passage of fish species. Migration delay can lead to increased pre-spawning mortality. The Gold and Fish pamphlet restricts stream obstructions, water diversion, or channel dewatering to only that necessary to divert water to a Class I sluice box and in no case shall a dam or diversion exceed more than half the wetted channel width. The intent is to support a minimum of half a wetted channel width for fish passage. As such, the risk of take due to upstream passage delay of migrating fish is considered low.

Stranding of juvenile and adult fish or exposure of freshwater shellfish can occur when stream flows recede and the fish become trapped, dewatered, or exposed to predators if side channels or a portion of the main channel are diverted for mineral processing. Limited information is available regarding the effect of small-scale mineral prospecting on stranding. The Gold and Fish pamphlet’s requirements that: (1) dams and water diversion sites be restored to original conditions if a collection site is abandoned for more than 16 hours following in-channel work; and (2) any trapped fish be returned to the flowing stream, minimize the potential for take due to stranding.

7.6 Prey Base Alterations

Suction dredging may affect fish food availability. Certain groups of macroinvertebrates are favored by salmonids as food items. These include mayflies, caddisflies, and stoneflies.

These species prefer large substrate particles in riffles and are negatively affected by fine sediment (Everest et al. 1987; Waters 1995). Turbidity and suspended solids can affect macroinvertebrates in multiple ways through increased invertebrate drift, feeding impacts, respiratory problems, and loss of habitat (Cederholm and Reid 1987).

The effect of light reduction from turbidity has been well documented as increasing invertebrate drift (Waters 1995; Birtwell 1999). Drift may be a behavioral response associated with the night-active diel drift patterns of macroinvertebrates. While increased turbidity results in increased macroinvertebrate drift, it is thought that the overall invertebrate populations would not fall below a point of severe depletion (Waters 1995).

Sediment deposition can impair the growth and survival of organisms that are filter feeders or live on the substrate (Bash et al. 2001) by filling interstitial spaces needed for respiration and feeding. While the exact mechanisms are not known, it is clear that siltation causes changes in water flow through the gravel and results in a shift in algal and microbial communities (Tucker and Theiling 1998).

The concern for potentially covered species is an alteration to the food base of those species that depend on insect drift and of shellfish species that either filter the water column or forage on algae on the rock surfaces. As described in Sections 7.3 and 7.4, sedimentation can affect algal production and thus indirectly influence the limpet and snail species. Turbidity and TSS can also disrupt the filtering capacity of freshwater mussels.

Potential indirect impacts of small-scale mining include changes in macroinvertebrate communities, which may alter the food base for potentially covered species. Indirect impacts of small-scale mining include changes to prey communities. Several studies have investigated the impacts of suction dredging on benthic macroinvertebrates, including entrainment, changes in abundance, changes in taxonomic composition, and displacement. Limited research has been conducted on the impacts of entrainment on benthic macroinvertebrates. In a study on several streams in Idaho, over 3,500 macroinvertebrates were entrained during the collection of 12 ten-minute dredge samples using an intake diameter of 3 inches (7.6 centimeters). Less than 1 percent of the entrained invertebrates died or had severe injuries as a result of passing through the dredge (Griffith and Andrews

1981). Loss rates of this nature are unlikely to generate significant changes to the prey base of potentially covered species.

Many studies have investigated the impacts on benthic macroinvertebrate abundance and taxa richness, and most show some changes before and after mining activities. In general, the studies concluded that the impacts to benthic macroinvertebrates are localized and temporary. Macroinvertebrate populations recover rapidly (30 to 45 days) with the exception of long-lived species that might take up to a year to recover (Thomas 1985; Somer and Hassler 1992). The long-lived species are of interest since they are an indicator of habitat stability, but these species are generally not found in great abundance, compared to the short-lived opportunistic community types. A study conducted on Resurrection Creek and the Fortymile and Chatanika rivers in Alaska found no differences in macroinvertebrate density, taxonomic richness, EPT richness[14], or food resources between mining areas and downstream locations in Resurrection Creek during the mining activity (Prussian et al. 1999). However, the researchers detected a slight decrease in density at the Chatanika River site, as well as a decrease in abundance and diversity immediately downstream of dredging in the Fortymile River (Prussian et al. 1999). Benthic macroinvertebrate abundance decreased by 97 percent and taxa richness by 88 percent immediately downstream (0 to 33 feet; 0 to 10 meters) of a dredge operation in Fortymile River. However, the abundance and taxa richness values 262 to 525 feet (80 to 160 meters) downstream of dredging were similar to control values (Prussian et al. 1999). This study concluded that small-scale suction dredging caused only localized reductions in macroinvertebrate abundance.

A study on the impacts of suction dredging in two California streams also found changes in macroinvertebrate abundance as a result of small-scale gold mining (Harvey 1986). These differences were attributed to a change in substrate. Cobbles present before dredging were partially embedded with fine substrate immediately or soon after dredging and, as a result, macroinvertebrate abundance and taxa richness declined after seven days. However, 45 days after dredging there were no differences in macroinvertebrates between the dredged area and the control stations. This study confirms the temporary nature of the anticipated effect on benthic macroinvertebrates.

[14] EPT refers to intolerant invertebrate species of the orders Ephemoptera, Plecoptera, and Trichoptera. EPT taxa richness is used as an indicator to evaluate water quality.

A third study in a Montana stream similarly found fewer organisms in dredged areas (Thomas 1985). However, the author found the area was recolonized by the end of one month (Thomas 1985). A study on the Big East Fork Creek, California, found no significant differences in mean macroinvertebrate numbers or diversity indices over six weeks as a result of dredging (Somer and Hassler 1992). The displacement of benthic macroinvertebrates might also be considered a benefit because increased prey opportunities are introduced for fish and shellfish. Studies observed fish actively feeding on insects downstream of suction dredge sites (Hassler et al. 1986; Somer and Hassler 1992).

A fourth study focusing on suction dredging and food prey items in Big East Fork Creek, California, used artificial substrate to measure recolonization by aquatic invertebrates (Hassler et al. 1986). This study showed the response to dredging by aquatic invertebrates varied depending on the functional invertebrate feeding groups. Grazers and shredders were significantly more abundant above dredging and gatherers more abundant below, while no significant impacts were noted for filter feeders. Given a similarity in total abundance of aquatic invertebrates and the small differences in mean length and weight of juvenile steelhead trout collected during the study, it does not appear that suction dredge mining impacted the growth or production of steelhead populations during the study (Hassler et al. 1986). However, the authors concluded that impacts of dredging on individual fish could vary depending on specific site characteristics (Hassler et al. 1986).

Another macroinvertebrate study on the American River in California found the effects of dredging on invertebrates to be localized (Harvey et al. 1982). In nine of the ten sample sites, insect populations were lower 40 feet (12 meters) downstream of dredging sites than at the upstream control site, but populations again increased at stations 200 feet (60 meters) downstream. These results indicate the adverse effects on insect populations from suction dredge mining seen at 40 feet were generally not apparent at 200 feet.

In its biological opinion for 18 suction dredging permits in LoLo Creek, Idaho, on the Clearwater National Forest, NMFS concluded it was unlikely the amount or availability of fish food would change as a result of small-scale suction dredging in the creek because (1) a very small percentage of the stream bottom was affected and (2) almost all food of juvenile salmonid fishes is related to water column drift (NMFS 2006o).

Based on the scientific information generated to date with respect to individual small-scale suction dredge operations, the small-scale and brief nature of the anticipated reduction in invertebrate abundance is unlikely to have an adverse effect on feeding success of potentially covered species. This level of expected impact likely represents a low risk to potentially covered species.

For the most part, the reviewed invertebrate studies did not examine the impacts of continued activity during the season or the effects of cumulative impacts of multiple dredges. For a discussion of such potential cumulative effects refer to Section 8.

7.7 Disturbance

Information related to disturbance effects on potentially covered fish species was not located during the review. It is conceivable to assume that the presence of people and equipment over long periods could influence noise levels and indirectly displace potentially covered fish species. The influence of noise on salmonid fishes has been extensively reviewed in other HPA white papers prepared for WDFW, including the recent *Water Crossings White Paper* (Jones & Stokes et al. 2006). Research related to the amount of noise generated during small-scale mining activities is not available, so the anticipated influence on potentially covered species is speculative. Fish may stop feeding to seek cover, move to less desirable feeding locations, or intermittently suspend feeding due to repeated disruptions (NMFS 2006). Such behavioral changes could cause reduced growth rates in fish. Although the noises and movement of personnel associated with small-scale mining activities could offer negative effects on the feeding behavior of fish, NMFS, U.S. Forest Service (USFS), and mining industry personnel observed juvenile steelhead feeding within a few feet of the mining activity and often in the plume itself (NMFS 2006o). Noise and channel disturbances during in-stream activities under small-scale mining are anticipated to be low and the risk of such impact might fall under a mode of chronically low disturbance during the permitted period.

8 CUMULATIVE IMPACTS OF SMALL-SCALE MINERAL PROSPECTING

This section reviews available literature concerning cumulative impacts of multiple small-scale mineral prospecting activities occurring over time or at multiple sites in the same general geographic area. This discussion does not address the impacts of unrelated activities[15] on species or their habitats that may be a more watershed-dependent evaluation.

Cumulative impacts can result from small-scale mining in the same location for multiple years or from multiple mining operations occurring within an area. Nelson et al. (1991) imply the potential for cumulative effects depends upon the concentration of small-scale mining activities. Only a few studies have investigated the cumulative impacts of small-scale mining. A study of Canyon Creek, California, a stream with a range of flow between < 1 cubic foot per second (cfs) and 42 cfs, investigated the impacts of up to twenty-four 3- to 6-inch dredges operating along a 9.3-mile stretch of the creek (average of 2.6 dredges per mile; or nearly one dredge per 2,050 feet) during the 1984 dredging season (June 1 to September 15). The study found that, although infrequent, dredges operating within 0.31 mile (1,640 feet) of each other resulted in cumulative impacts on water quality (Hassler et al. 1986). This study did not provide specific information regarding the types or magnitude of the water quality impacts. We have assumed the anticipated effects resulted from changes in turbidity. All data presented in the study suggested turbidity levels remained below levels regarded as adverse sublethal impacts to salmonid fishes. A separate study in Butte Creek, California, a stream with an average streamflow of 7.2 cfs, found that operating six small dredges (nozzle diameter of < 6 inches) on a 1.2-mile stretch of stream (5 dredges per mile; approximately one dredge per 1,050 feet) had no additive impacts in terms of water quality, aquatic insects, and fish density (Harvey 1986). A study on the Yuba River that investigated the effects of suction dredge mining on a 6.8-mile (11-kilometer) stretch of river with approximately 40 dredges (5.9 dredges per mile; approximately one dredge in 900 feet) found no additive effects (Harvey et al. 1982). Further, a study of 59 stream reaches in Oregon's Siskiyou National Forest found no significant cumulative effects from suction dredging on total abundance of salmonids (Bayley 2003).

These studies suggest the risk of cumulative impacts resulting from multiple dredges is low, but in the absence of restrictions on the number of dredges operating within a stream, the potential

[15] Such as other management plans and policies and programs at the federal, state, and local levels that affect potentially covered freshwater species and their habitats.

for cumulative impacts remains. Little information is available on the cumulative impacts of dredging in the same location year after year. However, inter-annual cumulative impacts are not anticipated given peak-flow hydrological regimes of steep headwater streams, the localized impacts of small-scale mining (Prussian et al. 1999; Ecology 2005; Stern 1988), and the short time period (time to first freshet) documented in past studies for habitats to recover from small-scale mining activities (Thomas 1985; Somer and Hassler 1992; Prussian et al. 1999). Nonetheless, small stream size, degraded baseline habitat conditions, and the number of mining operations in a stream are all factors that might increase the likelihood of cumulative impacts from small-scale mining.

The geographic concentration of the individual HPAs reviewed for this white paper demonstrates the potential for significant portions of creeks to be mined and therefore highlights the importance of understanding or recognizing the potential for cumulative impacts to potentially covered species and their habitats. Thirty-seven of the 57 individual HPAs (65 percent) reviewed were located in the upper Skagit watershed in the Ruby Creek drainage upstream of Ross Lake, along Slate, Bonita, Park, and Canyon creeks. These HPAs were related to 20 mineral claims (Oregon Mining Claim[16] Serial Numbers between 08340 and 158848). Each individual mining claim is a minimum of 20 acres and multiple-party claims can extend to a maximum of eight individuals, or 160 acres (The Claim Post 2006). A total of 136 locations along Slate Creek supported the most HPAs during the 2006 season. Assuming 200 feet between each location, a total of 27,000 feet (5.1 miles) of Slate Creek, which is reported to be 14.1 miles in length, could be influenced annually. If each claim were mined to its full extent, then the concentration of small-scale mineral prospecting activity represents more than one-third of Slate Creek[17]. For the individual HPAs issued for the Upper Skagit River, Table 11 compares stream length to the stream distance potentially influenced by the mining activities.

[16] This terminology is used by the Bureau of Land Management to refer to claims in both Washington and Oregon.
[17] In the Ruby Creek drainage (Slate, Canyon, Bonita, and Park creeks), the only likely potentially covered species distributed in the vicinity of this area is the resident freshwater life history form of bull trout.

Table 11
Comparison of Stream Length to Stream Distance Influenced, Upper Skagit Tributary

WRIA 04 Upper Skagit Tributary	WRIA Stream Number	Stream Length (mi.)	2006 HPA Permitted Locations[1] (no.)	Stream Distance Influenced[2] (mi.)	Percent of Stream Length Potentially Influenced (%)
Slate Creek	04.2557	14.1	136	5.1	36%
Canyon Creek	04.2458	7.1	34	1.3	18%
Bonita Creek	04.2576	4.8	30	1.1	23%
Park Creek	04.2577	0.7	2	0.04	6%
Summary Statistics		**26.7**	**202**	**7.6**	**29%**

1 Individual HPAs permitted through September 18, 2006, which is near the likely end of the period during which permits will be requested and issued.

2 Assuming 200 feet between locations per HPA provisions.

9 POTENTIAL FOR TAKE AND QUALIFICATION OF RISK

The potential for incidental take resulting from the impact pathways discussed earlier is summarized for potentially covered species in Table 12. This table characterizes risk of take as Y (yes; potential for take), N (no potential for take), or U (unknown potential for take). These determinations are based on general consideration of the species distribution (only in terms of freshwater versus anadromous), habitat use (e.g., movements into mining areas during some life stage), habitat requirements (e.g., substrate preferences), prey resources (specifically related to habitat elements promoting their production), and water quality. The magnitude of the risk is highly dependent on how the impact is expressed. For species with no potential for take, no additional conservation measures would be required apart from those measures currently employed. For species where the potential for take is unknown, a lack of information on species life history or other data gaps identified in Section 10 precludes reaching a conclusion.

Table 12
Summary of Potential for Incidental Take of Potentially Covered Freshwater or Anadromous Species

Common Name	Scientific Name	Impact Mechanisms of Small-Scale Mineral Prospecting Activities: Excavation/Entrainment	Wading	Substrate Modification	Water Quality	Dewatering/Obstructions	Prey Items	Disturbance	Comments
Green sturgeon	*Acipenser medirostris*	N	N	Y	Y	N	N	U	Most vulnerable to projects that limit availability of deep pools and lead to scour of substrate holding incubating eggs
White sturgeon	*Acipenser transmontanus*	N	N	Y	Y	N	N	U	Most vulnerable to projects that limit availability of deep pools
California floater mussel	*Anodonta californiensis*	N	Y	Y	Y	Y	Y	N	Particularly vulnerable to burial, substrate modifications, and water quality impairment
Mountain sucker	*Catostomus platyrhynchus*	Y	Y	U	Y	Y	Y	U	Most vulnerable to projects that reduce the availability/accessibility of side channel or backwater habitats
Margined sculpin	*Cottus marginatus*	Y	Y	Y	Y	Y	Y	U	Particularly vulnerable to projects that impair water quality or reduce availability of sand and gravel substrate
Lake chub	*Couesius plumbeus*	Y	U	U	Y	Y	Y	U	Particularly vulnerable to projects that impair water quality, reduce availability of gravel substrate, or reduce availability of terrestrial insects
Giant Columbia River limpet	*Fisherola nuttalli*	Y	Y	Y	Y	Y	Y	N	Particularly vulnerable to burial, substrate modifications, water quality impairment, and high flows
Great Columbia River spire snail	*Fluminicola columbiana*	Y	Y	Y	Y	Y	Y	N	Particularly vulnerable to burial, substrate modifications, and water quality impairment
Western ridged mussel	*Gonidea angulata*	Y	Y	Y	Y	Y	Y	N	Particularly vulnerable to burial, substrate modifications, and water quality impairment. Also vulnerable if larva distribution on fishes is limited by habitat accessibility conditions.

Common Name	Scientific Name	Impact Mechanisms of Small-Scale Mineral Prospecting Activities: Excavation/Entrainment	Wading	Substrate Modification	Water Quality	Dewatering/Obstructions	Prey Items	Disturbance	Comments
River lamprey	*Lampetra ayresi*	Y	Y	Y	Y	Y	N	U	Particularly vulnerable to projects that impair water quality or reduce the availability/accessibility of backwater habitats and other areas with mud/silt accumulations
Western brook lamprey	*Lampetra richardsoni*	Y	Y	Y	Y	Y	N	U	Particularly vulnerable to projects that impair water quality or reduce the availability/accessibility of backwater habitats and other areas with mud/silt accumulations
Pacific lamprey	*Lampetra tridentata*	Y	Y	Y	Y	Y	N	U	Particularly vulnerable to projects that impair water quality or reduce the availability/accessibility of backwater habitats and other areas with mud/silt accumulations; species is often concentrated in extremely high numbers, therefore short-term lethal conditions (e.g., chemical spills or extremely high suspended solids) can affect large portion of population
Olympic mudminnow	*Novumbra hubbsi*	N	N	N	N	N	N	N	Particularly vulnerable to projects that impair water quality or reduce the availability/accessibility of quiet water habitats, such as bogs or swamps, with mud and dense aquatic vegetation
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Pink salmon	*Oncorhynchus gorbuscha*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Chum salmon	*Oncorhynchus keta*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Coho salmon	*Oncorhynchus kisutch*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Redband trout	*Oncorhynchus mykiss gairdneri*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Steelhead	*Oncorhynchus mykiss*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Sockeye salmon	*Oncorhynchus nerka*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Chinook salmon	*Oncorhynchus tschawytscha*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms

Common Name	Scientific Name	Impact Mechanisms of Small-Scale Mineral Prospecting Activities							Comments
		Excavation/Entrainment	Wading	Substrate Modification	Water Quality	Dewatering/Obstructions	Prey Items	Disturbance	
Pygmy whitefish	*Prosopium coulteri*	Y	Y	U	Y	Y	Y	U	Most vulnerable to projects that impair water quality or reduce the availability/accessibility of shallow water and tributary streams
Leopard dace	*Rhinichthys falcatus*	Y	Y	U	Y	Y	Y	U	Most vulnerable to projects that reduce the availability/accessibility of slow moving shallow water, decrease habitat structure used for refuge, or reduce prey availability
Umatilla dace	*Rhinichthys umatilla*	Y	Y	U	Y	Y	Y	U	Most vulnerable to projects that impair water quality; lack of information on food habits, precludes evaluation of impacts to prey availability
Bull trout	*Salvelinus confluentus*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Dolly Varden	*Salvelinus malma*	Y	Y	Y	Y	Y	Y	Y	Potential vulnerability via all impact mechanisms
Longfin smelt	*Spirinchus thaleichthys*	N	N	U	Y	N	N	U	Most vulnerable to projects that impair water quality and access to streams
Eulachon	*Thaleichthys pacificus*	N	N	Y	Y	N	N	U	Most vulnerable to projects that impair water quality and availability of sandy habitats in marine, estuarine, and lower rivers

When evaluating risk of take for habitat-modifying projects, including small-scale mineral prospecting activities, the federal agencies generally do not attempt to quantify the number of fish injured or killed because the relationship between habitat conditions and the distribution and abundance of those individuals in the action area is imprecise. Instead, the federal agencies tend to quantify the extent of anticipated take by measuring the amount of impacted habitat (e.g., length or area of the stream bed modified). No explicit take thresholds were identified during a review of biological opinions prepared by NOAA Fisheries (i.e., NMFS) and USFWS in recent years. However, it can be interpreted that by characterizing a project's incidental take based on the percent of available habitat in a given reach potentially disrupted, the federal agencies deem cumulative effects of multiple small-scale mineral prospecting operations as having a potential for some level of take.

For the purposes of evaluating the risk of take, the potential impacts were divided into two categories: those associated with suction dredging and those associated with all other prospecting activities permitted under the Gold and Fish pamphlet. Potential impacts associated with suction dredging are generally short term, e.g., habitat modifications, elevated suspended and settled solids, and noise levels. Many of the potential operational impacts can be avoided or minimized using BMPs or other conservation measures, such as those described in the WACs and RCWs pertinent to mineral prospecting and those described herein in Section 11. The potential risk of take associated with small-scale mineral prospecting activities will therefore be highly dependent on the measures taken to avoid or minimize impacts. Little information is available on potential thresholds based on the available literature presented in Section 7. The reviewed literature almost exclusively focused on impacts to salmonid fishes and bivalve molluscs.

An operation's size and location and the type of material excavated dictate the potential for and magnitude of take. As described above, NOAA Fisheries and USFWS generally characterize incidental take as the length or area of habitat impacted. In many cases, an evaluation of permit-specific impacts may conclude there are only small, incremental levels of take. However, small-scale mineral prospecting has the potential to generate considerable risk of take when the cumulative impacts of multiple permits are considered, and many of the potential impacts associated with small-scale mineral prospecting may be more evident in a cumulative impacts evaluation than in a permit-specific evaluation.

9.1 Evaluation of Gold and Fish Pamphlet Restrictions and Risk of Take

The 1999 Gold and Fish pamphlet does not provide detailed information concerning potential impacts, such as how to recognize and avoid fish spawning areas, how to recognize when impacts are occurring, or how violating the prospecting rules could affect aquatic organisms and their habitat. Similarly, the pamphlet does not incorporate specific references to support the discussion of potential adverse impacts. Literature support for specific numbers, distances, or intake screening dimensions used in the pamphlet as minimization measures is lacking. For the uninitiated, the pamphlet lacks clarity and the trail of thought is often not clear. Recommendations for updating the pamphlet are included in Section 11, *Habitat Protection, Conservation, Mitigation, and Management Strategies.*

9.2 Evaluation of Relative Risk of Take

All small-scale mineral prospecting activities have potential for some take, unless none of the potentially covered species occur in the project area, including the areas upstream and downstream that may be impacted by the operations. General guidelines regarding the project elements that contribute to making a small-scale mineral prospecting activity of "low," "moderate," or "high" risk are included in Table 13. These general categories are based primarily on the best professional judgment of the analysis team and go beyond the empirical data available in the literature. The categorizations are intended to be widely applicable to potentially covered species. However, it is possible that the categorizations will not be valid for all species, particularly those with less-known habitat and ecological requirements. Since much of the literature is based on impacts to salmonid fishes and mussel species, the categorizations are perhaps most applicable to the salmonids and the two potentially covered mussel species.

For a small-scale mineral prospecting activity to be low risk, it must meet all applicable requirements in the low-risk category, i.e., the project cannot have any moderate or high risk aspects. A separate row is provided in the table for suction dredge-related activities. The low risk conditions in this row must also be satisfied for a project to be considered low risk. In general terms, activities in the low-risk category appear to be well-suited for programmatic approval, whereas activities in the high-risk category would require consideration of project-specific elements (e.g., environmental setting, size, and extraction techniques) and present a clear need to implement conservation measures to reduce the risk of take. The appropriateness of programmatic approval of activities in the moderate-risk category is debatable and would depend in part on the use of conservation measures. The risk evaluation summarized in Table 13 assumes that potentially covered species are present when the described impact occurs. Thus, impacts may be avoided by performing the activities when or where covered species are absent.

Table 13
Summary of Risk of Take Related to Small-Scale Mineral Prospecting Activities

Activity	Risk of Take			Rationale and Assumptions
	Low	Moderate	High	
Panning (non-motorized)	• Project areas where the presence of any potentially covered fish or invertebrate species is documented and the panning activity coincides with their presence, but activity occurs in accordance with the Gold and Fish Pamphlet. • Activities that excavate aggregate more than 1 foot (ft) deep in gravel beds; but follow the Gold and Fish pamphlet requirement to avoid spawning sites or mussel beds.	• Activities that minimize the removal of native riparian vegetation, large woody debris (LWD), or small woody debris (SWD). • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. Impacts are minimized by recognizing the situation and terminating excavation in the sensitive area.	• Activities that do not minimize the removal of native riparian vegetation, LWD, or SWD • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. No minimization techniques are used.	Hand panning for mineral extraction is a low volume, relative quiet activity with a minimal amount of equipment and low risk of hydrocarbon releases. Low risk of entrainment of eggs, larvae, or fry life history stages of potentially covered species Moderate risk of wading effects unless redds are avoided. Low risk of channel bed modifications. Low risk of water quality modifications. Low risk of dewatering or passage obstruction effects. Low risk of influencing prey abundance. Low risk of human disturbances/noise. Although the activity under Class O is restricted to areas between the OHWL and the wetted surface, fish may have spawned in the gravel bed at higher stream flows than during the panning operation, offering a risk to excavating active redds between the wetted perimeter and OHWM. Salmonid fish eggs are typically buried beneath 8 to 15 inches of gravel depending upon the species and grain size of the available substrate. Median egg pocket depth is typically greater than 12 inches deep. Resident cutthroat with smaller and shallower redds in small streams may be at higher risk.
Panning (motorized)	• Allowable work windows based on tributary-specific species presence and periodicity data that avoid working during periods of species presence of migratory species (e.g., anadromous species) and/or species that move	• Allowable work windows based on general species presence information (e.g., statewide species distribution maps) and periodicity data that attempt to avoid working during periods of species presence for areas inhabited by only migratory species, (e.g.,	• Project areas where potentially covered invertebrate species presence is documented • Project areas where any potentially covered fish species presence is documented and the construction timing coincides with their	Motorized panning for mineral extraction is a slightly higher volume operation that includes mechanical equipment with a greater probability of channel disturbance than with hand panning. For this risk assessment, we assume water is supplied either by hand or by mechanical means and dewatering of portions of the channel does not occur. Low risk of entrainment of eggs, larvae, or fry life

Activity	Risk of Take			Rationale and Assumptions
	Low	Moderate	High	
	between habitats with some predictability (e.g., spawning runs from lakes to streams), • Activities that do not entail removing native riparian vegetation, LWD, or SWD • Activities that avoid the need for dewatering a portion of the channel • Activities that excavate aggregate more than 1 ft deep in gravel beds; but follow the Gold and Fish pamphlet requirement to avoid spawning sites or mussel beds.	anadromous species) and/or species that move between habitats with some predictability (e.g., spawning runs from lakes to streams), • Project areas where non-migratory potentially covered fish species presence is presumed, but not documented • Activities that minimize the removal of native riparian vegetation. LWD, or SWD • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. Impacts are minimized by recognizing the situation and terminating excavation sensitive area.	presence • Activities that do not minimize the removal of native riparian vegetation, LWD, or SWD • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. No minimization techniques are used.	history stages of potentially covered species. Moderate risk of wading effects unless spawning areas and mussel beds are avoided. Low risk of channel bed modifications. Low risk of water quality modifications, with the exception of a potential for introduction of hydrocarbons due to oil, grease or fuel releases from mechanical equipment. Low risk of dewatering or passage obstruction effects. Low risk of influencing prey abundance. Low to moderate risk of human disturbances/noise. Activity under Class I is restricted to areas below the OHWL and 200 ft landward of the OHWL. Fish could have spawned in the gravel bed at higher stream flows than during the panning operation offering a risk to excavating biologically active sites between the wetted perimeter and OHWM. Salmonid fish eggs are typically buried beneath 8 to 15 inches of gravel depending upon the species and grain size of the available substrate. Median egg pocket depth is typically greater than 12 inches deep.
Use of Sluice Boxes	• Allowable work windows based on tributary-specific species presence and periodicity data that avoid working during periods of species presence of migratory species (e.g., anadromous species) and/or species that move between habitats with some predictability (e.g., spawning runs from lakes to streams), • Activities that do not entail	• Allowable work windows based on general species presence information (e.g., statewide species distribution maps) and periodicity data that attempt to avoid working during periods of species presence for areas inhabited by only migratory species, (e.g., anadromous species) and/or species that move between habitats with some predictability (e.g., spawning runs from lakes to streams),	• Project areas where potentially covered invertebrate species presence is documented • Project areas where any potentially covered fish species presence is documented and the construction timing coincides with their presence • Activities that do not minimize the removal of native riparian vegetation • Activities that include	Sluice boxes entail a trough equipped with riffles across its bottom that is used to concentrate gold and other minerals by means of hydraulic separation. Water supplied to the head of the trough will sort the material by weight. This technique assumes water is supplied either by hand or by direct placement within the stream. Low risk of entrainment of eggs, larvae, or emergent fry life history stages of potentially covered species with hand application of water to the sluice box. Low risk of entrainment of eggs, larvae, or emergent fry life history stages of potentially covered species with water supplied to the sluice box.

Activity	Risk of Take			Rationale and Assumptions
	Low	Moderate	High	
	removing native riparian vegetation, LWD, or SWD • Activities that avoid the need for dewatering a portion of the channel • Activities that excavate aggregate more than 1 ft deep in gravel beds; but follow the Gold and Fish pamphlet requirement to avoid spawning sites or mussel beds.	• Project areas where non-migratory potentially covered fish species presence is presumed, but not documented • Activities that minimize the removal of native riparian vegetation • Activities that minimize the dewatered area and length of time, remove species from area prior to dewatering, and implement BMPs to minimize the addition of suspended solids. • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. Impacts are minimized by recognizing the situation and terminating excavation in the sensitive area.	dewatering a portion of channel and either do not remove species from area prior to dewatering or do not implement BMPs to reduce introduction of suspended solids • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. No minimization techniques are used.	Moderate risk of wading effects unless spawning areas and mussel beds are avoided. Low risk of channel bed modifications. Low risk of sedimentation of redds or covered invertebrates. Low risk of water quality modifications, with the exception of a potential for introduction of hydrocarbons due to oil, grease or fuel releases from mechanical equipment. Moderate risk of dewatering or passage obstruction effects. Low risk of influencing prey abundance. Low to moderate risk of human disturbances/noise. Activities under Class I are restricted to areas below the OHWL and 200 ft. landward of the OHWL. Fish could have spawned in the gravel bed at higher stream flows than during the prospecting operations offering a risk to excavating biologically active sites between the wetted perimeter and OHWM. Salmonid fish eggs are typically buried beneath 8 to 15 inches of gravel depending upon the species and grain size of the available substrate. Median egg pocket depth is typically greater than 12 inches deep. to 15 inches of gravel depending upon the species and grain size of the available substrate. Median egg pocket depth is typically greater than 12 inches deep.
Suction Dredging	• Allowable work windows based on tributary-specific species presence and periodicity data that avoid working during periods of species presence of migratory species (e.g., anadromous species) and/or species that move	• Allowable work windows based on general species presence information (e.g., statewide species distribution maps) and periodicity data that attempt to avoid working during periods of species presence for areas inhabited by only migratory species, (e.g.,	• Project areas where potentially covered invertebrate species presence is documented • Project areas where any potentially covered fish species presence is documented and the construction timing coincides with their	Suction dredging entails the use of a mechanical water pump which removes submerged bed materials by means of hydraulic suction. The bed materials are processed through an attached sluice box. Water pumped by means of suction could entrain small life history stages of sensitive species. It is possible portions of the channel could be dewatered to concentrate flow to the intake hoses.

Activity	Risk of Take			Rationale and Assumptions
	Low	Moderate	High	
	between habitats with some predictability (e.g., spawning runs from lakes to streams), • Activities that do not entail removing native riparian vegetation, LWD, or SWD • Activities that avoid the need for dewatering a portion of the channel • Activities that excavate aggregate more than 1 ft deep in gravel beds; but follow the Gold and Fish pamphlet requirement to avoid spawning sites and mussel beds. • Excavation sites are located in gravel, cobble or boulder substrates.	anadromous species) and/or species that move between habitats with some predictability (e.g., spawning runs from lakes to streams), • Project areas where non-migratory potentially covered fish species presence is presumed, but not documented • Activities that minimize the removal of native riparian vegetation, LWD, or SWD • Activities that minimize the dewatered area and length of time, remove species from area prior to dewatering, and implement BMPs to minimize the addition of suspended solids. • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. Impacts are minimized by recognizing the situation and terminating excavation in the sensitive area. • Excavation sites are located in sand substrates.	presence • Activities that do not minimize the removal of native riparian vegetation, LWD, or SWD • Activities that include dewatering a portion of channel and either do not remove species from area prior to dewatering or do not implement BMPs to reduce introduction of suspended solids • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. No minimization techniques are used. • Excavation sites are located in silt or clay substrates.	High risk of entrainment of eggs, larvae, or emergent fry life history stages of potentially covered species with water pumped from the channel to the sluice box. Moderate risk of wading effects unless spawning areas and mussel beds are avoided. Moderate risk of channel bed modifications. Moderate risk of sedimentation of redds or covered invertebrates. Moderate risk of water quality modifications (turbidity, metals, hydrocarbons due to oil, grease or fuel releases from mechanical equipment. Moderate risk of dewatering or passage obstruction effects if stream flow is concentrated to facilitate suction dredging/otherwise low risk. Low risk of influencing prey abundance. Moderate risk of human disturbances/noise. Activities under Class II are restricted to areas below the OHWL, such that channel banks cannot be suction dredged. Fish could have spawned in the gravel bed at higher stream flows than during the dredging operation, offering a risk to excavating biologically active sites between the wetted perimeter and OHWM. Salmonid fish eggs are typically buried beneath 8 to 15 inches of gravel depending upon the species and grain size of the available substrate. Median egg pocket depth is typically greater than 12 inches deep.
Highbanking / Mini-	• Allowable work windows	• Allowable work windows	• Project areas where	Concentrators include any physical or mechanical

Activity	Risk of Take			Rationale and Assumptions
	Low	Moderate	High	
Rocker Boxes / Highbanking Combinations / Other Concentrators .	based on tributary-specific species presence and periodicity data that avoid working during periods of species presence of migratory species (e.g., anadromous species) and/or species that move between habitats with some predictability (e.g., spawning runs from lakes to streams), • Activities that do not entail removing native riparian vegetation, LWD, or SWD • Activities that avoid the need for dewatering a portion of the channel • Activities that excavate aggregate more than 1 ft deep in gravel beds; but follow the Gold and Fish pamphlet requirement to avoid spawning sites and mussel beds. • Excavation sites are located in gravel, cobble or boulder substrates.	based on general species presence information (e.g., statewide species distribution maps) and periodicity data that attempt to avoid working during periods of species presence for areas inhabited by only migratory species, (e.g., anadromous species) and/or species that move between habitats with some predictability (e.g., spawning runs from lakes to streams), • Project areas where non-migratory potentially covered fish species presence is presumed, but not documented • Activities that minimize the removal of native riparian vegetation, LWD, or SWD • Activities that minimize the dewatered area and length of time, remove species from area prior to dewatering, and implement BMPs to minimize the addition of suspended solids. • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. Impacts are minimized by recognizing the situation and terminating excavation in the sensitive area. • Excavation sites are located in sand substrates.	potentially covered invertebrate species presence is documented • Project areas where any potentially covered fish species presence is documented and the construction timing coincides with their presence • Activities that do not minimize the removal of native riparian vegetation, LWD, or SWD • Activities that include dewatering a portion of channel and either do not remove species from area prior to dewatering or do not implement BMPs to reduce introduction of suspended solids • Activities that excavate aggregate more than 1 ft deep in gravel beds; but do not avoid spawning sites or mussel beds. No minimization techniques are used. • Excavation sites are located in silt or clay substrates.	devise used to concentrate the minerals for separation from aggregate. Highbanking includes the use of a shoreside concentrator wherein water, aggregate and minerals are separated with the use of water supplied by hand or pumping. The highbanker consists of a sluice box, hopper, and the water supply. Aggregate is supplied to the highbanker by any means. Highbankers exclude mini-rocker boxes. Water pumped from the channel could entrain small life history stages of sensitive species. It is possible portions of the channel could be dewatered to concentrate flow to the intake hoses. Moderate risk of entrainment of eggs, larvae, or emergent fry life history stages of potentially covered species with water pumped from the channel to the concentrator. Risk of wading effects varies depending upon where the aggregate is removed from the channel. Low risk if fish spawning and mussel beds are avoided. Moderate risk of channel bed modifications. Moderate risk of sedimentation of redds or covered invertebrates. Moderate risk of water quality modifications (turbidity, metals, hydrocarbons due to oil, grease or fuel releases from mechanical equipment. Moderate risk of dewatering or passage obstruction effects if stream flow is concentrated to facilitate the water supply. Low risk of influencing prey abundance. Moderate risk of human disturbances/noise. Activities under Class II and III are restricted to areas below the OHWL, and 200 ft. landward of the OHWL. Fish could have spawned in the gravel bed at higher

Activity	Risk of Take			Rationale and Assumptions
	Low	Moderate	High	
				stream flows than during the highbanking operation, offering a risk to excavating biologically active sites between the wetted perimeter and OHWM. Salmonid fish eggs are typically buried beneath 8 to 15 inches of gravel depending upon the species and grain size of the available substrate. Median egg pocket depth is typically greater than 12 inches deep.

The risk of taking potentially covered species varies depending on the type, extent, and duration of mining impact, the size of the stream relative to the type and extent of mining activity, the presence or absence of the species within the mining area, and the life-history stages present when mining activities occur. The potential for take of potentially covered species as a result of small-scale mining is expected to be greatest in locations immediately adjacent to shellfish beds and adjacent to or during periods of fish spawning and incubation. During spawning, eggs and young life-history stages of fish are susceptible to mortality caused by entrainment, displacement, sediment deposition, dewatering, or the physical impacts of wading. Direct mortality can result from entrainment when eggs, larvae or emergent fry pass through the dredging device, when a prospector steps on a redd, or when a redd is excavated with a shovel. The risk of mortality is also high during the incubation period as a result of egg or fry displacement from excavation. As such, the risk of take is increased when bed excavation is extreme and occurs adjacent to shellfish beds or during fish spawning periods near potential spawning areas. The Gold and Fish pamphlet requires prospectors to avoid shellfish beds and fish spawning areas. The risk of take to these species would occur only if operators did not understand they were excavating in a spawning or shellfish bed. Although fish stranding due to changes in channel morphology could result in mortality, the risk of take due to stranding is considered low based on the lack of evidence of stranding in prior studies and Gold and Fish pamphlet guidelines that require the filling of pools and leveling of piles.

Allowable work windows specified in the Gold and Fish pamphlet span anywhere from June 1 to October 31, depending on the specific timing for various streams or basins within a county. Most work windows focus on the period between July 1 and September 30 (refer to Table 5) based on the presence and life history timing of potentially covered fish species. Because of the potential overlap between fall spawning fish and permitted mining activities, small-scale mining is most likely to impact several life-history stages of fish, including spawning, egg incubation, adult migration, and emergence of early fall-spawning salmon and char species. It is also possible that the eggs and alevins (a developmental stage between eggs and fry) of late spring-spawning trout species, such as westslope cutthroat trout, rainbow/steelhead trout, as well as whitefish and lamprey species, could remain in the gravel during work windows. Egg incubation life-history stages of non-salmonid fishes like sturgeon, sucker, dace, and chub could also be potentially exposed to activities during the work window. Take of these species is most likely to occur as a result of direct physical impact (wading, excavation)), sedimentation of redds, or entrainment during the overlap of small-scale mining activities and species presence. The relative level of risk is directly related to species presence. If present in the excavation area, non-salmonid fishes such as sturgeon, sucker, dace, chub, and lamprey deposit eggs on the surface of the stream bed or slightly buried in sand and gravel substrates. The risk that developing eggs or emergent fry of these non-salmonid fish species could be adversely affected by small-scale mineral prospecting activities during the month of July is moderate to high. Although the Gold and Fish pamphlet is designed to avoid peak spawning and incubation periods as much as practical, overlap occurs between the timing of allowable mining activities and incubation/emergence periods for various potentially covered species (Table 7).

Mining can also impact late fall-spawning species such as chum, coho, and pink salmon, and take of these species can result if work windows extend to October or if spawning occurs on unstable mine tailings, which can wash away later in the incubation period during high flows. Anadromous species with year-round life-history stages (e.g., coho salmon, steelhead trout, char, sturgeon, lamprey), resident fish species (e.g., rainbow, cutthroat, or bull trout, Western brook lamprey, leopard dace), and freshwater invertebrates (e.g., mussels, snails, limpets) will also be exposed to in-channel activities.

Changes to water quality can adversely influence the egg incubation process or create acute or chronic toxic conditions for fish and shellfish. Potential causes of incidental take include impacts attributable to increases in turbidity and TSS. These impacts include indicators of major and minor physiological stress, habitat degradation, and impaired homing behavior. The effects at TSS levels normally observed during mineral prospecting activities are sublethal, but are still considered take under the ESA (NMFS 2006b).

Changes in TSS can adversely impact freshwater mollusc species, such that water quality degradation can be considered take. Assuming that the current mining rules are followed, however, the risk of take from changes to water quality is considered low to moderate. The majority of studies have shown that changes to water quality are temporary and modifications are most likely to occur in a localized area (within 30 feet) downstream of the mining activity. Moderate risk of take is more likely in areas of concentrated levels of activity or in small streams.

Take can also occur as a result of mining impacts on the prey base. The majority of research studies have shown only temporary (30 to 45 days) and localized impacts on the density and taxonomic distribution of benthic macroinvertebrates as a result of small-scale dredging. Therefore, the risk of take as a result of changes in food sources is considered low.

In addition, take can occur as a result of changes to channel morphology and habitat conditions. Such activities as excavation, deposition of tailings, discharge of fine sediment, subsequent sediment deposition and filling of downstream pools, streambank modifications, removal of bed structure (LWD and large bed elements such as boulders), and loss of riparian vegetation or instream cover could result in simplifying, straightening, and steepening channels, developing plane-bedded streams and shifting stream bed composition. The productivity and abundance of potentially covered species could be adversely influenced with such habitat changes (Refer to Section 7.3, *Substrate Modification / Channel Hydraulics*). The risk of take associated with changes to channel morphology is difficult to quantify, because risk will vary depending on the channel type. Most studies suggest minor impacts to channel morphology, but impacts can be substantial in small streams, streams with a high concentration of fines, or streams where small-scale mining activity is concentrated. Therefore, the risk of take of potentially covered species due to morphological channel changes from mining impacts is considered low, except for small streams, streams with a high concentration of fines, and streams where small-scale mining activity is concentrated; in these situations, the potential for take is moderate.

Most of the scientific literature addresses suction dredge operations and, clearly, such operations involve the highest risk to potentially covered species (Table 13). Although other small-scale mineral prospecting extraction methods involve the removal of water and aggregate from the channels and the return of tailings to the stream bed, the volume of material processed is typically far less than the material removed during suction dredging. The in-channel disturbance of sediments during suction dredging generates turbidity plumes of higher magnitude and longer duration than the other extraction methods.

Based on location in or near the stream channel and the type of equipment used in excavating and processing aggregate, the relative risk of potential for take associated with various classes of small-scale mining activities can be summarized for each of the activity classes as follows:

Class 0 < Class III < Class I < Class II

Activity Classes 0 and III generally represent a low relative risk of potential take based on either the non-motorized panning techniques in the case of Class 0 or the 200 foot distance landward of the OHWM in the case of Class III activities, while Classes I and II offer a more moderate risk of take. None of the activities is regarded as a high risk of take unless: (1) the excavation activity occurs in direct proximity of fish spawning or mollusc beds and the operator does not follow the current version of the Gold and Fish pamphlet or (2) the excavation occurs in silt or clay or involves dewatering a portion of the channel and the prospector does not follow BMPs related to species removal and sediment minimization prior to dewatering. In its biological opinion for suction dredge operations in Lolo Creek, Idaho, NMFS (2006o) found that mineral prospecting activities performed in compliance with the Clearwater National Forest (CNF) permit conditions offered a low risk of take to steelhead trout.

10 DATA GAPS

In general, not many of the studies reviewed for this paper were related to small-scale mining impacts. Much information is still needed on the science of small-scale mineral prospecting and the impact to potentially covered species. As such, a level of uncertainty remains concerning a thorough evaluation of the impacts of small-scale mineral prospecting activities. Current data gaps are outlined below as relevant to the type of mining activity or the equipment used, the degree of impact, and management issues.

10.1 Mineral Extraction and Processing Methods

The majority of information available regarding small-scale mining is focused on the impacts of suction dredging on fish, invertebrates, and water quality. Little information is available regarding Class 0, I, and III mining activities. However, given that Class 0, I, and III mining methods are generally less intrusive than suction dredging, we assume that impacts would either be reduced or similar to suction dredging depending on the degree of effort and whether water is pumped from the channel, sections of channel are dewatered, or the channel banks are disturbed.

- An assessment documenting relative differences with respect to various extraction and processing methods would be helpful in conditioning activities under the Gold and Fish pamphlet or individual HPAs for small-scale mineral prospecting operations.
- The influence of various suction dredge nozzle sizes has not been addressed in the available research. Additional studies would be helpful in limiting potential effects if it were determined that the size of the nozzle was instrumental in the degree of impact.

10.2 Direct Impacts of the Covered Activities to Potentially Covered Species

The majority of literature focuses on fisheries, water quality, or aquatic invertebrates. Little information was found regarding the direct impacts of small-scale mining on some of the other potentially covered species, including mussels, snails, limpets, and non-salmonid fishes. Effects on these species were inferred from the literature based on the influence of potential impact pathways and mechanisms of effects. Additional research is under way concerning the influence of small-scale mineral prospecting on freshwater mussel species, but the information was not available for this review. Such research would be beneficial compared to the use of assumptions and relative inferences based on similar situations.

- Information in the literature regarding the use and success of fish redds built in dredge tailings is mixed. This aspect could use additional study to clarify the beneficial or adverse effects of fish spawning in loosely consolidated tailings. Specifically, research is needed on the successful recruitment of young-of-the-year fish from spawning sites built in tailing deposits.
- Additional information is necessary to assess the impacts of small-scale mining on small streams and tributaries with differing channel morphologies. Some researchers implied the effect of small-scale mining may be a larger impact on small streams compared to large streams based on relative scale of the operations and difference in stream power. However, empirical data are lacking. The literature review considered the impacts of small-scale mining on a range of stream sizes (summarized in Table 14), including small streams, but the range of channel sizes is limited and the approaches varied between each study.
- Effort is needed to describe the relationship between the specific mining activity, channel size, and distance and duration of effect for various impact mechanisms. We view this research as the most critical need for regulating future small-scale mineral prospecting activities in the state.
- There is a need for more specific information on the requirements of non-salmonid potentially covered species related to small-scale mineral prospecting activities. Most research has focused on salmonid fishes.
- Documentation of the existing distribution and timing of life-history stages of non-salmonid species is sorely needed.

Table 14
Size Ranges of Study Streams

State	Stream/Tributary	Order	Range/Average Flow	Reference
Idaho	Burns Creek Yankee Fork[1/] Napias Creek Summit Creek	3rd Order 6th Order 4th Order 2nd Order	Unknown	Griffith and Andrews 1981
California	North Fork American River Butte Creek	Unknown	18 cfs 8 cfs	Harvey 1986
California	Canyon Creek	4th Order	35-1500 cfs	Somer and Hassler 1992
California	Elk Creek South Fork Salmon River Scott River	Unknown	Unknown	Harvey and Lisle 1999
Washington	Similkameen River	Unknown	1000 cfs	Ecology 2005
Montana	Gold Creek	3rd Order	14 cfs	Thomas 1985
Alaska	Fortymile River Resurrection Creek Chatanika River	Unknown	Unknown	Prussian et al. 1999

1) The mining projects on some of these creeks were not restricted to small-scale mining operations.

cfs = cubic feet per second

- Water quality studies related to either suspended or deposited sediment loads are needed to improve biological response assessments. Concentrations should be reported with the perspective of duration such that the dose, duration, and likely biological response can be determined. Duration of the exposure to high sediment levels is generally lacking in the literature assessments.

10.3 Indirect Impacts of the Covered Activities to Potentially Covered Species

- Additional studies are needed on the influence of suspended and settled sediment on aquatic productivity and macroinvertebrate community changes as a prey base for fish and freshwater shellfish species. For instance, oxygen consumption in mussels was determined to be reduced in water with turbidities as low as 5 NTUs (Alexander et al. 1994). Most research with respect to freshwater shellfish in turbid water has focused on feeding disruptions and gill irritation. Species-specific work is needed on the effects of turbidity on respiration and oxygen consumption of the four potentially covered freshwater invertebrates.
- Further work is needed on the influence of streamside human disturbances on behavior and use of habitat by potentially covered species.

10.4 Cumulative Effects of the Covered Activities to Potentially Covered Species

Studies reported in the literature suggest the impacts from individual and multiple small-scale suction dredging operations are minimal. Nevertheless, researchers suggest the impacts could increase if dredging occurred in small stream channels where flows are not large enough to redistribute disturbed substrate.

The long-term impacts of repeated dredging in one area have also not been fully investigated. Additional information is needed to assess the impacts of repeated dredging on water quality, aquatic insects, and fish growth, in particular for small stream systems having degraded baseline habitat conditions.

10.5 Conservation Measures, Best Management Practices, and Mitigation

- Monitoring studies (both short and long term) are needed to confirm that reasonable and prudent measures, BMPs, and conservation measures have the desired effect.
- Objective, post-project evaluations are needed to maximize opportunities to learn from past experience and improve future design.

10.6 Management Recommendations

No information is currently available to quantify the number of small-scale mining permits granted for any one location in Washington. As a result, it is difficult to quantify the potential impacts of multiple small-scale mining operations. Gathering additional permitting information would be useful for quantifying the amount of small-scale mining occurring at any one time, the areas of greatest mining activity, and the potential cumulative impacts.

- There is a need to collect and summarize information on the process and potential outcomes for use of adaptive management related to small-scale mineral prospecting activities.
- A system is needed for tracking and evaluating small-scale mineral prospecting impacts at the watershed level.

11 HABITAT PROTECTION, CONSERVATION, MITIGATION, AND MANAGEMENT STRATEGIES

The impacts of small-scale mineral prospecting can be minimized primarily through operational restrictions, including the type of mining equipment, limitations on excavation zones within streams, and allowable work windows (North 1993). Such restrictions are included in the Gold and Fish pamphlet, which allows only specific types of mining equipment and restricts its use to authorized excavation zones based on the wetted perimeter and the OHWL (refer to Figure 1). In addition, all streams within Washington are subject to specifically designated work windows. Some streams require an individual HPA permit for mining activity. These restrictions, and others outlined in the Gold and Fish pamphlet, help avoid and minimize the impacts of small-scale mining. However, based on our review of the pamphlet and the available scientific literature, additional measures and management strategies could be implemented to further reduce the impacts of small-scale mining and the potential for take of potentially covered freshwater species. Fourteen mitigation/conservation measures and four management recommendations summarized in Table 15 are offered to address these issues.

Table 15
Additional Mitigation, Conservation, and Management Strategies Recommended for Minimizing the Impacts of Small-Scale Mineral Prospecting

	Recommendation	Rationale
Mitigation/ Conservation Measures	1. Provide additional detail, including illustrations, in the Gold and Fish pamphlet to help miners identify potential spawning locations and potentially covered species.	Impacts occur when prospectors do not recognize spawning areas NMFS (2006o),.
	2. Provide additional information by tributary on known spawning areas and the periodicity of spawning. Conversely, request spawning surveys prior to annual operations.	NMFS (2006o) required as a reasonable and prudent measure (RPM) that the Clearwater National Forest perform spawning surveys prior to dredging operations and provide a fish biologist on site to assist in identify sensitive habitats where life-history stages might be present.
	3. The Gold and Fish pamphlet requests miners avoid spawning sites. It would be beneficial to specify requirements to conduct mining activities at a minimum distance from redds or known spawning areas. Recommendation is to restrict mining activity to areas 300 feet upstream and 50 feet downstream of known spawning areas or shellfish beds for species and life history stages present during the permit period.	Work windows will not always guarantee the absence of effect on incubating embryos or alevins. NMFS (2006o) used as an RPM restricting dredge operations 50 ft distance from active redds to avoid wading, trampling and crushing impacts. This recommendation is a good downstream distance to limit small-scale mining operations from wading effects. The earliest reported metal concentrations, macroinvertebrate populations and turbidity levels returned to ambient levels between 260 and 328 feet downstream from small-scale mining operations (Stern 1988; Prussian et al. 1999).
	4. Preclude mining activities during periods when eggs and alevins are susceptible to disturbance.	
	5. Restrict daily operations to daylight periods between 8:00 AM and 7:00 PM.	NMFS (2006o) required this daily work window as an RPM to allow juvenile steelhead to re-establish territories in streams and feed at peak aquatic drift cycles each day. This time period corresponds to primary feeding times at twilight that occur in the late evening and early morning when the natural aquatic drift of aquatic insects, a food source for salmonids, peaks in streams (Hynes 1970, Waters 1962, and Everest 1969 as cited in NMFS 2006o).
	6. Improve documentation and maintain specific stream and tributary work windows based on distribution of each of the potentially covered species where appropriate. Update statewide databases with subbasin planning and watershed analysis information on a routine basis.	

	Recommendation	Rationale
	7. Limit activities based on the size of a stream.	North (1993) suggests small channels are more susceptible to adverse effects of mineral prospecting than large channels. Bankfull channel widths are indicative of peak flow runoff and drainage basin characteristics (Leopold et al. 1964). Channel gradient and confinement (channel bankfull width relative to valley width) are a good descriptors of potential stream power to transport bedload. Recommend using four channel sizes small, medium, large, and mainstem channels for consistency in accordance with the average Washington statewide stream widths for the WDNR Forest and Fish Report final environmental impact statement (WFPB 2001) of small < 10 ft; medium 10 – 30 ft.; large 30 – 75 ft. and mainstem > 75 ft bankfull width.
	8. Increase the required distance between suction dredging operations from 200 feet to 300 feet to avoid cumulative water quality effects based on literature cited in item No. 3 above, as shown in Table 16.	NMFS (2006o) reviewed 18 suction dredge permits in Lolo Creek, ID on the Clearwater National Forest where the excavations ranged between 8 ft and 518 ft in length while averaging 255 ft in length on a stream channel with an average bankfull width of 30 ft. The recommended distance should be adjusted based on stream channel sizes (small, medium, large and mainstem) once research has established the proper distance relationships.
	9. Limit the number of permits granted per unit length or unit area of stream. As our professional opinion, impacts are not generally noticeable until 10 percent or more of the area is influenced.	NMFS (2006o) reviewed 18 suction dredge permits that ranged between 8 ft and 518 ft in length while averaging 6 ft in width. Surface areas disturbed ranged between 24 and 3,108 ft^2 The average area mined was 255 ft in length with a surface area 1,500 ft^2 Using a 10% rule of thumb for an observable effect, 1,500 ft^2 disturbed would not necessarily be detectable in 15,000 ft^2 (0.3 acres). Since Lolo Creek averaged 30 ft in width the threshold area in Lolo Creek would have been on the order of 500 lineal feet in channel length per mining permit. Using area instead of stream length automatically adjusts for the influence of stream size.
	10. Request operators visually monitor the stream for 300 feet downstream of the dredging operation after the first half hour of continuous operation. If noticeable turbidity is observed downstream, the operation must cease immediately or decrease in intensity until no increase in turbidity is observed.	Clearwater National Forest measure to minimize or avoid effects of suction dredging on Snake River steelhead (NMFS 2006o)
	11. Specifically require that operators not undermine, excavate, or remove any stable woody debris or rocks that extend from the bank into the channel.	Clearwater National Forest measure to minimize or avoid effects of suction dredging on Snake River steelhead (NMFS 2006o)

	Recommendation	Rationale
	12. Specifically require that operators not remove, relocate, or disturb stable instream woody debris greater than 4 inches or boulders greater than 12 inches in diameter.	The Gold and Fish pamphlet includes a general provision that large woody material shall not be disturbed in any manner. A minimum size defining large woody material and other large bed elements like boulders would be warranted. This measure is included in the Clearwater National Forest provisions to minimize or avoid effects of suction dredging on Snake River steelhead (NMFS 2006o)
	13. Store gasoline and other petroleum products in spill-proof containers at a location that minimizes the opportunity for accidental spills. Check mechanical equipment checked for leaks, and repair all leaks, prior to the start of operations each day. The fuel container used for refueling must contain less fuel than the amount needed to fill the tank. The suction dredge must be on stilts or anchored to the stream bank when refueling while afloat, so that the distance over which fuel must be carried over water is minimized. Unless the dredge has a detachable fuel tank, operators may transfer no more than 1 gallon of fuel at a time during refilling. Operators must use a funnel while pouring, and place an absorbent material under the tank while refueling to catch spillage. A spill kit must be available in case of accidental spills. If soil is contaminated by spilled petroleum products, the soil must be excavated to the depth of saturation and removed for proper disposal.	Clearwater National Forest measures to minimize or avoid effects of suction dredging on Snake River steelhead (NMFS 2006o)
	14. Ensure the intake screen dimensions are consistent with the latest NMFS criteria for fish screens.	NMFS is in the process of finalizing their 2004 *Draft Anadromous fish passage facility guidelines and criteria* (NMFS 2004). The final criteria may be available in early 2007 when the pamphlet is updated.
Management Recommendations	1. Quantify the number of permits granted under the Gold and Fish pamphlet procedures. Require miners to obtain a Gold and Fish pamphlet annually and document the number of pamphlets released using uniquely coded numbers.	
	2. Collect additional information from pamphlet holders as an annual operational plan, including the location, class, schedule, and duration of the proposed mining activity and the approximate amount of material to be dredged/mined. Request annual post-mining summaries of actual activities and material mined. Compile this information in a statewide database to enable future impact assessment.	
	3. Enforce Gold and Fish pamphlet rules. Visit areas where mining activity is greatest to ensure the guidelines are followed.	
	4. Monitor active small-scale operations and the impact of mining on habitat. Monitor downstream influence of notable effects including magnitude and duration; report changes in stream morphology as a result of mining.	NMFS (2006o) RPMs for suction dredge operations.

As has been discussed, the potential for take as a result of mining activities increases substantially during spawning and incubation periods. It is therefore important for miners to understand where and when various life-history stages for the potentially covered species occur, as well as to be able to identify and thus avoid potential spawning locations. The Gold and Fish pamphlet does not provide sufficient information or illustrations to assist a miner who is unfamiliar with fish biology in avoiding spawning grounds. Additional information specifying the distribution of potentially covered species and the periodicity of spawning in each watershed would help miners understand when they might encounter redds. The Gold and Fish pamphlet currently specifies that "incubating fish eggs or fry shall not be disturbed" and that if "fish eggs or fry are encountered during excavation of the bed, operations shall immediately cease." Additional rules stating that potential spawning areas should be avoided or that mining activities are not to occur within a specified distance of redds are needed.

In Idaho, miners are required to avoid operating in natural spawning areas, such as gravel bars at the tails of pools (Idaho Department of Water Resources [IDWR] 2004). In addition, government personnel identify site-specific spawning areas before the mining season and these areas are made known to miners. The biological opinion for recreational suction dredge mining at Lolo Creek (NMFS 2006o) recommended that mining activities remain a minimum of 50 feet from known spawning areas, while the Alaskan National Pollutant Discharge Elimination System permit for medium-size (4- to 10-inch) suction dredges specifies that dredging and discharging are prohibited within 500 feet upstream of known locations where fish are spawning (USEPA 2005).

Because water quality studies have shown that metals, turbidity, and macroinvertebrate communities return to ambient (i.e., background) conditions between 260 and 525 feet downstream of mineral prospecting activities (Table 16), an upstream rule that restricts mining activities to a round number of at least 300 feet upstream of known spawning areas may be warranted. Such a rule is more conservative than the one in the current Gold and Fish pamphlet. This distance is likely a factor of stream size and should be adjusted based on small, medium, large, and mainstem channel sizes once research has established the proper distance relationships. It also may be appropriate to limit physical impacts by restricting small-scale mining activities to 50 feet downstream from known spawning areas, as suggested in NMFS (2006o). Another option is to restrict mining activities to those periods when eggs and fry are not susceptible to disturbance. This approach would likely require an adjustment of current work windows and would require additional stream-specific work windows.

Table 16
Influence of Distance from Small-Scale Mineral Prospecting on Return to Ambient Levels

Attribute	Distance Downstream	Comment
Water Quality		
Turbidity	200 feet	1.2 to 1.8 times ambient level but within Washington water quality standards[1]
	328 feet	Return to ambient level[2]
	525 feet	Return to ambient level[3]
Metals	50 feet	- Concentrations of lead and zinc remain above Colorado water quality standards[4] - Dissolved concentrations of copper, lead, zinc and total arsenic are 1.0 to 5.6 times the ambient level but an order of magnitude below Washington water quality criteria for aquatic life[1]
	100 feet	Concentrations of zinc remain above Colorado water quality standards[4]
	200 feet	Dissolved concentrations of copper, lead, zinc and total arsenic are 1.0 to 1.9 times ambient level but an order of magnitude below Washington water quality criteria for aquatic life[1]
	260 feet	Total copper and zinc concentrations return to ambient level.[3]
Macroinvertebrate Indices	260 to 525 feet	Return to normal[3]

1 Similkameen River, Washington (Ecology 2005)
2 Canyon Creek, California (Stern 1988)
3 Fortymile and Chatanika rivers and Resurrection Creek, Alaska (Prussian et al. 1999)
4 Arkansas River, Colorado (in North 1993)

Although the Gold and Fish pamphlet restricts mining work windows, a comparison of Table 5 and Table 7 shows that there is potential for overlap between mining work windows and spawning and incubation periods. Because life-history timing varies by stream, conditioning HPAs or the rules and regulations of the Gold and Fish pamphlet to avoid spawning periods specific to each stream reach could enhance the protection of potentially covered species. Figure 3 graphically displays major watershed (WRIAs) in conjunction with counties of the state. In some cases, counties may encompass up to seven different WRIAs. Reporting life history timing on major channel networks within WRIAs would allow WDFW to easily identify overlap between potential sensitive life-history stages and work windows in each stream, increasing the flexibility to call for extra precautions when necessary to avoid sensitive areas and to institute less restrictive precautions if overlap does not occur in a given stream.

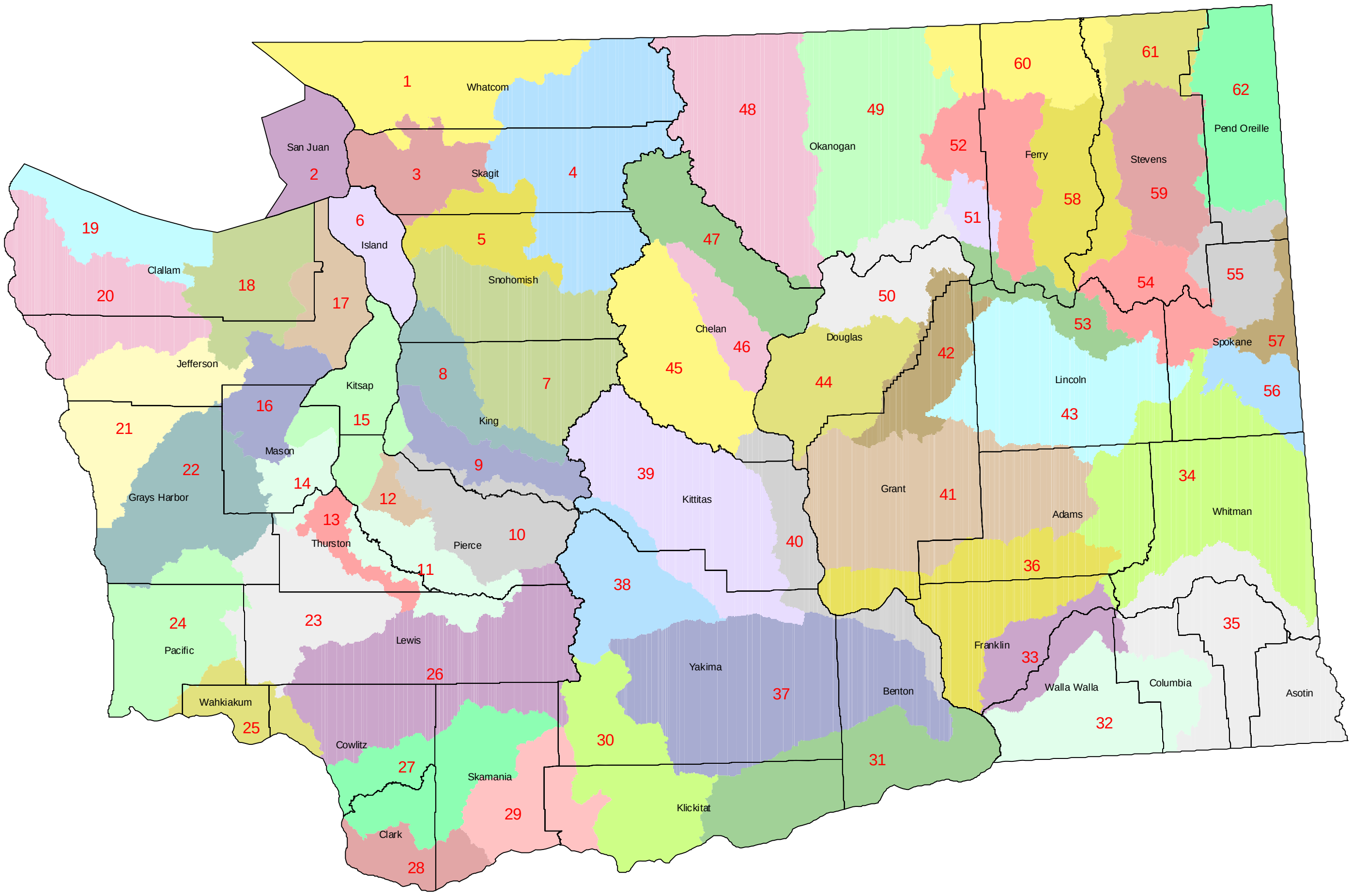

Figure 3
Overlap of Counties and Numbered Water Resource Inventory Areas in Washington State

North (1993) indicates that mining impacts have the potential to magnify in small or headwater streams as compared to large streams having more stream power (i.e., stream flow and gradient). Additional protection of aquatic resources could be derived by limiting small-scale mining activities on the basis of stream size. However, little information is available on the impacts of specific small-scale mining activities in small or headwater streams or the variations in impact resulting from differing channel morphologies, making regulation of small-scale mining activities on the basis of stream size gradations difficult. Bankfull channel widths are indicative of peak flow runoff and drainage basin characteristics (Leopold et al. 1964). Channel gradient and confinement (channel bankfull width relative to valley width) is a good descriptor of potential stream power to transport bedload. We recommend using four channel sizes as an initial starting point: small (< 10 feet), medium (10 to 30 feet), large (30 to 75 feet), and mainstem channel (>75 feet) bankfull widths for consistency with the average Washington statewide stream widths for the WDNR Forest and Fish Report final environmental impact statement (WFPB 2001).

The Gold and Fish pamphlet currently requires a distance of 200 feet between excavation sites. However, the influence of potential water quality impacts from suction dredging can exceed 200 feet. We therefore recommend increasing the required distance between suction dredging operations to a round number of 300 feet, which is representative of the weight of evidence between the earliest reported distances when metal, turbidity, and macroinvertebrate communities returned to ambient levels. This approach would help ameliorate dredging impacts and minimize the potential for cumulative impacts from multiple operations in one area. We found no information related to downstream distance of effects of non-suction dredging operations. The Gold and Fish pamphlet currently requires 200 feet between excavation sites. We have no reported information to recommend adjusting this distance, but it seems logical that the distance could be shorter depending on the operation and the size of the channel. The lack of information related to this topic has been identified as a data gap.

The Gold and Fish pamphlet also requires a 400-foot distance between excavation sites and fishways or fish hatchery intakes. A distance of 400 feet falls within the distance ranges identified for turbidity, metals, and macroinvertebrate communities to return to ambient conditions downstream of mineral prospecting activities (Table 16). Therefore, the current 400-foot distance is supported by the scientific literature reviewed for this white paper. This distance is likely a factor of stream size and should be adjusted based on small, medium, large, and mainstem channel sizes once research has established the proper distance relationships.

Given the potential for downstream impacts from any one small-scale mining operation and the almost complete lack of information on cumulative impacts associated with multiple operations, we recommend restricting the number of permits allowed per surface area of stream in any one year. Based on our professional judgment we suggest a minimal effects ratio of 10 percent disturbance. As described in Table 15 (Item 8), this surface area allowed for one permit per 500 linear feet of Lolo Creek (mean bankfull width of 30 feet). This management measure would limit the potential for cumulative impacts from suction dredging concentrated in a given stream.

Washington State has no existing mechanism for enumerating the small-scale mining operations in any given location (with the exception of streams regulated by individual HPAs). No separate record is kept of the number of small-scale mining activities conducted under the Gold and Fish pamphlet procedure or of where or when the activities occur. Enumerating the density of small-scale mining operations is a critical prerequisite to assessing the cumulative impacts of mining and areas of greatest small-scale mining activity. The location of the small-scale mining activity relative to critical habitat and the extent, duration, and timing would be needed as well. Therefore, we recommend the following changes to the current permitting procedure:

1. Require miners to obtain a new Gold and Fish pamphlet annually. Add a uniquely coded number to each Gold and Fish pamphlet indicating the year and individual permit number (e.g., 2007–100).
2. Create a simple database that allows tracking of annual small-scale mining activities. A miner who requests a Gold and Fish pamphlet would be required to fill out a short form indicating:
    a. Who is conducting the mining activities
    b. The location of the proposed mining operation
    c. The class of mining activity proposed
    d. The proposed schedule and duration of mining activities
    e. The approximate amount of material to be mined

This information could be entered into a statewide database and used to assess the impacts of permitted mining activities and identify high-use, small-scale mining areas that may require monitoring or individual permits. When subscribing to the permit, operators should be required to submit annual reports of activities conducted under the Gold and Fish pamphlet to confirm the level of surface area of stream bed excavated compared to the proposed excavation. We also recommend that WDFW survey small-scale mining activities under the Gold and Fish permit in select streams. Increased monitoring for compliance and effectiveness is needed to study whether prospectors are complying with the rules and whether the rules are having the intended protective effects. Field enforcement of the existing rules in the Gold and Fish pamphlet is also an important management strategy that can help minimize inappropriate activities. High-use, small-scale mining areas should be visited during and outside of work windows and procedures should be implemented to address miners who fail to follow the guidelines. A statewide database of permitted operations is an essential component of any effort to facilitate enforcement.

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APPENDIX A

GOLD AND FISH RULES AND REGULATIONS FOR MINERAL PROSPECTING AND PLACER MINING IN WASHINGTON STATE

IMPORTANT NOTICE

The online version of the Gold and Fish pamphlet is for informational purposes only and copies of it do not satisfy the requirement to have a copy of the Gold and Fish pamphlet on the job site when conducting mineral prospecting or placer mining operations. Please obtain an official copy from the WDFW.

Washington Department of FISH and WILDLIFE

Addendum to the *Gold and Fish* pamphlet

June, 2005

The following information is provided to clarify information in the *Gold and Fish* pamphlet. For further information, please contact any office of Washington Department of Fish and Wildlife listed in the back of the pamphlet.

- The term "**power sluice**" is not specifically mentioned in the *Gold and Fish* pamphlet, but is the same as a **highbanker**. You may find a definition for highbanker on page 22. The use of this equipment is restricted by the provisions listed under Class II (page 37) and Class III (page 39).
- **Rockhounding** activities are not addressed or authorized by the rules outlined in the *Gold and Fish* pamphlet. Unless you are conducting these activities in a manner that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state, you may do so without a permit from Washington Department of Fish and Wildlife. Other agencies may require authorization for these activities, so be sure to check with them prior to metal detecting or rockhounding. If you will be altering the bed or flow of state waters by these activities, you must first obtain a written Hydraulic Project Approval from Washington Department of Fish and Wildlife. If you use mineral prospecting equipment as defined on page 24 of the *Gold and Fish* pamphlet to process material while rockhounding, you must follow the requirements in the pamphlet.
- The use of **metal detectors for activities such as searching for coins** is not restricted by the *Gold and Fish* pamphlet or rules. However, excavations and other activities that would affect the bed or flow of waters of the state such as washing objects in a stream require a written Hydraulic Project Approval. If you are using other mineral prospecting equipment such as a pan or dredge to process material while searching for coins or other objects, you must follow the requirements of the pamphlet. For example, if you collect 5 gallons of dirt from an area that your detector indicates a coin might be located and you process that material with a pan or sluicebox in the stream, you must follow the rules in the *Gold and Fish* pamphlet because you are using mineral prospecting equipment in a manner that would recover minerals.
- **When used to assist in locating minerals, metal detectors** are classified as mineral prospecting equipment. You may use metal detectors to indicate likely deposits of minerals without restriction, but digging or excavating is restricted to the methods and time periods outlined in the *Gold and Fish* pamphlet. For example, if you are looking for gold and your metal detector gives a signal 100 feet from the ordinary high water line, you may not excavate that site under the authority of the *Gold and Fish* pamphlet because it is within the 200 foot protected area. As with other exceptions to the *Gold and Fish* pamphlet, however, you can apply for a separate, written Hydraulic Project Approval to excavate in this area. If fish life can be protected, you will be issued a permit.
- **Year-round panning** is allowed only through the provisions listed under Class 0 (page 34). In order to protect incubating fish eggs and fry you may **not** collect gravel for panning from below the water and you may **not** pan any material in the water (provision 3). All work must be conducted in the dry streambed. **Class 0 does *not* require you to deposit your wastewater 200 feet above the stream.** You may pan into a tub or in a depression in a dry gravel bar and dispose of tailings and wastewater there while making sure that sediment does not enter the waters of the stream. Any pits or potholes need to be filled before leaving the site.
- **Disposal of wastewater more than 200 feet from the stream** while panning is required **only** when you are processing aggregate with Class I equipment within 200 feet of the stream (provisions 4 and 5, pages 35 and 36). As stated above, **Class 0 does *not* require you to deposit your wastewater 200 feet above the stream.** For example, you want to pan out a bucket of gravel at your campsite which is 50 feet from the stream. To do so, you need to pan into a container of water and then dispose of the wastewater more than 200 feet from the stream. Disposal of wastewater during Class III highbanking must also be done more than 200 feet from the stream (provisions 3 and 9, pages 39 and 40).
- **Suction dredge and highbanker pump intakes must be properly screened** to prevent fish from being killed (provision 6, pages 37 and 39). Most intake screens provided by the pump manufacturers have holes that are too large and therefore must be modified or replaced. The three authorized screening materials are woven wire mesh, perforated plate and profile bar. These materials may not be readily available from neighborhood hardware stores, particularly with the hole size and spacing required, but screens may be obtained from irrigation equipment vendors, some pump manufacturers or direct from screen manufacturers. Many of these suppliers also carry or can manufacture the screen material so you can make your own pump intake screens. The unit cost of these materials may be high for individual orders, so it may be beneficial to combine orders for a number of people or from a whole prospecting club to be most economical. A good place to search for manufacturers is to search the Internet using keywords such as "woven wire", "wire mesh", "screen", "perforated plate", and "profile bar". You can also check the yellow pages for irrigation suppliers, pump vendors or screen manufacturers.
  An inexpensive substitute for commercially available materials is to make your own. For example, you can drill 3/32

inch holes that are spaced with staggered centers 5/32 inch apart in a plastic bucket or PVC pipe that is sized as described below. You can fit the bucket with a tight-fitting lid and the pipe with a cap that is attached to your pump intake. Alternatively, you can drill holes in the same way in sufficient gauge sheet metal or plastic and construct this into a screen box. The perforated material must be strong enough so that it will not collapse when the pump is operated.

Because of the rule requiring at least 1 square foot of screen you must have a screen at least that size for pumps drawing 180 gallon per minute (gpm) or less. For pumps drawing more water than 180 gpm, the size of the screen depends on how much water the pump can draw. For every cubic foot per second (cfs) of water drawn through the pump, you must have at least 2.5 square feet of screen with holes of the correct size and spacing. Check the ratings plate on your pump or in the operator’s manual to determine the maximum listed draw. Size your screen according to that maximum, even if you don’t normally run the pump that high. Be sure to use the pump intake rating and not the dredge capacity or water volume through the sluice box.

Here are some helpful formulas and standards:

$$\text{Minimum screen area} = \frac{\text{Maximum pump intake (cfs)}}{\text{0.4 ft/sec. (Velocity through screen)}}$$

1 cfs = 450 gpm

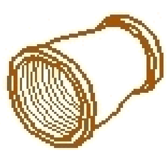
Screen must be at least 2.5 square feet/cfs of pump intake

Example: Your dredge pump intake is rated to draw a maximum of 250 gpm. By dividing 250 gpm by 450 gpm/cfs you know that your pump draws 0.56 cfs.

$$\text{Minimum screen size} = \frac{\text{0.56 cfs}}{\text{0.4 ft/sec}} = \text{1.39 square feet}$$

More information on screening requirements for water diversions may be obtained at the Washington Department of Fish and Wildlife website: **http://www.wdfw.wa.gov/hab/engineer/fishscrn.htm**

- **Suction dredge nozzles greater than 4" inside diameter** may only be used if either the nozzle or suction hose is attached in a manner that forces all the water and aggregate through a single opening that is no greater than 4" inside diameter. A bell reducer or similar fitting with closed, solid walls terminating in a maximum 4" inside diameter that is attached to the nozzle will meet this requirement. A single ring or series of progressively smaller rings attached to a nozzle greater than 4" inside diameter will **not** comply with this requirement if water or aggregate can pass through any opening other than the 4" ring.



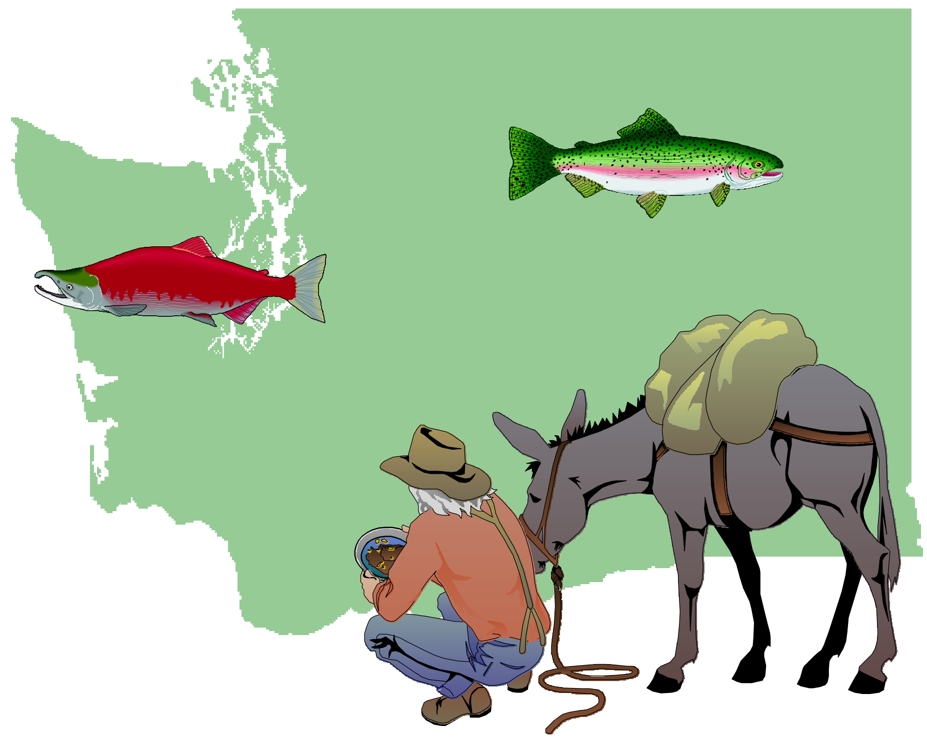

Acceptable Reducers

- **Failure to comply** with the provisions of the Gold and Fish pamphlet could result in a civil penalty of up to one hundred dollars per day or a gross misdemeanor charge, possibly punishable by fine and/or imprisonment.

Washington Department of FISH and WILDLIFE

Gold and Fish

Rules and Regulations for Mineral Prospecting and Placer Mining in Washington State



January, 1999

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Washington Department of FISH and WILDLIFE

Gold and Fish

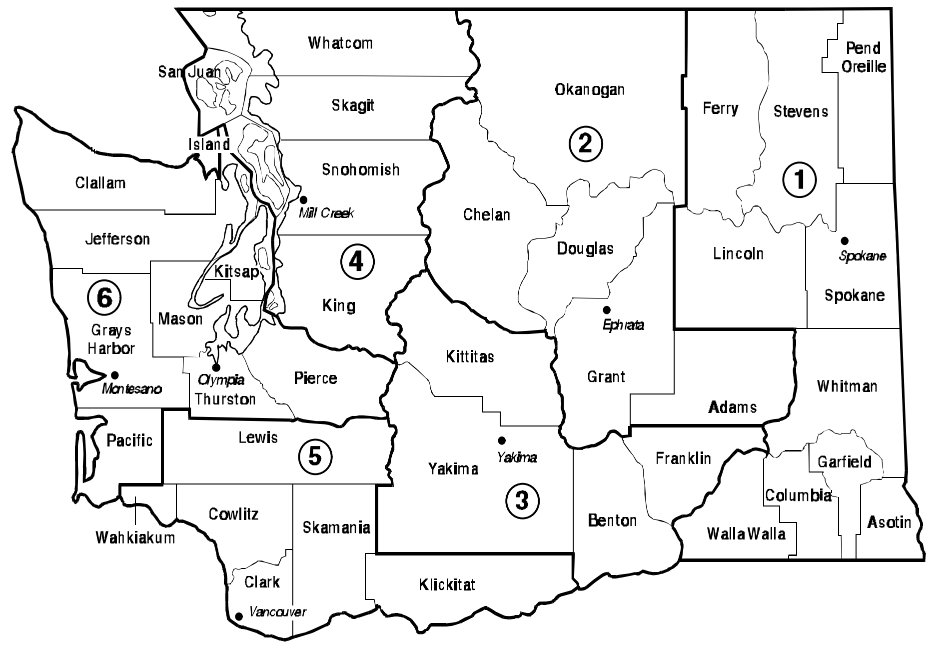
Gold and other minerals helped shape the history of Washington state. Many of the miners bound for the gold fields of Alaska during the Gold Rush of the late 1800's passed through Seattle and other parts of Washington. Much of the gold mined there found its way to Seattle where it influenced the development of that city and much of the state. More recently, interest in the gold-bearing streams of Washington has grown, partly because improvements in mineral prospecting equipment make it easier for the casual or part-time prospector to pursue this activity.

Previous to 1980, a permit was not required from the state to prospect for minerals in Washington state waters. Concern about the effect of certain prospecting activities on fish life prompted Washington Department of Fisheries and Department of Game to require Hydraulic Project Approvals (HPAs) for most prospecting activities after that time. In 1980 the first edition of the Gold and Fish pamphlet was issued which served as the HPA for panning and other small-scale activities, while an individual, written HPA was required for others. Since then, several editions of the Gold and Fish pamphlet have been issued, the last being published in 1987.

In 1997, the Washington State Legislature passed substitute House Bill 1565 [Chapter 415, Laws of 1997] which defined “small scale mining and prospecting” as the use of pans, non-motorized sluice boxes, concentrators and mini-rocker boxes for the discovery and recovery of minerals; prohibited any requirement of obtaining a written HPA prior to conducting small scale mining and prospecting, and required Washington Department of Fish and Wildlife (WDFW) to update the 1987 Gold and Fish pamphlet. This publication is the result of that legislation and was produced with input from members of the mineral prospecting and environmental communities as well as representatives from various state and federal government agencies.

This publication outlines when you need a permit (HPA) from WDFW to prospect or placer mine in the State; how to obtain an HPA; what other agencies you might need to contact before prospecting or mining; what equipment and timing requirements you need to follow in order to protect fish; definitions of important terms; and what is important habitat for fish.

Washington Department of Fish and Wildlife Regions



This edition of the Gold and Fish pamphlet supercedes all previous editions of it. It remains valid until a new edition is published by Washington Department of Fish and Wildlife. All mineral prospecting and placer mining in Washington state must be conducted in accordance with the rules contained in this pamphlet, or you must obtain a separate, written permit from the Washington Department of Fish and Wildlife.

When conducting mineral prospecting and placer mining activities, the most current edition of the Gold and Fish pamphlet must be on the job site. Please review the provisions contained in this pamphlet for complete details. Questions regarding the pamphlet can be directed to any Washington Department of Fish and Wildlife office. Contact information is listed elsewhere in the pamphlet.

Table of Contents

Common Questions and Answers About Permits

Do I need a permit to placer mine or prospect for minerals in Washington?

Yes. Washington Department of Fish and Wildlife (WDFW) was given authority by the Washington State Legislature to regulate anyone that "desires to construct any form of hydraulic project or perform other work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state" when it passed the Hydraulic Code (Chapter 75.20 RCW). Mineral prospecting and placer mining activities that will use, divert, obstruct, or change the natural flow or bed of waters of the state qualifies as "other work" and you must have a valid permit from WDFW to legally conduct that activity. Other types of mining that will not affect waters of the state are not required to obtain a permit from WDFW, but you will need other permits from other agencies. Contact Washington Departments of Natural Resources and Ecology for more information.

What type of permit(s) do I need?

You must have a *Gold and Fish* pamphlet on the job site when conducting small scale prospecting and mining. Prior to conducting other mineral prospecting or placer mining activities where waters of the state will be affected, you must obtain an Hydraulic Project Approval (HPA) issued by WDFW. Two types of HPAs are available - the *Gold and Fish* pamphlet and a separate, written HPA. In most cases the *Gold and Fish* pamphlet will be the HPA you need to authorize mineral prospecting or placer mining. In addition, you might need permits from other state and federal agencies, including authorization from the National Marine Fisheries Service and U.S. Fish and Wildlife Service to operate in waters containing species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531-1544).

I understand there are different types of HPAs. Which kind is best for me?

The *Gold and Fish* pamphlet lists the rules which you must follow when conducting small scale prospecting and mining and serves as the permit or HPA authorizing the other activities described in it. If the area you wish to operate in and the method you wish to use is listed in the pamphlet, then use it as your HPA. You must follow all timing, location, equipment and method provisions listed in it. If the activity you propose is not covered in the pamphlet, you must apply to WDFW for a separate, written HPA or written supplement to the *Gold and Fish* pamphlet.

How do I get an HPA?

There are a number of ways to get an HPA. The *Gold and Fish* pamphlet is available upon request from any WDFW office. No application is required to obtain the pamphlet. Contact information is listed at the end of this pamphlet. Many mineral prospecting clubs and vendors of prospecting equipment have a supply of the pamphlets available to their members or customers. Requests for minor exceptions to the location or timing restrictions may be made by phone or in writing to the WDFW Regional office for the Region in which you plan to work. You will receive a written supplement to the *Gold and Fish* pamphlet for the minor exception if fish life can be protected, and you must still follow all other requirements of the pamphlet. Requests for major exceptions to the technical provision or equipment requirements of the *Gold and Fish* pamphlet must be made in writing by submitting a Joint Aquatic Resource Permit Application (JARPA) to WDFW. If your application is approved you will be issued an HPA with specific timing, location and equipment restrictions.

Where do I get a JARPA (HPA application) and how do I fill it out?

The JARPA is available from any WDFW office, most county planning offices, or from the WDFW internet web site. The JARPA comes with instructions on how to complete it and should be self-explanatory. A written HPA may be issued to only one individual, family, or organization. Applications with multiple names or addresses will not be accepted. All sections of the application must be completed, including legal description (section, range and township), description of work, method, equipment, vicinity map, etc. If you are proposing to work on an existing mining claim, attach a copy of the Notice of Claim Location. Send your completed JARPA to the WDFW address listed on it.

How long does it take to get a written HPA?

Once WDFW has received your complete application we have 45 days to either issue, condition, or deny a permit.

Can I appeal a decision to deny my application for exceptions to the limitations in the *Gold and Fish* pamphlet?

Yes. You can appeal the denial of or conditions in a written HPA within

30 days of the decision. You must follow the procedures included with the denial or the HPA. You cannot, however, appeal the denial of, or conditions in a written supplemental approval to the *Gold and Fish* pamphlet. If you disagree with action taken in this case, you must submit a JARPA requesting a written HPA and then consider an appeal based on the decision made regarding that application.

Is there any case where I do not need a pamphlet or an HPA for mineral prospecting?
Yes. If your activity does not use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state you do not need an HPA. This case might apply to situations where you are collecting aggregate far away from any water body, you do not withdraw water from any water body, and wastewater and tailings do not enter or influence any water body. Unless you are certain that your activity does not require an HPA, though, it would be wise to consult with WDFW prior to conducting that activity.

Do I need other permits in addition to an HPA?
Yes. Every individual conducting activities in areas containing fish species listed as threatened or endangered under the Endangered Species Act will also need authority to conduct those activities if they may harm those species. Contact the U.S. Fish and Wildlife Service or National Marine Fisheries Service for more information. Other permits may be necessary from local, state or federal agencies before prospecting or placer mining operations are legal. It is important for you to consult with all jurisdictions before starting your operation. A contact list of other agencies is provided at the end of this pamphlet for your convenience.

Do I need a water right prior to prospecting or placer mining?
In some cases, yes. Removal of water from state waters for any beneficial use, including highbanking and other mineral prospecting and placer mining activities that take water from the stream channel, requires a water right issued by Washington Department of Ecology (WDOE). Dredging, sluicing or panning within a stream where you do not remove the water from the stream does not require a water right. Contact WDOE for more information.

I prospect for gold as recreation rather than as a commercial operation. Do I still need an HPA?
Yes. Regulations governing mineral prospecting and placer mining are designed to protect fish life regardless of whether those operations are “recreational” or “for profit”. These regulations apply to all prospectors and miners conducting operations within or near the waters of the state of Washington.

How do I know where I can prospect or placer mine and what restrictions I must follow?
The *Gold and Fish* pamphlet lists all the waters in Washington open to prospecting and placer mining and all other restrictions you are required to follow. Supplements issued to the *Gold and Fish* pamphlet HPA and separate, written HPAs will detail additional provisions and timing when issued.

Can I prospect or mine anywhere I choose provided I have all required permits?
No. You must follow the location restrictions outlined in the pamphlet or written HPA. Not all waters of the state are open to prospecting or mining and those that are open are open only during certain times of the year. In addition, no HPA issued by WDFW or other permits issued by other agencies authorizes trespass on public or private property, or trespass on existing mining claims. It is your responsibility to obtain permission from the land owner or claim holder prior to conducting any work on a site.

What is the difference between waters listed as CLOSED and SUBMIT APPLICATION in the streamlist?
Waters listed as CLOSED are not open for typical prospecting or mining through any type of HPA because they are either too sensitive to withstand disturbance by that activity (such as marine waters and most freshwater lakes) or are contained in areas where the administrator for the land of that area does not allow prospecting (national parks). An application (JARPA) submitted to WDFW for authorization to prospect or mine by typical methods in any area listed as CLOSED likely will be denied. Applications proposing special methods to protect fish and their habitat will be considered for approval. Waters listed as SUBMIT APPLICATION may be able to withstand some prospecting or mining activity, but are too sensitive to allow it without individual review of an application by a WDFW biologist. To request authorization to work in these waters you must submit a written application (JARPA) to WDFW. If your proposed activity can be conducted without harming fish life you will be issued a written HPA.

Does everyone in my family (or club or group) need a separate *Gold and Fish* pamphlet?

No. There need be only one pamphlet per job site. All workers must comply with all provisions and restrictions in the pamphlet. Whether or not you are required to have a *Gold and Fish* pamphlet, you must be familiar with and follow its provisions and information to avoid damaging fish life or habitat.

I'm going on a club outing to one of my club's claims. Does everyone working that claim have to have a *Gold and Fish* pamphlet?

No. It is recommended, but not required, that each person prospecting or placer mining have a *Gold and Fish* pamphlet. All workers must be familiar with and follow the contents and provisions of the pamphlet, but there need be only one pamphlet per job site. There may be many excavation sites and job sites on a single club claim, so be sure you are familiar with the meaning of "excavation site" and "job site" listed in the definitions section.

I want to prospect in a stream listed in the *Gold and Fish* pamphlet but want to go after the season ends. I also want to use a larger dredge than allowed. Is this possible?

Yes. Because you are asking for exceptions to both timing and equipment limitations, you must submit a JARPA to WDFW for consideration of a separate, written HPA for your activity. Each request is dealt with on an individual case-by-case basis and written HPAs will be issued only when fish life can be protected. If you desire an exception only to the location or timing restrictions for a stream, you may make a verbal request to the WDFW Regional office in which the stream is located. If approved, you will receive a written supplement for attachment to the pamphlet. You must also follow all provisions in the pamphlet.

I am a claim holder. The 1872 Mining Law allows me to prospect and mine on public land. Do I still have to follow the restrictions of a pamphlet or written HPA?

Yes. The Hydraulic Code (Chapter 75.20 RCW) authorizes WDFW to regulate those activities that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state. Nothing in the 1872 Mining Law prohibits the State from exercising its legal authority to protect the state's fish resources.

How do I find out who owns or is a claim holder of the land on which I want to prospect?

WDFW does not maintain records of property owners or claim holders and cannot provide that information to you. Private property information can typically be obtained from local governments. Counties and the U.S. Bureau of Land Management (BLM) both are sources of mining claim records. Those with unpatented mining claims should keep in mind that the general public has a right to cross over and to use (hunt, fish, pick berries, recreate, etc.) the surface of your claim, as long as that use does not interfere with your mining operation.

Do I have to have the HPA on my body as I work?

No. The HPA (written or *Gold and Fish* pamphlet) only has to be on the job site at all times that work is being conducted. The HPA should be immediately accessible by you if a WDFW representative asks to see it. This could mean the HPA is in your vehicle within sight of your operation or is in a backpack on the streambank adjacent to your excavation site.

How long is the *Gold and Fish* pamphlet issued for?

The *Gold and Fish* pamphlet is valid until a new version is published. The pamphlet will be revised and reissued as needed to continue offering protection of fish life while still allowing certain prospecting and placer mining activities. There is no set schedule for this, but should occur a minimum of every five years.

How will I know if there is a more recent version of the *Gold and Fish* pamphlet available than the one I have?

You can contact any WDFW office and ask for the publication date of the most recent version. This information will also be on the WDFW internet web site. To be automatically notified when a new *Gold and Fish* pamphlet is published, provide your name, address and phone number to the Olympia WDFW office (the address is at the end of this pamphlet). Your name will be added to the mailing list of those requesting notification of the latest edition of the pamphlet.

Is there a fee for the *Gold and Fish* pamphlet or written HPA?

No. We also do not charge for any pamphlets we distribute to clubs or vendors of prospecting and mining equipment.

Why are there limitations on how and where I prospect, how many people work my excavation site and how close the sites can be?

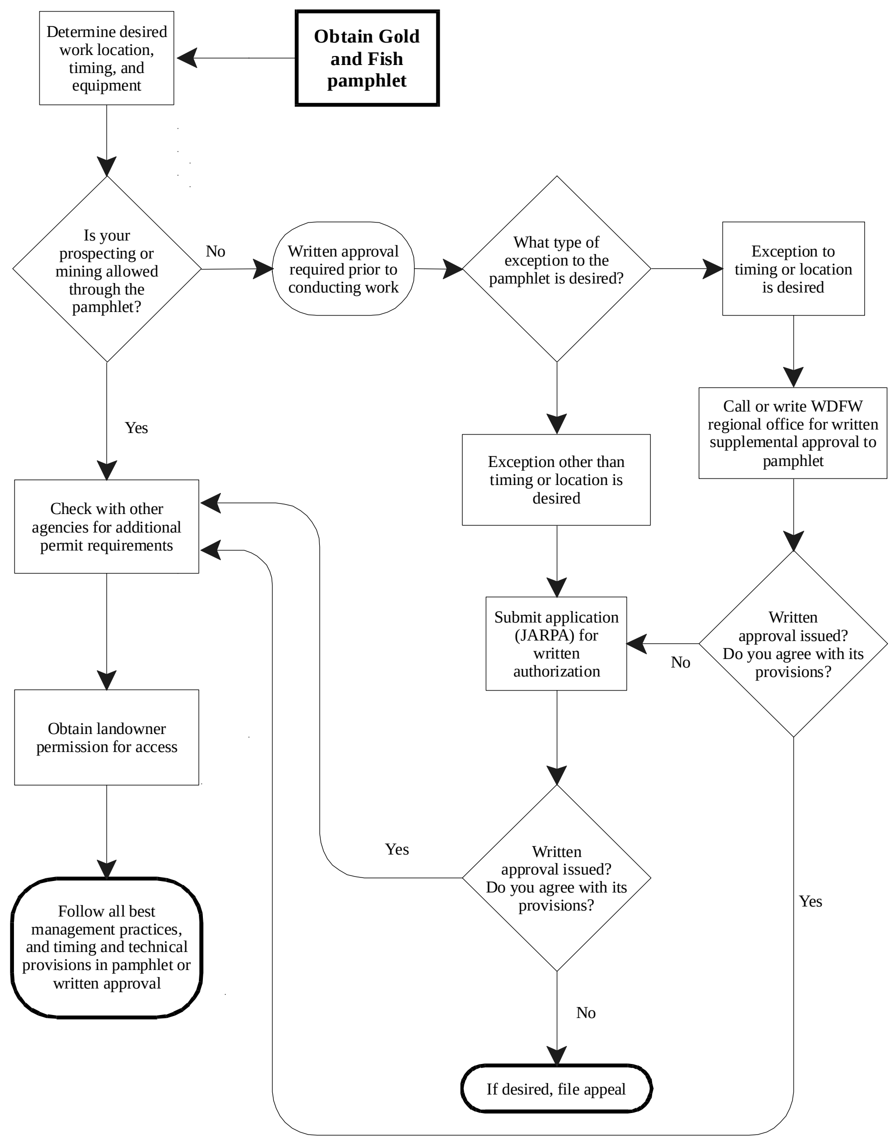
Mineral prospecting and placer mining activities can have a detrimental effect on fish and their habitat if not conducted properly. All the limitations and restrictions included in the *Gold and Fish* pamphlet and any written HPA are designed to ensure the protection of fish life while still allowing as much mining activity as possible. Limitations on the number of people working a site and the distance between sites are to reduce the effect of combining a number of small impacts.

Are there any special provisions exempting children from the rules?

Yes. Children under 8 years old are exempted from the limit of no more than 5 individuals working an excavation site. They must follow all the other rules, however.

How do I legally prospect or placer mine for minerals in Washington?

Please refer to rules outlined in this pamphlet for complete details.



Fish Habitat and Mining Impacts

Many small scale prospecting and mining activities can be compatible with fish and their habitat if proper mining practices are followed.

What is Fish Habitat?

Habitat is what any living thing needs to survive, and all fish species require the same basics: good water quality, cover to hide from predators, spawning (reproducing) and rearing areas, access to and from these areas, and food. Loss of any one of these basic habitat needs will reduce or eliminate fish survival.

Water quality is influenced by temperature, sediment, and streamflow. Variations in these factors determine what kinds of fish, and how many, will live in a particular waterway. Most salmon and trout species, for instance, generally require cool, clean, free-flowing water.

When stream water temperatures rise, fish may lose some of their ability to withstand diseases and stress, and to feed, spawn, migrate, and generally thrive. Streamside trees, shrubs, and other vegetation shade the water and keep it cool; removal of that vegetation commonly results in higher water temperatures.

Sediment (particles of dirt and mud debris, either suspended in water or settled on the stream bottom) can affect fish habitat in a number of ways. It can reduce both the kinds and numbers of plants in the water (which host food sources and provide cover) and bottom-dwelling animals (food sources for some fish). It can also directly reduce fish numbers by decreasing food supplies, damaging gills, making it difficult to see and catch food, and covering gravel spawning areas with silt that suffocates eggs and/or young fish incubating in the gravel. Freshwater invertebrates, including mussels, can be smothered because they are not able to migrate to cleaner waters or substrate in which they live.

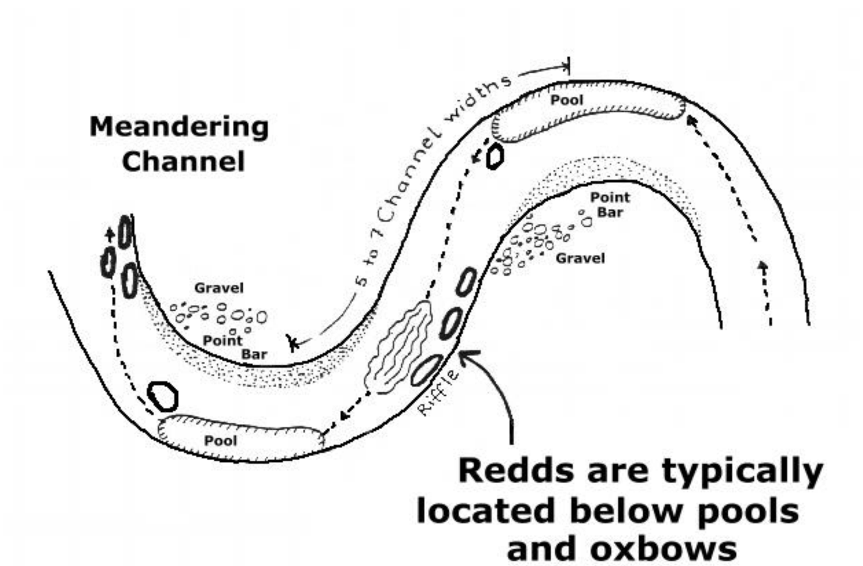
Stream flow is critical to all factors because it affects oxygen levels, sediment loads and deposits, and even some food production. It varies seasonally, with rain, snow fall and runoff, and structurally with the streambed. Fast flowing water is generally full of oxygen, which is needed by all fish and their developing eggs and young. At high flows, sediment is suspended in the water, and at low flows, it is deposited in the streambed.

Feeding, spawning and general survival can be affected by both high and low flows depending on the amount of sediment, the season, and the fish species.

When changes are made to the streambed or bank, water quality changes in ways that can harm fish. The streambed and bank is also the basis for the other fish habitat needs of cover, spawning areas, access and food.

Characteristics of a Healthy Stream

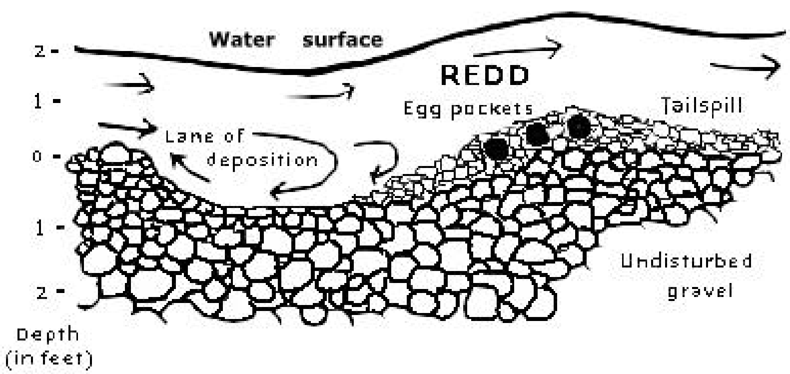
A typical healthy stream has a meandering series of pools spaced every five to seven stream widths apart, with “glides” and shallower “riffles” carrying the flow between them. Higher water velocities occur in riffle areas because of streambed slope, structure, or narrower channel width. They are called the “white water” or turbulent areas of the stream and often include boulders, rocks and coarse gravel or cobble. The faster water and living spaces among rocks make them ideal for insects, so they are important fish food-producing areas of the stream. They are also important spawning areas for some fish species, including trout and salmon.



Overhead view of a typical stream.

Pools are the deeper, wider areas where water flows more slowly and the water surface appears more flat and smooth. An important component of many pool habitats is the presence of large woody debris such as logs and tree root wads, which often help to create the pools and which provide fish with cover from predators and protection from high streamflows. Large woody debris is also excellent insect habitat. The streambed in pools is typically made up of smaller rocks, gravel, or even sand and silt. Pools may be used as resting areas for adult fish and as rearing areas for juveniles.

The "tail" is the end of a pool where flows pick up speed before heading downstream toward the next riffle and pool. Like some riffles, these areas are often used by trout and salmon to create spawning nests or "redds". Redds are generally oval depressions in the gravel that look brighter or cleaner than surrounding gravel. Trout, including steelhead, usually spawn in the spring with eggs and juveniles remaining in the gravel through mid-summer. Salmon generally spawn from mid-August through mid-February, with eggs and juveniles remaining in the gravel until spring or early summer. Char, including bull trout and brook trout, spawn between August and October, with juveniles in the gravel until mid-April.



Salmonid redd (nest) in cross section. Lengthwise cross section of salmonid redd showing the downstream tailspill where the egg pockets are located and the upstream area where excavation stopped. The upstream basin becomes an area of fine sediment deposition. Water accelerates as it approaches the riffle formed by the tailspill. This forces oxygen-rich water through the gravels and to the eggs. This constant flow of fresh water not only supplies oxygen to but removes waste products from the developing eggs.

One notable exception to the preference of trout and salmon for riffles and tails for spawning nests is in streams with bedrock or large boulder bottoms. Here small patches of gravel located on the downstream side of large boulders may provide the only suitable spawning areas for fish.

Other fish species present in a particular stream , such as whitefish, catfish and minnows, may construct nests on gravel and sand bottoms or otherwise utilize smaller substrate for spawning than that preferred by trout and salmon. They may also spawn at different times of the year.

The streambank helps maintain the system of riffles, pools, and tails. It is the slope of land that adjoins a body of water, extends down to the bed of that water body, and contains that water body except in cases of floods. The streambank includes upland vegetation, undercut banks, large rocks, embedded logs, and low overhanging vegetation. Streambank vegetation root systems help stabilize the soil and prevent erosion and excessive stream sediment. The streambank trees, including fallen trees which are partially in the water, shrubs and other plants provide shade and cover for fish as well as habitat for insects utilized for food.

What About Mining Impacts and Benefits?

Mining and prospecting activity, if done improperly, can harm fish populations in our waters. Changes created in stream dynamics caused by altering physical features of streams may start a chain of events that results in loss of fish. Keeping streambed and bank structures as natural and intact as possible is the key to keeping fish populations healthy.

The use of proper practices has the potential to enhance certain stream segments that have become degraded over the years. Removal of mercury, lead, trash, debris and fishing line from the aquatic habitat while working in the stream provides additional benefits to fish, wildlife and people.

Examples of mining practices that can help reduce adverse impacts to fish and fish habitat include:

- Strict compliance with stream closure periods and provisions, thereby protecting important fish spawning/incubation areas.
- Keeping at least 200 feet between excavation sites to reduce cumulative impacts of mining activities.
- Not introducing sediment into the stream channel by methods such as excavating streambanks or washing aggregate collected above the ordinary high water line.
- Protecting streamside vegetation.

- Preventing fuel or oil spills. Whenever possible, refueling motorized equipment well away from the stream.
- Returning rocks, cobbles and boulders to their original positions.
- Leaving large woody material in place.
- Not stacking cobbles or depositing tailings on or near the bank.
- Replacing tailings when excavation is completed.
- Distributing cobbles and tailings as broadly as possible in the channel.
- Periodically stopping operations and pivoting the back of the dredge to help spread tailings.
- Avoiding areas within 400 feet of fishways and fish hatchery water intakes.
- Not using mercury or other hazardous substances for amalgamating gold or other minerals.
- Making sure that human wastes are not deposited where they may enter the water. Using low-impact camping methods.
- Keeping vehicles on established roads at all times, particularly when in flood plains.
- Reporting any observed violations to the nearest WDFW office listed in the Agency Contacts section of this pamphlet.

You can also help the stream environment by keeping the areas you visit clean and free of litter. If you would like to participate in streambank stabilization or other fish enhancement projects, please contact WDFW's Volunteer Program at (360) 902-2235.

Agencies With an Interest in Mineral Prospecting

While this pamphlet only gives authority to conduct mineral prospecting or placer mining operations from Washington Department of Fish and Wildlife, many other federal, state, tribal and local government agencies have their own requirements that must be met before you can legally prospect or mine in areas under their jurisdiction. Below is a brief explanation of the interest these agencies have in mineral prospecting or placer mining. Please contact these agencies as necessary. A contact list is located at the back of this pamphlet.

Federal

U.S. Army Corps of Engineers (Corps)
The Corps is responsible for many beneficial uses of water, including transportation, navigation, recreation and power production. Under the Federal Clean Water Act of 1977, the Corps may require suction dredge operators to obtain a Section 404 permit. Further information and permit applications are available from the Corps' District Regulatory Branch Office in Seattle, Washington (see Agency Contacts section).

U.S. Bureau of Land Management (BLM)
Mining is authorized by a variety of laws on lands managed by the BLM. The Mining Law of 1872, as amended (public lands) and the Mineral Leasing Act of 1947, as amended (acquired lands), are the main laws authorizing placer gold prospecting on federal mineral estate.

BLM manages the surface and mineral estate on some federal lands, and the mineral estate on other lands where the surface is managed by other agencies, or is privately owned. The entry provisions for prospecting and the degree of BLM involvement vary depending on the land ownership and applicable laws.

Under the Mining Law, it is your responsibility to determine if there are prior existing mining claims in your area of interest. Information on existing mining claims, rules, regulations, mineral status maps, survey plats, filing fees, etc., are available in Washington at BLM's Spokane District Office and Wenatchee Resource Area Office, and in Portland, Oregon at BLM's Oregon/Washington State Office. If you locate a mining claim, the Federal

Land Policy and Management Act of 1976 requires you to file a copy of the official notice or certificate of location and a map of claim boundaries with the BLM State Office within 90 days of locating the claim.

Exploration and mining activities on BLM-managed lands are also subject to BLM regulations that vary depending on the authorizing laws and land ownership. On most public lands, the regulations depend on the amount of disturbance and require you to submit either a Notice of Intent (five acres or less) or Plan of Operations (more than five acres). "Casual use" activities causing only negligible disturbance (e.g., hand sample collection) are allowed on most public lands without advance notifications. Occupying the public lands under the mining laws for more than 14 calendar days in any 90 - day period within a 25 mile radius of the initially occupied site requires authorization from BLM.

Instream activities allowed through the *Gold and Fish* pamphlet HPA are considered casual use by BLM. Generally, if WDFW requires a separate HPA for mining activity or if there are highbanking operations above the ordinary high water line, BLM will require a Notice of Intent. Reclamation is required for all surface disturbance and abandonment of a claim does not relieve you of that responsibility.

On acquired lands, you must contact BLM and any surface management agency with jurisdiction to determine if a permit or other conditions are required before entering the lands for hobby or non-commercial collecting. Under the Mineral Leasing Act, commercial activities require filing exploration plans and obtaining a permit for prospecting; if a commercial deposit is found, a lease and an approved mining and reclamation plan is required to mine.

U.S. Forest Service (USFS)

USFS System lands which are open to entry and location under the General Mining Laws are generally open to mineral prospecting and development. Questions about the status of USFS System lands may be addressed to local USFS offices. USFS regulations (36 CFR 228) require that mineral operators file a Notice of Intent with the local USFS Ranger District if significant surface disturbance might be caused by their activities. This determination, even for the same activities, may vary from place to place due to site-specific environmental conditions.

When you intend to (1) suction dredge, (2) highbank, (3) camp for longer than 14 days, or (4) when WDFW issues a supplemental approval or requires a written HPA, you should submit a plan of operation or at least

file a Notice of Intent with the appropriate District Ranger. The District Ranger will then notify you if an operating plan or reclamation bond are necessary. Advance notice to the District Ranger is recommended in case an operating plan and environmental analysis must be completed before your activities can be approved.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS)

NMFS, which has regulatory authority for anadromous fish issues, and USFWS, which regulates issues involving resident fish, other animals and plants, together govern the Endangered Species Act (ESA). This law requires government agencies to conserve all plants and animals, and their critical habitats, that are listed as threatened or endangered with extinction. In some areas of Washington, chinook, sockeye, chum and coho salmon, steelhead and bull trout are listed or are proposed for listing under ESA.

Instream activities in stream sections containing critical habitat for listed fish species may be restricted or extremely limited in order to fully protect those species.

Both NMFS and USFWS have the responsibility to ensure that no activity will harm or destroy any member of a listed species. One method used to accomplish this is by issuing Incidental Take Permits to holders of permits such as HPAs.

National Park Service (NPS)

Mineral development including exploration, extraction, production, storage, and transportation of minerals may be allowed in National Parks only where there are existing valid mining claims, federal mineral leases, or nonfederally owned minerals. In some parks all or certain types of mineral development are specifically prohibited by law.

All persons who conduct mineral development within parks must do so only in conformance with applicable laws, regulations, and NPS policies. Persons may not use or occupy surface lands in a park for purposes of removing minerals outside the park unless provided for in law.

All parks are closed to the location of new mining claims on federal lands under the General Mining Law of 1872. NPS may permit mineral development only on existing valid mining claims in conformance with the park's enabling legislation and the regulations for mining claims. NPS will perform a validity examination of a claim before approving a plan of operations. All mineral development and use of resources in connection with a claim will be confined to the boundaries of the claim itself, except for access and transport that are permitted under existing regulations.

All parks are closed to new federal mineral leasing except for five national recreation areas including Lake Chelan and Ross Lake, where Congress has explicitly authorized federal mineral leasing in each area's enabling legislation. Portions of four of these units and all of Lake Chelan National Recreation Area have been closed to federal mineral leasing by the Secretary of the Interior. No person may explore for federal minerals in any of these areas except under an oil and gas lease, or in the case of solid materials, under a prospecting permit issued pursuant to regulations in 43 CFR 3500. Before consenting to a federal mineral lease or subsequent permit in any of these areas, the responsible regional director will determine that leasing, and the subsequent mineral development in connection with leasing, will not result in a significant adverse effect on park resources or administration.

Some park areas contain leases that existed at the time the park was created or expanded. These leases are valid existing rights and will continue to exist until such time as they expire under the regulations that govern federal mineral leasing. When such a lease expires, the minerals and lands containing such minerals cannot be leased again.

State of Washington

Washington Department of Ecology (WDOE)

WDOE oversees the Shoreline Management Act which sets goals and guidelines for protection of shorelines as valuable natural resources. WDOE also administers water quality standards to prevent interference with or harm to beneficial uses of state waters in lakes, streams, rivers, and marine areas. No degradation of water quality is allowed in waters within national parks, recreation areas, wildlife refuges, scenic rivers, or areas of ecological importance. WDOE checks complaints of water quality violations and can prosecute offenders. Information on water quality degradation is included in the Fish Habitat and Mining Impacts section of this pamphlet.

Water rights are administered by WDOE. A valid water right is required for any surface water removal from waters of the state. Since highbanking removes water from a stream, a water right may be required for this activity. Contact WDOE if you are intending to remove water from any waters of the state.

Washington Department of Fish and Wildlife (WDFW)

WDFW administers the Washington State Hydraulic Code and therefore is the lead state agency in regulating instream mining and prospecting. This law requires that anyone wishing to use, divert, obstruct, or change the natural flow or bed of any river or stream must first obtain an Hydraulic Project Approval so that potential harm to fish and fish habitat can be avoided or corrected.

WDFW owns and manages various lands and you must obtain the permission of the Land Manager for the area prior to entry. Furthermore, any individual 16 years of age or older who wishes to use department lands or access facilities and who does not already have a hunting, fishing, trapping, or free license from the department must purchase a $10 Conservation License. A spouse, children under 16 years of age, and youth groups may use department lands and access facilities without possessing their own licenses if they are accompanied by a license holder. Contact the nearest WDFW Regional Office for more information (see Agency Contacts section).

Washington Department of Natural Resources (WDNR)

The Department of Natural Resources manages, as trust manager, approximately 3 million acres of state-owned uplands and more than 2 million acres of state-owned Aquatic Lands throughout Washington. State-owned uplands managed by the WDNR are identified on the map “Washington State Major Public Lands”, which can be obtained from the WDNR office in Olympia or any of the seven regional offices. Each category of trust land provides funds for a specific purpose, spelled out in law. Public use of these lands that is not compatible with the financial obligations of the management of these trust lands may not be permitted.

State-owned aquatic lands managed by the WDNR include shorelines and beds of navigable lakes and rivers, lying below the ordinary high water line. The WDNR also manages state-owned tidelands, which are shores of navigable tidal waters lying between the ordinary high tide line and the extreme low tide line, and Harbor Areas established by the Harbor Line Commission.

Non-motorized panning may be conducted by individuals on WDNR-managed lands that are open to panning, provided that the rules in *Gold and Fish* pamphlet and additional WDNR requirements are followed. A land use license must be obtained for guided groups or groups of 25 or more people. Panning is permitted only during the authorized work times identified in Table 2 with no extensions. WDNR may not have legal access to all lands under its management and may limit access to or the use of an area for panning at any time. Information on WDNR requirements and land that is open for panning may be obtained by visiting or sending a self-stamped addressed envelope to the regional office managing the area where the panning will be conducted.

The right to explore or develop mineral resources on WDNR-managed lands by means other than non-motorized panning can be acquired by obtaining a mineral prospecting lease, a mining contract, or a placer mining contract. These agreements, which are issued only after a thorough site specific review, require the payment of annual rent, proof of general liability insurance and a performance security. Any work conducted in the leased area must follow the approved plan of operations and any required permits. A royalty is paid to the state for minerals removed.

The WDNR also administers the state's Surface Mine Reclamation Act (SMRA). Exploration activities that disturb more than one acre out of every eight acres or surface mine operations that disturb more than 3 acres must have a SMRA permit.

Information on the geology and mineral resources in Washington can be obtained from the Division of Geology and Earth Resources library in Olympia.

Washington State Office of Archaeology and Historic Preservation
The preservation of Washington's rich cultural heritage, whether it is an historic building or an ancient Indian campsite, is a responsibility that we all share. Protection of these historic sites on Federal or Indian lands is afforded by the Archeological Resources Protection Act (16 USC 470) of 1979, while state laws protect sites on other public or privately owned lands. These laws prohibit such activities as digging or altering Native American grave sites, removing arrowheads, artifacts, old coins or bottles, and the buying and selling of artifacts found on public or Indian lands. If you find a potential Indian or archaeological historic site, contact the Office of Archaeology and Historic Preservation.

Washington State Parks and Recreation Commission (State Parks)
Panning, sluicing or dredging for gold or other minerals is not allowed within streams or other waterways in any state park. Such activity is also prohibited in the state Seashore Conservation Area, which lies between the line of extreme low tide and the line of ordinary high water, extending from Cape Disappointment to the south boundary of the Makah Indian Reservation on the outer Washington coast (RCW 43.51.665).

Local Government - Cities, Counties, Municipalities, Etc.
Cities and counties locally administer the Shoreline Management Act through master plans for shoreline protection. They identify areas where activities can or cannot be conducted. They also require permits for any shoreline use or activity valued at $2,500 or more, or which materially interferes with the normal public use of the waterway or shoreline area. Contact the local planning office before mining to ensure you comply with this law and any other local ordinances.

Tribal Governments
Streams and waterways on treaty Indian tribal lands or reservations are closed to all mineral mining or prospecting unless permission is granted by the tribal government. The tribes are also interested in protection of treaty fish habitat from environmental degradation and in restoring damaged habitat to its full productive potential. Technical staffs of many tribes can provide background fisheries information for various streams and may also provide assistance in fish habitat improvement projects. Please contact the individual tribes for further information.

Definitions of Terms

The following definitions apply to mineral prospecting activities conducted under authorization of this pamphlet and the Hydraulic Code. Terms in these definitions that are highlighted in **bold** are also defined in this section**.**

Aggregate - A mixture of minerals separable by mechanical or physical means.

Bank - Any land surface above the **ordinary high water line** that adjoins a body of water and contains it except during floods. Bank also includes all land surfaces of islands above the ordinary high water line that adjoin a water body and that are below the flood elevation of their surrounding water body.

Bed - The land below the **ordinary high water lines** of **state waters**. This definition shall not include irrigation ditches, canals, storm water run-off devices, or other artificial **watercourses** except where they exist in a natural watercourse that has been altered by man.

Bed materials - Naturally occurring material, including, but not limited to, gravel, cobble, rock, rubble, sand, mud and aquatic plants, found in the **beds** of state waters. Bed materials may be found in deposits or bars above the **wetted perimeter** of water bodies.

Boulder - A **stream** substrate particle larger than ten inches in diameter.

Concentrator - A device used to physically or mechanically separate and enrich the valuable mineral content of **aggregate**. **Pans**, **sluice boxes** and **mini-rocker boxes** are examples of concentrators.

Entirely artificial watercourse - Irrigation ditches, canals, storm water run-off devices, highway ditches or other watercourses that were never and are not now part of a natural stream channel, altered or otherwise.

Excavation site - The pit, furrow, or hole from which **aggregate** is being removed for the processing and recovery of minerals.

Fish life - All fish species, including but not limited to **food fish**, **shellfish**, **game fish**, and other nonclassified fish species and all stages of development of those species.

Fishway - Any facility or device that is designed to enable fish to effectively pass around or through an obstruction without undue stress or delay.

Food fish - Those species of the classes Osteichthyes, Agnatha, and Chondrichthyes that shall not be fished for except as authorized by rule of the director of the department of fish and wildlife.

Freshwater area - Those **state waters** and associated **beds** below the **ordinary high water line** that are upstream of **river** mouths including all **lakes**, ponds, and **streams**.

Game fish - Those species of the class Osteichthyes that shall not be fished for except as authorized by rule of the fish and wildlife commission.

Glide - Calm water flowing smoothly and gently, with moderately low velocities (10-20 cm/sec), and little or no surface turbulence.

Gold and Fish pamphlet - A pamphlet which details the rules required to be followed when conducting **small scale prospecting and mining** activities as well as other prospecting and mining activities and which serves as the **Hydraulic Project Approval** for certain mineral prospecting and mining activities in Washington State.

Hand-held tools - Tools that are held by hand and are not powered by internal combustion, hydraulics, pneumatics, or electricity. Some examples of hand-held tools are shovels, rakes, hammers, pry bars and cable winches.

Hatchery - Any water impoundment or facility used for the captive spawning, hatching, or rearing of **fish** and **shellfish**.

Highbanker - A stationary **concentrator** capable of being operated outside the **wetted perimeter** of the water body from which water is removed, and which is used to separate gold and other minerals from **aggregate** with the use of water supplied by hand or pumping, and consisting of a **sluice box**, hopper, and water supply. Aggregate is supplied to the highbanker by means other than **suction dredging**. This definition excludes **mini-rocker boxes**.

Highbanking - The use of a **highbanker** for the recovery of minerals.

Hydraulic Code - Chapter 75.20 of the Revised Code of Washington.

This code authorizes Washington Department of Fish and Wildlife to issue and condition **Hydraulic Project Approvals** for the protection of **fish life**.

Hydraulic project - Construction or performance of other work that will use, divert, obstruct, or change the natural flow or **bed** of any of the salt or fresh **waters of the state**.

Hydraulic project application - A form provided by and submitted to the Department of Fish and Wildlife accompanied by plans and specifications of the proposed **hydraulic project**.

Hydraulic Project Approval (HPA) - In the case of mineral prospecting and mining, an HPA is either:

(a) A written approval for a **hydraulic project** signed by the director of the Department of Fish and Wildlife (WDFW), or the director's designates; or

(b) A "*Gold and Fish*" pamphlet issued by WDFW which identifies and authorizes specific hydraulic project activities for mineral prospecting.

Hydraulicing - The use of water spray or water under pressure to dislodge minerals and other material.

Incidental Take Permit - A permit issued by U.S. Fish and Wildlife Service or National Marine Fisheries Service which authorizes the incidental **take** of a species listed as threatened or endangered under the Endangered Species Act.

Job site - The space of ground including and immediately adjacent to the area where work is conducted under the authority of a **Hydraulic Project Approval**. For mineral prospecting and placer mining projects, the job site includes the **excavation site**.

Joint Aquatic Resource Permits Application (JARPA) - The application used to apply for a written **Hydraulic Project Approval**.

Lake - Any natural or impounded body of standing freshwater, except impoundments of the Columbia and Snake rivers.

Large woody material - Trees or tree parts larger than four inches in diameter and longer than six feet and rootwads, wholly or partially waterward of the **ordinary high water line**.

Mean higher high water or **MHHW -** The tidal elevation obtained by averaging each day's highest tide at a particular location over a period of 19 years. It is measured from the **MLLW** = 0.0 tidal elevation.

Mean lower low water or **MLLW -** The 0.0 tidal elevation. It is determined by averaging each days' lowest tide at a particular location over a period of 19 years. It is the tidal datum for vertical tidal references in the saltwater area.

Mineral prospecting equipment - Any natural or manufactured device, implement, or animal other than the human body used in any aspect of prospecting for or recovering minerals. Classifications of mineral prospecting equipment are as follows:

(a) Class 0 - nonmotorized pans.

(b) Class I.

(i) **Pans**.

(ii) Nonmotorized **sluice boxes**, **concentrators** and **mini-rocker boxes** with a **riffle** area not exceeding 10 square feet, and not exceeding 50 percent of the width of the **wetted perimeter** of the stream.

(c) Class II.

(i) **Suction dredges** with a maximum nozzle size of 4 inches inside diameter.

(ii) **Highbankers** or suction dredge/highbanker combinations with a maximum water intake size of 2.5 inches inside diameter, when operated wholly below the **ordinary high water line**.

(d) Class III.

(i) **Highbankers** supplied with water from a pump with a maximum water intake size of 2.5 inches inside diameter, when used to process **aggregate** at locations 200 feet or greater landward of the **ordinary high water line**.

(ii) Suction dredge/highbanker combinations supplied with water from a pump with a maximum water intake size of 2.5 inches inside diameter, when used to process aggregate at locations 200 feet or greater landward of the ordinary high water line.

(iii) Other concentrators supplied with water from a pump with a maximum water intake size of 2.5 inches inside diameter, when used to process aggregate at locations 200 feet or greater landward of the ordinary high water line.

Mini-rocker box - A nonmotorized **concentrator** operated with a rocking motion and consisting of a hopper attached to a cradle and a **sluice box** with a **riffle** area not exceeding 10 square feet. The mini-rocker box shall only be supplied with water by hand and be capable of being carried by one individual. A mini-rocker box shall not be considered a **highbanker**.

Natural conditions - Those conditions which arise in or are found in nature. This is not meant to include artificial or manufactured conditions.

Ordinary high water line - The mark on the shores of all waters that will be found by examining the **bed** and **banks** and ascertaining where the presence and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland: *Provided*, That in any area where the ordinary high water line cannot be found the ordinary high water line adjoining **saltwater** shall be the line of **mean higher high water** and the **ordinary high water line** adjoining **freshwater** shall be the elevation of the mean annual flood.

Pan - The following equipment used to separate gold or other metal from **aggregate** by washing:

(a) An open, metal or plastic dish operated by hand; or,

(b) A motorized rotating open, metal or plastic dish without pumped or gravity-fed water supplies.

Panning - The use of a **pan** to wash **aggregate**.

Person - An individual or a public or private entity or organization. The term "person" includes local, state, and federal government agencies, and all business organizations.

Placer - A glacial or alluvial deposit of gravel or sand containing eroded particles of minerals.

Pool - A portion of the **stream** with reduced current velocity, often with water deeper than the surrounding areas.

Protection of fish life - Prevention of loss or injury to **fish** or **shellfish**, and protection of the habitat that supports fish and shellfish populations.

Provisions - The conditions in a written or pamphlet **Hydraulic Project Approva**l which dictate how the **hydraulic project** shall be conducted in order to protect **fish life**.

Riffle - (a) The bottom of a **concentrator** containing a series of interstices or grooves to catch and retain a mineral such as gold; or,
(b) A shallow rapids in a **stream** where the water flows swiftly over completely or partially submerged obstructions to produce surface agitation, but standing waves are absent.

River - See **Watercourse**.

Saltwater area - Those **state waters** and associated **beds** below the **ordinary high water line** and downstream of **river** mouths.

Shellfish - Those species of saltwater and freshwater invertebrates that shall not be taken except as authorized by rule of the director of the department of fish and wildlife. The term "shellfish" includes all stages of development and the bodily parts of shellfish species.

Sluice box - A trough equipped with **riffles** across its bottom, used to recover gold and other minerals with the use of water.

Sluicing - The use of a **sluice box** for the recovery of gold and other minerals.

Small scale mineral prospecting equipment - Encompasses the equipment included in **mineral prospecting equipment, Class I**.

State waters - See **Waters of the state**.

Stream - See **Watercourse**.

Suction dredge - A machine equipped with an internal combustion engine or electric motor powering a water pump which is used to move submerged **bed materials** by means of hydraulic suction. These bed materials are processed through an attached **sluice box** for the recovery of gold and other minerals.

Suction dredging - The use of a **suction dredge** for the recovery of gold and other minerals.

Supplemental Approval - A written addendum issued by the department to a pamphlet **Hydraulic Project Approval** for approved exceptions to conditions of that pamphlet HPA or for any additional authorization by the department when required by a pamphlet HPA. See **Hydraulic Project Approval**.

Tail - A transition between **stream** habitat types. It is the downstream section of a **pool**, usually shallow and with increasing velocity, and without a broken surface.

Tailings - Waste material remaining after processing **aggregate** for minerals.

Take - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any species listed under the Endangered Species Act, or to attempt to engage in any such conduct.

Toe of the bank - The distinct break in slope between the stream **bank** or shoreline and the stream bottom or marine beach or **bed**, excluding areas of sloughing. For steep banks that extend into the water, the toe may be submerged below the **ordinary high water line**. For artificial structures, such as jetties or bulkheads, the toe refers to the base of the structure, where it meets the stream bed or marine beach or bed.

Watercourse - Any portion of a channel, **bed**, **bank**, or bottom waterward of the **ordinary high water line** of waters of the state including areas in which **fish** may spawn, reside, or through which they may pass, and tributary waters with defined bed or banks, which influence the quality of fish habitat downstream. This includes watercourses which flow on an intermittent basis or which fluctuate in level during the year and applies to the entire bed of such watercourse whether or not the water is at peak level. This definition does not include irrigation ditches, canals, storm water run-off devices, or other **entirely artificial watercourses**, except where they exist in a natural watercourse which has been altered by humans.

Water right - A certificate of water right, a vested water right or a claim to a valid vested water right, or a water permit, pursuant to Title 90 RCW.

Waters of the state - All **salt waters** and **fresh waters** waterward of **ordinary high water lines** and within the territorial boundaries of the state.

WDFW - Washington Department of Fish and Wildlife

Wetted perimeter - The areas of a **watercourse** covered with water, flowing or nonflowing.

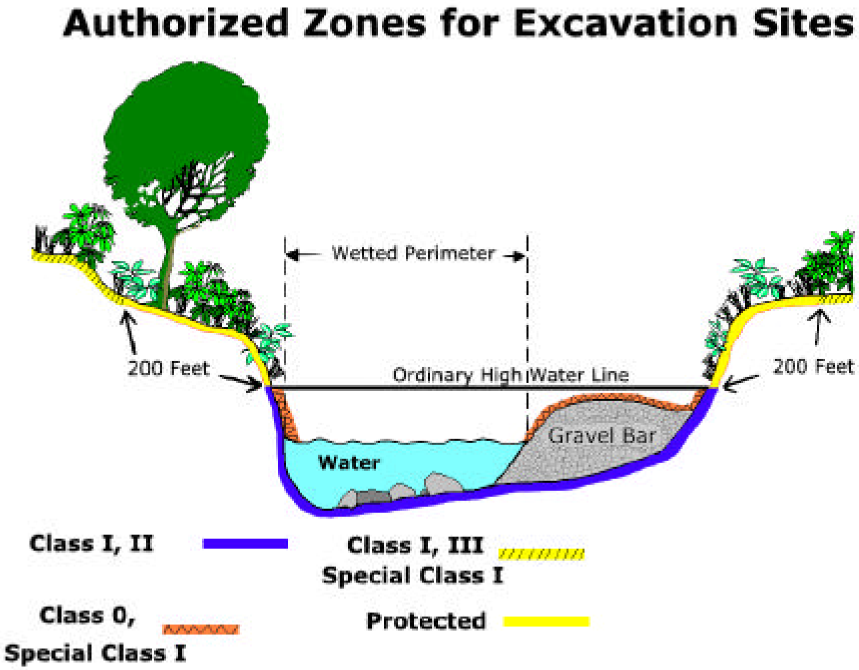
Mineral Prospecting Equipment, Method, Location and Timing Requirements

> *Note: Terms highlighted in **bold type** have specific definitions which can be found in the definitions section of this pamphlet.*

If you are conducting **small scale mineral prospecting and mining** activities, you must follow the rules listed in this pamphlet. Likewise, if you are conducting other prospecting and mining activities and are using this pamphlet as the **Hydraulic Project Approval (HPA)** for them, you must follow the rules listed in it. Not only must you follow the common technical provisions listed below whenever conducting any mineral prospecting or placer mining activities, but you must also comply with the specific provisions for Class 0, I, II, and III **mineral prospecting equipment** listed after the common technical provisions if you are using that equipment. You may only conduct activities in waters during open seasons as listed in Tables 1, 2, 3 and 4. There are limitations on where excavation and processing of **aggregate** may occur in waters open for these activities. These limitations are described in the specific provisions for each class of mineral prospecting equipment and are illustrated below.

If you want to conduct mineral prospecting or mining activities at different times or locations than allowed in this pamphlet or use different equipment, you must obtain written approval from WDFW. You can apply for changes to the location or timing of authorized activity by phoning or writing the WDFW Regional office in which the area you are interested in is located (see the Agency Contacts section of this pamphlet for phone numbers and addresses). You must provide your name, address and phone number and specify the requested exception. Written requests must be signed and dated. For all other changes to the requirements of this pamphlet, you must submit a written application (**JARPA**) to WDFW for review. JARPAs are available from any WDFW, Washington Department of Ecology, Army Corps of Engineers and many local government offices. If **fish life** can be protected from the effects of your proposed activity, a **Supplemental Approval** to the pamphlet, or an **HPA** will be issued to you. You must attach the Supplemental Approval to your *Gold and Fish* pamphlet, which must be on the **job site** when you are prospecting or mining.

Washington Department of Fish and Wildlife (WDFW) may need to change the timing or add additional restrictions to the pamphlet or to an HPA on an emergency basis if it determines that new biological or physical information requires further protection for fish or their habitat. Any changes will be publicized through public media, WDFW's internet website and/or by posting of the affected streams.



COMMON TECHNICAL PROVISIONS *

> *Note: A water right from Washington Department of Ecology (WDOE) is required before you can legally remove water from state waters for any beneficial use, including highbanking or other activities. Contact WDOE for more information.*

Collecting and Processing Aggregate

1. Excavation, collection and processing of **aggregate** from the **bed** shall comply with the timing and location restrictions specified in Tables 1-4. Excavation, collection and processing of aggregate within the **wetted perimeter** shall only occur between 5:00 a.m. and 11:00 p.m.

2. **Excavation sites** shall be separated by at least 200 feet.

3. There shall be no excavation, collection or processing of **aggregate** within 400 feet of any **fishway**, dam or **hatchery** water intake.

4. Except as specified in Class I, **aggregate** collected from outside the **bed** shall not be washed, sluiced, processed or deposited within 200 feet landward of the **ordinary high water line**.

5. A maximum of five individuals eight years of age and over may collect and process **aggregate** from any **excavation site**. No more than one pit, furrow or pothole at a time shall be excavated by any one individual.

6. Excavations shall not occur between the **ordinary high water line** and 200 feet landward of the ordinary high water line. Excavations between the ordinary high water line and the **toe of the bank** shall not result in undercutting below the ordinary high water line or in disturbance of land surfaces above the ordinary high water line.

7. There shall be no disturbance of live rooted vegetation of any kind. Woody debris jams and **large woody material** shall not be disturbed in any manner.

8. With the exception of **aggregate** excavated by a **suction dredge**, all excavations of aggregate shall only be performed by hand or with **hand-held tools**. A maximum of one hand-operated cable, chain or rope winch may be used to move **bed** material below the **ordinary high water line**. Additional safety cables, chains or ropes may be attached to this material provided they do not offer a mechanical advantage and are used solely to hold material in place. The use of horses, other livestock or motorized **mineral prospecting equipment**, except those specifically authorized under Class I, II, and III, is

prohibited. Materials too large to be moved with a single hand-operated cable, chain or rope winch shall not be disturbed.

9. **Boulders** may be moved only to facilitate collection of **aggregate** underneath them. Boulders shall be immediately replaced in their original location prior to working another **excavation site** or leaving the excavation site. Not working the excavation site for more than 16 hours constitutes leaving the site.

10. Only equipment, methods, locations and timing for processing **aggregate** specified in the most current edition of the *Gold and Fish* pamphlet are authorized. Exceptions shall require additional authorization from **WDFW** in the form of a supplemental approval to the *Gold and Fish* pamphlet or a written **HPA**. A written HPA shall be required for exceptions in cases where "submit application" or "closed" is listed for state waters in Tables 1- 4. Only the following exceptions may be authorized through a supplemental approval to the *Gold and Fish* pamphlet:
    a. Timing and location only for Class I and Class II **mineral prospecting equipment**.
    b. Location only for Class III mineral prospecting equipment.

11. With the exception of sieves for classifying aggregate, **mineral prospecting equipment** shall not be combined in series, joined or ganged with additional mineral prospecting equipment to increase the **riffle** area or efficiency of mineral recovery of a single piece of mineral prospecting equipment.

12. There shall be no damming or diversion of the flowing stream except as provided in Class I.

13. Prior to working another **excavation site** or leaving the excavation site, tailings of **aggregate** collected from below the **ordinary high water line** shall be returned to the location from which the aggregate was originally collected. Sand and lighter material washed away by the streamflow during aggregate processing and **tailings** resulting from **suction dredging** may be left where processed.

14. Except as required in provision 13 of this section, **tailings** shall not be deposited in existing pools.

Encountering Fish

15. Incubating **fish** eggs or fry shall not be disturbed. If fish eggs or fry are encountered during excavation of the **bed**, operations shall immediately cease and **WDFW** shall be notified immediately. No further excavations shall occur until all eggs and fry have emerged from the gravel. Further approval shall be required by **WDFW** prior to resuming mineral prospecting or placer mining activities in that stream.

16. **Beds** containing live freshwater mussels shall not be disturbed. If live mussels are encountered during excavation of the bed, operations shall immediately cease and shall be relocated a minimum of 200 feet from them.

17. All pits, furrows, tailing piles, and potholes created during excavation or processing of **aggregate** shall be leveled or refilled with **bed materials** or tailings prior to working another **excavation site** or leaving the excavation site. Not working the excavation site for more than 16 hours constitutes leaving the site. No more than one pit, furrow or pothole at a time shall be excavated.

18. **Fish** entrapped within pits, furrows or potholes created during excavation or processing of aggregate shall immediately be safely collected and returned to flowing waters and the pits, furrows or potholes leveled or filled.

19. At no time shall mining or prospecting activity create a blockage or hindrance to either the upstream or downstream passage of **fish**.

20. If at any time as a result of project activities or water quality problems, **fish life** are observed in distress or a fish kill occurs, operations shall cease and both **WDFW** and the Department of Ecology shall be notified of the problem immediately. Work shall not resume until further approval is given by **WDFW**. Additional measures to mitigate impacts may be required.

Miscellaneous

21. No motorized, tracked, or wheeled vehicles shall be:
    a. Operated or allowed below the **ordinary high water line** of the stream; or;
    b. Be operated so as to affect the **bed** or flow of **waters of the state** in any way.

22. Entry onto private property or removal of minerals from an existing mining claim or state-owned lands without the permission of the landowner or claim holder is not authorized. The permittee is responsible for determining land ownership, land status (i.e., open to entry under the mining laws) and the status and ownership of any mining claims.

23. Mercury and other hazardous materials shall not be used on the **job site** for amalgamating minerals.

24. Mercury, lead and other hazardous materials removed from **aggregate** or collected in **concentrators** during processing of aggregate shall not be returned to **waters of the state** and shall be disposed of as specified by the Department of Ecology. Contact the Department of Ecology for direction on disposal.

25. Once mining or prospecting at a job site is completed, or mining or

prospecting is not conducted at the **job site** for more than one week, the job site shall be restored to preproject conditions, all disturbed areas shall be protected from erosion and revegetated with native plants, and all pits, furrows, **tailing** piles, and potholes shall be leveled or refilled as required in provision 17 of this section.

26. A copy of the current *Gold and Fish* pamphlet shall be on the **job site** at all times.

CLASS 0 EQUIPMENT TECHNICAL PROVISIONS

Class 0 equipment includes:
☞ Nonmotorized **pans**

In addition to the Common Technical Provisions, you must comply with the following technical provisions when conducting Class 0 mineral prospecting and placer mining projects.

1. The common technical provisions and the timing and location restrictions as specified in Table 1 shall apply to all mineral prospecting and placer mining projects conducted with Class 0 equipment.

2. The use of a single hand-operated nonmotorized **pan** is authorized.

3. Collection and processing of **aggregate** shall be limited to that portion of the **bed** above the **wetted perimeter**.

CLASS I EQUIPMENT TECHNICAL PROVISIONS

Class I equipment includes:

- ☞ **Pans**
- ☞ Nonmotorized **sluice boxes**, **concentrators** and **mini-rocker boxes** with a **riffle** area not exceeding 10 square feet, and not exceeding 50 percent of the width of the **wetted perimeter** of the stream.

In addition to the Common Technical Provisions, you must comply with the following technical provisions when conducting Class I mineral prospecting and placer mining projects.

1. The common technical provisions and the timing and location restrictions as specified in Tables 2 and 3 shall apply to all mineral prospecting and placer mining projects conducted with Class I **mineral prospecting equipment**.

2. The use of only Class I **mineral prospecting equipment** is authorized. In addition to the use of one hand-held **pan**, no more than one other piece of mineral prospecting equipment shall be operated by an individual at any one time and location.

3. There shall be no **hydraulicing**.

4. The following shall also apply to all mineral prospecting and placer mining projects conducted with Class I equipment during the general or specific tributary seasons as specified in Tables 2 and 3:
   a. Collection of **aggregate** shall be limited to the **bed**, or to 200 feet or greater landward of the **ordinary high water line**.
   b. Aggregate may be processed either on or above the bed: *Provided*, That within 200 feet landward of the ordinary high water line:
      (i) Any water used shall be fully contained in pans, buckets or similar vessels.
      (ii) Wastewater resulting from processing of aggregate shall be discharged 200 feet or greater landward of the ordinary high water line.
      (iii) Settleable solids shall be removed from wastewater. Sediments resulting from collection or processing of aggregate shall be deposited so they will not enter waters of the state.
   c. Class I mineral prospecting equipment shall only be supplied with water flowing naturally in the stream, or with water collected with and contained in hand-carried buckets or pans.
   d. There shall be no damming or diversion of the flowing stream beyond that necessary to direct water into a Class I **sluice box** as described in (c) of this subsection, and in no case shall greater than 50 percent of the width of the **wetted perimeter** of the stream be dammed or diverted. In no case shall the stream be directed outside of the existing wetted perimeter. The site of the dam or diversion shall be restored to its original condition prior to working another site or leaving the site.

5. The following shall also apply to all mineral prospecting and placer mining projects conducted with Class I equipment during the special Class I season as specified in Table 3:
   a. Collection of **aggregate** shall be limited to that portion of the **bed** above the **wetted perimeter**, or to 200 feet or greater landward of the **ordinary high water line**.
   b. **Aggregate** shall be processed above the wetted perimeter: *Provided*, That within 200 feet landward of the ordinary high water line:
      (i) Any water used shall be fully contained in pans, buckets or similar vessels.
      (ii) Wastewater resulting from processing of aggregate shall be discharged 200 feet or greater landward of the ordinary high water line.
      (iii) Settleable solids shall be removed from wastewater. Sediments resulting from collection or processing of aggregate shall be deposited so they will not enter **waters of the state**.
   c. Equipment shall only be supplied with water collected with and contained in hand-carried buckets or pans.
   d. There shall be no damming or diversion of the flowing stream.

CLASS II EQUIPMENT TECHNICAL PROVISIONS

Class II equipment includes:

- **Suction dredges** with a maximum nozzle size of 4 inches inside diameter.
- **Highbanker**s or suction dredge/highbanker combinations with a maximum water intake size of 2.5 inches inside diameter, when operated wholly below the **ordinary high water line**.

In addition to the Common Technical Provisions, you must comply with the following technical provisions when conducting Class II mineral prospecting and placer mining projects.

1. The common technical provisions and the timing and location restrictions as specified in Tables 2 and 3 shall apply to all mineral prospecting and placer mining projects conducted with Class II equipment.

2. With the exception of the use of one hand-held **pan**, the use of only Class II **mineral prospecting equipment** is authorized. In addition to the use of a hand-held **pan**, no more than one piece of **mineral prospecting equipment** shall be operated by an individual at any one time and location.

3. Only one piece of Class II equipment shall be operated at any time at any **excavation site**.

4. Collection of **aggregate** shall be limited to the **bed**.

5. A nozzle greater than four inches inside diameter shall be used on a **suction dredge** only if a reducer or smaller diameter hose is attached to restrict the inside diameter to four inches or less.

6. Any device used for diverting or pumping water from a fish-bearing stream shall be equipped with a fish guard to prevent passage of **fish** into the diversion device pursuant to RCW 75.20.040 and 77.16.220. To prevent fish from entering the system the pump intake shall be screened with either:
   a. 0.06 inch (eighteen gauge) woven wire mesh with openings no greater than 0.087 inches; or
   b. Perforated plate with openings no greater than 0.094 inch (3/32 inch); or
   c. Profile bar with openings no greater than 1.75 millimeter (0.069 inch).

   The screened intake shall consist of a facility with enough surface area to ensure that the velocity through the screen is less than 0.4 feet per

second, but in no case shall the surface area be less than one square foot. Screens shall be maintained to prevent injury or entrapment to juvenile fish and screens shall remain in place whenever water is withdrawn from the stream through the pump intake.

7. There shall be no **hydraulicing** outside of the **wetted perimeter**. Hydraulicing may be conducted only for redistribution of **tailings** within the **bed** to level or fill pits, potholes or furrows, and the nozzle or jet shall be submerged at all times.

8. Petroleum products or other harmful materials shall not enter **waters of the state**. Equipment shall be well maintained and inspected frequently to prevent fuel and fluid leaks.

9. Water shall be pumped only from a water body to a **suction dredge** operated within the **wetted perimeter** or to a **highbanker** located below the **ordinary high water line**.

CLASS III EQUIPMENT TECHNICAL PROVISIONS

Class III equipment includes:

- ☞ **Highbankers** supplied with water from a pump with a maximum water intake size of 2.5 inches inside diameter, when used to process **aggregate** at locations 200 feet or greater landward of the **ordinary high water line**.
- ☞ Suction dredge/highbanker combinations supplied with water from a pump with a maximum water intake size of 2.5 inches inside diameter, when used to process aggregate at locations 200 feet or greater landward of the ordinary high water line.
- ☞ Other **concentrators** supplied with water from a pump with a maximum water intake size of 2.5 inches inside diameter, when used to process aggregate at locations 200 feet or greater landward of the ordinary high water line.

In addition to the Common Technical Provisions, you must comply with the following technical provisions when conducting Class III mineral prospecting and placer mining projects.

1. The common technical provisions and the timing and location restrictions as specified in Table 4 shall apply to all mineral prospecting projects conducted with Class III equipment.

2. With the exception of the use of one hand-held **pan**, the use of only Class III **mineral prospecting equipment** is authorized. In addition to the use of a hand-held pan, no more than one piece of mineral prospecting equipment shall be operated by an individual at any one time and location.

3. **Aggregate** shall be collected and processed 200 feet or greater landward of the **ordinary high water line**.

4. There shall be no motorized movement of **bed materials**.

5. The pump intake shall be placed in the water without moving or relocating any material in or on the **bed** or **banks**.

6. Any device used for diverting or pumping water from a fish-bearing stream shall be equipped with a fish guard to prevent passage of **fish** into the diversion device pursuant to RCW 75.20.040 and 77.16.220. To prevent fish from entering the system the pump intake shall be screened with either:
   a. 0.06 inch (eighteen gauge) woven wire mesh with openings no

greater than 0.087 inches; or
   b. Perforated plate with openings no greater than 0.094 inch (3/32 inch); or
   c. Profile bar with openings no greater than 1.75 millimeter (0.069 inch).

   The screened intake shall consist of a facility with enough surface area to ensure that the velocity through the screen is less than four-tenths feet per second, but in no case shall the surface area be less than one square foot. Screens shall be maintained to prevent injury or entrapment to juvenile fish and screens shall remain in place whenever water is withdrawn from the stream through the pump intake.

7. Petroleum products or other harmful materials shall not enter **waters of the state**. Equipment shall be well maintained and inspected frequently to prevent fuel and fluid leaks.

8. There shall be no **hydraulicing**.

9. Settleable solids shall be removed from wastewater prior to the water reentering **waters of the state**. Sediments resulting from collection or processing of **aggregate** shall be deposited so they will not enter waters of the state.

LOCATION AND TIMING REQUIREMENTS

Use the following tables to determine where and when mineral prospecting is allowed in state waters. Mineral prospecting and placer mining using Class 0, I, II, or III equipment shall only occur in watercourses and times as specified below. If you wish to prospect or mine at other locations or times than allowed in these tables you must obtain written authorization of Washington Department of Fish and Wildlife. See page 28 for more information.

Equipment Class	Work Time and Watercourse Table
Class 0	Table 1
Class I	Tables 2 and 3
Special Class I	Table 3
Class II	Tables 2 and 3
Class III	Table 4

Table 1. Authorized work times and watercourses for mineral prospecting and placer mining projects using Class 0 equipment only.

1. The work times apply to all watercourses listed and their tributaries.

2. Mineral prospecting and placer mining within 200 feet landward of the ordinary high water line in state waters listed as "submit application" or "closed" is not authorized under the *Gold and Fish* pamphlet. Site review and a written HPA is required for these state waters.

WATERCOURSE	WORK TIME
All watercourses not listed as "submit application" or "closed" in Tables 2 and 3	January 1 - December 31
All watercourses listed as "submit application" in Tables 2 and 3	submit application
All watercourses listed as "closed" in Tables 2 and 3	closed

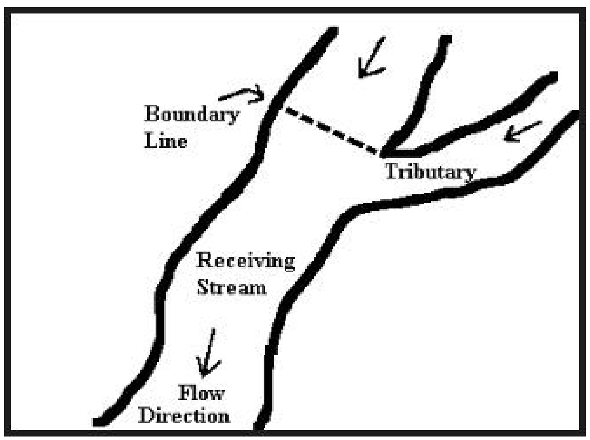
Table 2. Authorized work times and watercourses for mineral prospecting and placer mining projects by specific watercourse, except the Columbia and Snake rivers, lakes, salt waters and waters within National Park boundaries using Class I and II equipment.

1. The general work time for a county applies to all streams within that county, unless otherwise indicated under specific stream and tributary work times. See Table 3 for Class I and II worktimes in the Columbia and Snake rivers, lakes, salt waters and waters within National Park boundaries.

2. The work time for a listed stream applies to all its tributaries, unless otherwise indicated. Some streams flow through multiple counties. Check the listing for the county in which mineral prospecting or placer mining is to be conducted to determine the work time for that stream.

3. Where a tributary is listed as a boundary, that boundary shall be the line perpendicular to the receiving stream that is projected from the most upstream point of the tributary mouth to the opposite bank of the receiving stream. (See Figure 1)

Figure 1. Stream boundary line



4. Mineral prospecting and placer mining within 200 feet landward of the ordinary high water line in state waters listed as "submit application" or "closed" is not authorized under the *Gold and Fish* pamphlet. Site review and a written HPA is required for these state waters.

		SPECIFIC STREAM & TRIBUTARY WORK TIMES	
COUNTY	GENERAL WORK TIMES	STREAM & ALL TRIBUTARIES	WORK TIME
Adams	July 1 - October 31	Esquatzel Creek	July 1 - September 30
		Palouse River	June 15 - October 15
Asotin	July 1 - October 31	Asotin Creek	July 15 - August 15
		Grande Ronde River	July 15 - August 15

		SPECIFIC STREAM & TRIBUTARY WORK TIMES	
COUNTY	GENERAL WORK TIMES	STREAM & ALL TRIBUTARIES	WORK TIME
Benton	June 1 - September 30	Yakima River tributaries	July 1 - September 30
		--Corral Creek	July 15 - September 30
		--Spring Creek	July 15 - September 30
Chelan	July 1 - August 15	Beaver Creek	July 1 - October 31
		Colockum Creek	July 1 - October 31
		Peshastin Creek	
		--mouth to Negro Creek	July 1 - August 15
		--above Negro Creek	July 1 - October 31
		Squilchuck Creek	July 1 - October 31
		Stemilt Creek	
		--mouth to falls	July 1 - October 31
		Wenatchee River	
		--mouth to lake	July 1 - September 30
Clallam	July 15 - September 30	Bogachiel River	July 15 - August 15
		Calawah River	July 15 - August 15
		Clallum River	July 15 - September 15
		Dungeness River	submit application
		Elwha	
		--mouth to lower dam	July 1 - August 15
		Hoko River	July 15 - September 15
		Jimmycomelately Creek	submit application
		Lyre River	July 15 - September 15
		McDonald Creek	July 1 - August 15
		Morse Creek	July 1 - August 15
		Pysht River	July 15 - September 15
		Sekiu River	July 15 - September 15
		Sol Duc River	July 15 - August 15
		Sooes River	July 15 - September 15
Clark	July 1 - September 30	Lewis River	
		--mouth to forks	June 1 - October 31
		--East Fork Lewis River	
		----mouth to LaCenter road bridge	July 1 - October 31
		----above LaCenter & all tributaries	submit application
		--North Fork Lewis River	
		----mouth to Merwin Dam	August 1 - August 31
		----Cedar Creek	August 1 - September 30
		----Merwin Dam to Swift Dam	July 1 - July 31
		Lake River	June 1 - October 31
		Washougal River	August 1 - August 31
Columbia	July 15 - October 31	Tucannon River	July 15 - August 15
		Touchet River	July 15 - August 15
Cowlitz	July 1 - September 30	Cowlitz River	August 1 - August 31
		--Coweeman River	August 1 - September 30
		--Toutle River	submit application
		Kalama River	August 1 - August 31

		SPECIFIC STREAM & TRIBUTARY WORK TIMES	
COUNTY	GENERAL WORK TIMES	STREAM & ALL TRIBUTARIES	WORK TIME
Cowlitz	July 1 - September 30	Lewis River	
(cont.)		--mouth to forks	June 1 - October 31
		--North Fork Lewis River	
		----mouth to Merwin Dam	August 1 - August 31
		----Merwin Dam to Lower Falls	July 1 - July 31
		----above Lower Falls	July 1 - October 31
Douglas	July 1 - October 31	None	
Ferry	July 1 - August 31	None	
Franklin	June 1 - September 30	Palouse River	
		--above falls	June 15 - October 15
Garfield	July 15 - October 31	Asotin Creek	July 15 - August 15
		Tucannon River	July 15 - August 15
Grant	July 1 - October 31	None	
Grays Harbor	July 15 - October 31	Cedar Creek	July 15 - September 30
		Chehalis River	
		--mouth to Porter Creek	June 1 - October 31
		--above Porter Creek	July 15 - September 30
		Cloquallum River	July 15 - September 30
		Copalis River	July 15 - October 15
		Elk River	July 15 - September 30
		Hoquiam River	July 15 - October 15
		Humptulips River	July 15 - October 15
		Johns River	July 15 - September 30
		Moclips River	July 15 - October 15
		North River	July 15 - September 15
		Porter Creek	July 15 - September 30
		Quinault River	July 15 - August 31
		Satsop River	July 15 - August 31
		Wishkah River	July 15 - October 15
		Wynoochee River	July 15 - October 15
Island	June 15 - September 15	None	
Jefferson	July 15 - October 31	Big Quilcene River	July 15 - August 31
		Bogachiel River	July 15 - August 15
		Chimacum Creek	July 15 - August 31
		Clearwater River	July 15 - September 15
		Donovan Creek	July 15 - September 30
		Dosewallips River	July 15 - August 31
		Duckabush River	July 15 - August 31
		Dungeness River tributaries	submit application
		Hoh River	July 15 - August 15
		Little Quilcene River	July 15 - August 31
		Matheny Creek	July 15 - September 15
		Queets River	July 15 - September 15
		Quinault River	July 15 - August 15
		Salmon Creek	submit application
		Sams River	July 15 - September 15
		Snow Creek	submit application

COUNTY	GENERAL WORK TIMES	SPECIFIC STREAM & TRIBUTARY WORK TIMES: STREAM & ALL TRIBUTARIES	WORK TIME
King	July 1 - September 30	Green River (Duwamish)	August 1 - August 31
		Greenwater River	July 15 - August 31
		Lake Washington tributaries including Cedar and Sammamish rivers	July 1 - August 31
		--Issaquah Creek	June 15 - July 31
		Snoqualmie River	
		--mouth to Snoqualmie Falls	July 1 - September 15
		--Snoqualmie Falls to mouth of South Fork Snoqualmie River	June 15 - October 31
		--North, Middle and South Fork Snoqualmie rivers and tributaries	July 15 - October 31
		--Tolt River	
		-----mouth to forks	July 15 - October 31
		-----North Fork	
		-------mouth to Yellow Creek	July 15 - September 15
		-------above Yellow Creek	July 15 - October 31
		-------mouth to dam	July 15 - September 15
		-------above dam	July 15 - October 31
		White River	July 15 - August 31
Kittitas	June 1 - September 30	Colockum Creek	July 1 - October 31
		Yakima River	
		--above Roza Dam	submit application
		--Gold Creek (Lake Keechelus)	July 1 - July 31
		--Kachess River	
		----above Lake Kachess	July 1 - July 31
		----Box Canyon Creek (Lake Kachess)	July 1 - July 31
		--Little Naches River	July 15 - August 15
		--Wenas Creek	August 1 - October 31
		--other Yakima River tributaries	July 15 - August 31
Kitsap	July 15 - October 31	Seabeck Creek	July 15 - August 31
		Gorst Creek	July 15 - August 31
Klickitat	July 1 - September 30	Klickitat River	July 1 - August 15
		White Salmon River	July 1 - August 15
Lewis	July 1 - September 30	Chehalis River	
		--upstream of South Fork Chehalis River confluence	July 1 - August 31
		Cispus River	
		--mouth to Walupt Creek	August 1 - August 31
		--above Walupt Creek	submit application
		--McCoy Creek	August 1 - September 30
		Connelly Creek	August 1 - September 30
		Cowlitz River	August 1 - August 31
		Newaukum River	July 1 - August 31
		Nisqually River	
		--above Alder Lake	July 1 - September 30

COUNTY	GENERAL WORK TIMES	SPECIFIC STREAM & TRIBUTARY WORK TIMES: STREAM & ALL TRIBUTARIES	WORK TIME
Lewis	July 1 - September 30	Skookumchuck River	July 1 - August 31
(cont.)		Tilton River	August 1 - September 30
		Toutle River	
		--tributaries	submit application
		Walupt Creek	submit application
		Packwood Lake tributaries	submit application
Lincoln	June 15 - October 15	None	
Mason	July 15 - October 31	Cloquallum Creek	July 15 - September 30
		Coulter Creek	July 15 - September 15
		Hamma Hamma River	
		--mouth to falls	July 15 - August 31
		--John Creek	July 15 - August 31
		Johns Creek	July 15 - August 31
		Lilliwaup River	
		--below falls	July 15 - August 31
		--above falls	July 1 - October 31
		Mill Creek	July 15 - October 15
		Satsop River	July 15 - August 31
		Schaerer Creek	July 15 - August 31
		Sherwood Creek	July 15 - September 15
		Skokomish River	July 15 - September 15
		Tahuya River	July 15 - September 15
		Twanoh Creek	June 1 - October 31
		Union River	June 1 - September 15
Okanogan	July 1 - August 15	Aneas Creek	
		--mouth to falls	July 1 - October 31
		Chewiliken Creek	
		--mouth to falls	July 1 - October 31
		Chiliwist Creek	
		--mouth to falls	July 1 - October 31
		Methow River	
		--mouth to Carleton	July 1 - September 30
		Mosquito Creek	July 1 - October 31
		Nine Mile Creek	July 1 - October 31
		Omak Creek	
		--mouth to falls	July 1 - October 31
		Similkameen River	
		--mainstem	July 1 - September 30
		--all Similkameen River tributaries	July 1 - August 15
		Tunk Creek	
		--mouth to falls	July 1 - October 31
Pacific	July 15 - September 30	Chehalis River	July 1 - August 31
		Chinook River	August 1 - August 31
		Grays River	August 1 - September 30
		North River	July 15 - September 15

COUNTY	GENERAL WORK TIMES	SPECIFIC STREAM & TRIBUTARY WORK TIMES: STREAM & ALL TRIBUTARIES	WORK TIME
Pend Oreille	July 1 - August 31	Big Muddy Creek	June 1 - August 31
		Bracket Creek	June 1 - August 31
		Calispel Creek	
		--mouth to Calispel Lake	June 1 - August 31
		Exposure Creek	June 1 - August 31
		Kent Creek	June 1 - August 31
		Lime Creek	June 1 - August 31
		Little Spokane River	June 15 - August 31
		Lodge Creek	June 1 - August 31
		Marshall Creek	June 1 - August 31
		Pee Wee Creek	
		--above falls	June 1 - October 31
		Renshaw Creek	June 1 - August 31
Pierce	July 15 - August 31	Nisqually River	
		--mouth to Alder Lake	July 1 - August 31
		--tributaries below Alder Lake	submit application
		--above Alder Lake & tributaries	July 15 - September 15
		Carbon River	July 15 - August 31
		--South Prairie Creek	
		----mouth to Forest Service road #7710	July 15 - September 15
		----above Forest Service road #7710	July 1 - October 31
		--Voights Creek	
		----mouth to falls	July 15 - September 15
		----above falls	July 15 - October 31
		--Wilkeson Creek	
		----mouth to Snell Lake	July 1 - September 30
		----above Snell Lake	July 1 - October 31
		Rocky Creek	July 15 - September 30
San Juan	June 1 - August 31	None	
Skagit	July 1 - September 30	Baker River	
		--mouth to dam	June 15 - August 31
		Cascade River	June 15 - July 15
		Illabot Creek	June 15 - July 31
		Samish River	submit application
		Skagit River	
		--mouth to Sauk River	June 15 - August 31
		--above Sauk River	June 15 - July 31
		--Sauk River	July 15 - August 15
		----Suiattle River	July 15 - August 15
		Nooksack River	submit application
Skamania	July 1 - September 30	Cispus River	August 1 - August 31
		Lewis River	
		--East Fork Lewis River	submit application
		--North Fork Lewis River	
		----Cougar Creek	June 1 - July 31
		----Merwin Dam to Lower Falls and tributaries	July 1 - July 31

COUNTY	GENERAL WORK TIMES	SPECIFIC STREAM & TRIBUTARY WORK TIMES: STREAM & ALL TRIBUTARIES	WORK TIME
Skamania (cont.)	July 1 - September 30	----above Lower Falls	July 1 - October 31
		Little White Salmon River	July 1 - August 31
		McCoy Creek	August 1 - September 30
		Washougal River	August 1 - August 31
		White Salmon River	July 1 - August 31
		Wind River	August 1 - August 15
Snohomish	July 1 - September 30	Lake Washington tributaries	July 1 - August 31
		Sauk River	July 15 - August 15
		--Suiattle River	July 15 - August 15
		Snohomish River	
		--mouth to Highway 9	June 1 - October 31
		--above Highway 9	July 1 - August 31
		--Pilchuck River	July 1 - August 31
		----mouth to city of Snohomish diversion dam	July 1 - August 31
		----above city of Snohomish diversion dam	July 1 - September 15
		--Skykomish River	
		----mouth to forks	July 1 - August 31
		----North Fork Skykomish River	
		----mouth to San Juan campground	July 1 - August 31
		----San Juan campground to Deer Falls	submit application
		----above Deer Falls	July 15 - October 31
		----Salmon Creek	submit application
		----South Fork Skykomish River	
		----mouth to Sunset Falls	July 1 - August 31
		----Sunset Falls to Alpine Falls	July 1 - September 15
		----above Alpine Falls	July 15 - October 31
		----Beckler River	
		----mouth to Boulder Creek	July 1 - September 15
		----above Boulder Creek	July 15 - October 31
		----Rapid River	
		----mouth to Meadow Creek	July 15 - September 15
		----above Meadow Creek	July 15 - October 31
		----Foss River	
		----mouth to forks	July 15 - September 15
		----East Fork Foss River	submit application
		----West Fork Foss River	July 15 - October 31
		----Miller River	
		----mouth to forks	July 1 - September 15
		----above forks	July 1 - October 31
		----Olney Creek	
		----mouth to Olney Falls	July 1 - September 15
		----above Olney Falls	July 1 - October 31
		----Sultan River	
		----mouth to old diversion dam	July 1 - August 31
		----old diversion dam to Culmback Dam	July 1 - October 31
		----tributaries above Culmback Dam	August 1 - October 31

COUNTY	GENERAL WORK TIMES	SPECIFIC STREAM & TRIBUTARY WORK TIMES: STREAM & ALL TRIBUTARIES	WORK TIME
Snohomish (cont.)	July 1 - September 30	----Wallace River	
		------mouth to Wallace Falls	July 1 - September 1
		------above Wallace Falls	July 1 - October 31
		--Snoqualmie River	July 1 - August 31
		--all other Snohomish River tributaries	July 1 - August 31
		Stillaguamish River	
		--mouth to forks	July 1 - August 31
		--North and South Fork Stillaguamish Rivers	July 1 - August 15
		--Deer Creek	submit application
		--Canyon Creek	submit application
Spokane	June 15 - August 31	Latah Creek	
		--mainstem	June 15 - October 31
		--all Latah Creek tributaries	June 15 - August 31
Stevens	July 1 - August 31	Big Sheep Creek	
		--mouth to Sheep Creek Falls	submit application
		--above Sheep Creek Falls	July 1 - August 31
Thurston	July 15 - September 15	Cedar Creek	July 15 - September 30
		Little Deschutes River	July 15 - October 31
		McLane Creek	July 15 - October 31
		Nisqually River	
		--mainstem	July 1 - August 31
		--all Nisqually River tributaries	submit application
		Porter Creek	July 15 - September 30
		Schneider Creek	July 1 - October 31
		Skookumchuck River	July 1 - August 31
		Woodard Creek	July 1 - October 31
		Woodland Creek	July 1 - October 31
Wahkiakum	July 15 - September 15	Elochoman River	August 1 - September 30
		Grays River	August 1 - September 30
		Naselle River	July 15 - September 30
Walla Walla	July 15 - October 31	Touchet River	July 15 - August 15
		Walla Walla River	July 15 - August 15
Whatcom	July 1 - September 30	Baker River	submit application
		Nooksack River	
		--above forks	submit application
		--all Nooksack River tributaries	submit application
		Ross Lake tributaries	submit application
		Samish River	submit application
		Skagit River	June 15 - July 31
Whitman	June 15 - October 15	Palouse River	
		--mouth to falls	June 1 - September 30

COUNTY	GENERAL WORK TIMES	SPECIFIC STREAM & TRIBUTARY WORK TIMES: STREAM & ALL TRIBUTARIES	WORK TIME
Yakima	June 1 - September 30	Klickitat River	July 1 - August 15
		Yakima River	
		--mouth to Roza Dam	June 1 - September 15
		--Naches River	
		----mouth to Tieton River	June 1 - October 31
		----above confluence of Tieton River	June 1 - August 15
		----Indian Creek (Rimrock Lake)	July 1 - July 31
		----Tieton River	June 1 - August 15
		----Little Naches River	July 15 - August 15
		----Bumping River	July 15 - August 15
		------American River	submit application
		----Rattlesnake Creek	July 15 - August 15
		--Wenas Creek	August 1 - October 31
		--all other Yakima River tributaries	July 15 - August 31

Table 3. Authorized work times and watercourses for mineral prospecting and placer mining projects in the Columbia and Snake rivers, lakes, salt waters and waters within National Park boundaries using Class I and II equipment.

1. Where a tributary is listed as a boundary, that boundary shall be the line perpendicular to the receiving stream and which is projected from the most upstream point of the tributary mouth to the opposite bank of the receiving stream (See Figure 1.).

2. The general and special Class I work times apply only to the watercourses listed. See Table 2 for work times and locations for tributaries to the listed watercourses.

3. Use of Class I equipment only is authorized for the special Class I work times.

4. Mineral prospecting and placer mining within 200 feet landward of the ordinary high water line in state waters listed as "submit application" or "closed" is not authorized under the *Gold and Fish* pamphlet. Site review and a written HPA is required for these state waters.

WATERCOURSE	GENERAL WORK TIME	SPECIAL CLASS I WORK TIME
Columbia River		
--mouth to Snake River	submit application	June 1 - October 31
--Snake River to Priest Rapids Dam	August 1 - August 31	June 1 - August 1
--Priest Rapids Dam to Wenatchee River	October 16 - October 31	June 1 - October 16
--above Wenatchee River	September 1 - October31	June 1 - September 1
Snake River	August 1 - August 31	June 1 - August 1
Lakes	closed	closed
--Columbia River reservoirs	see Columbia River above	see Columbia River above
--Snake River reservoirs	see Snake River above	see Snake River above
Salt waters	closed	closed
All watercourses, including tributaries, within National Park boundaries	closed	closed

Table 4. Authorized work times and watercourses for mineral prospecting and placer mining projects using Class III equipment only.

1. The work times apply to all watercourses listed and their tributaries.

2. Mineral prospecting and placer mining within 200 feet landward of the ordinary high water line in streams listed as "closed" is not authorized.

WATERCOURSE	WORK TIME
All watercourses not listed as "closed" in Tables 2 and 3	January 1 - December 31
All watercourses listed as "closed" in Tables 2 and 3	closed

AGENCY CONTACTS

Federal Government

Bureau of Land Management
Conducting Placer Operations:
Spokane District Office
1103 N Fancher
Spokane WA 99212-1275
(509) 536-1200
FAX (509) 436-1275
Website: www.or.blm.gov/Spokane/

Wenatchee Resource Area Office
915 Walla Walla Street
Wenatchee WA 98801-1521
(509) 665-2100
FAX (509) 665-2121

Recordation of Mining Claims:
Oregon/Washington State Office
PO Box 2965
Portland OR 97208-2965
or
1515 SW Fifth Ave
Portland OR 97201
(503) 952-6001
(503) 952-6297
Website: www.or.blm.gov/

National Marine Fisheries Service
Washington State Branch Office
Habitat Conservation Division
510 Desmond Drive SE, Suite 103
Lacey WA 98503
(360) 753-9530

Northwest Regional Office
7600 Sand Point Way NE
BIN CI5700, Building 1
Seattle WA 98115-0070
(206) 526-6150
Website: www.nwr.noaa.gov/

National Park Service
Columbia Cascades Support Office
909 First Avenue
Seattle, WA 98104-1060
(206) 220-4020
FAX (206) 220-4159
Website: www.nps.gov/ccso/

U.S. Army Corps of Engineers
Seattle District
PO Box 3755
Seattle WA 98124-3755
Attn: Regulatory Branch
(206) 764-3495
FAX (206) 764-6602
Website:
http://www.nws.usace.army.mil/

U.S. Fish and Wildlife Service
For areas west of the Cascade crest:
Western Washington Office
Endangered Species Division
510 Desmond Drive SE, Suite 102
Lacey WA 98503
(360) 753-9440

For areas east of the Cascade crest:
Upper Columbia River Basin Field Office
11103 E Montgomery Drive, Suite 2
Spokane WA 99206
(509) 891-6839
Website: www.r1.fws.gov/

U.S. Forest Service
Region 6 Regional Office
PO Box 3623
Portland OR 97208-3623
(503) 808-2925
FAX (503) 808-2454
Website: www.fs.fed.us/r6/

Colville National Forest
765 S. Main
Colville WA 99114
(509) 684-7000
FAX (509) 684-7280

Gifford Pinchot National Forest
10600 NE 51st Circle
Vancouver WA 98682
(360) 891-5000
FAX (360) 891-5045

Mt. Baker-Snoqualmie National Forest
21905 64th Ave W
Mountlake Terrace, WA 98043
(425) 775-9702
FAX (425) 744-3255

Okanogan National Forest
1240 Second Ave S
Okanogan WA 98840
(509) 826-3275
FAX (509) 422-2014

Olympic National Forest
1835 Black Lake Blvd SW
Olympia WA 98512
(360) 956-2300
FAX (360) 956-2330

Wenatchee National Forest
215 Melody Lane
Wenatchee WA 98801
(509) 662-4335
FAX (509) 662-4368

Washington State Government

Washington State Office of Archaeology and Historic Preservation
PO Box 48343
Olympia WA 98504-8343
(360) 407-0752
FAX (360) 407-6217
Website:
www.wa.gov/cted/oahphome.htm

Washington Department of Ecology
For water quality issues, ask for the Water Quality Program.
For water right questions, ask for the Water Resources Program.
PO Box 47600
Lacey WA 98504-7600
(360) 407-6000
Website: www.wa.gov/ecology/

Central Regional Office
15 West Yakima Ave, Suite 200
Yakima WA 98902-3401
(509) 575-2490
FAX (509) 575-2809

Eastern Regional Office
N 4501 Monroe, Suite 202
Spokane WA 99205-1295
(509) 456-2926
FAX (509) 456-6175

Northwest Regional Office
3190 160th Ave SE
Bellevue WA 98008-5452
(425) 649-7000
(425) 649-7098

Southwest Regional Office
500 Desmond Drive Ave SE
Lacey WA 98504-7775
(360) 407-6300
FAX (360) 407-6305

Washington Department of Fish and Wildlife
Lands and Habitat Program
600 Capitol Way N
Olympia WA 98501-1091
(360) 902-2534
FAX (360) 902-2946
Website: www.wa.gov/wdfw/home.htm

Eastern Washington - Region 1
8702 North Division Street Spokane, Washington 99218
(509) 456-4082
FAX (509) 456-4071

North Central Washington - Region 2
1550 Alder Street NW
Ephrata, Washington 98823-9699
(509) 754-4624
FAX (509) 754-5257

South Central Washington - Region 3
1701 South 24th Avenue
Yakima, Washington 98902-5720
(509) 575-2740
FAX (509) 575-2474

North Puget Sound - Region 4
16018 Mill Creek Boulevard
Mill Creek, Washington 98012-1296
(425) 775-1311
FAX (425) 338-1066

Southwest Washington - Region 5
2108 Grand Boulevard
Vancouver, Washington 98661
(360) 696-6211
FAX (360) 906-6776

Coastal Washington - Region 6
48 Devonshire Road
Montesano, Washington 98563
(360) 249-4628
FAX (360) 664-0689

Washington Department of Natural Resources
Geology and Earth Resources Division
PO Box 47007
Olympia WA 98504-7007
(360) 902-1450
FAX (360) 902-1785
Website: www.wa.gov/dnr/

Washington State Parks and Recreation
Resources Development Division
PO Box 42650
Olympia WA 98504-2650
(360) 902-8500
Website: www.parks.wa.gov/

APPENDIX B

PROPOSED SPECIES LIST

The criteria for issuing Hydraulic Project Approval are statutorily restricted to protection of fish life, defined as all fish and shellfish species and all stages of development of those species (WAC 220-110-020). The WDFW proposes to limit the species considered for coverage under the Habitat Conservation Plan to fish and shellfish species on state and federal lists of threatened and endangered species, species of concern, and sensitive species, as well as candidates for such lists. Under Washington State's Priority Habitats and Species program, certain species and stocks with a depressed, critical, or unknown stock status under Washington's Salmonid Stock Inventory (SaSI) may also be considered. The following list includes certain unlisted Priority Habitats and Species and does not include SaSI stocks other than those also federally or state-listed as threatened, endangered, of concern, sensitive, or candidate.

Common Name	Scientific Name	Status
Black rockfish	*Sebastes melanops*	SC
Bocaccio rockfish	*Sebastes paucispinis*	SC
Brown rockfish	*Sebastes auriculatus*	SC
Bull trout	*Salvelinus confluentus*	FT/SC
Canary rockfish	*Sebastes pinniger*	SC
China rockfish	*Sebastes nebulosus*	SC
Chinook salmon	*Oncorhynchus tschawytscha*	FE/FT/SC
Chum salmon	*Oncorhynchus keta*	FT/SC
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	FSC
Coho salmon	*Oncorhynchus kisutch*	FC/FSC
Copper rockfish	*Sebastes caurinus*	FSC/SC
Dolly Varden	*Salvelinus malma*	SAR
Eulachon (Columbia River smelt)	*Thaleichthys pacificus*	FC/SC
Green sturgeon	*Acipenser medirostris*	SPHS
Greenstriped rockfish	*Sebastes elongates*	SC
Lake chub	*Couesius plumbeus*	SC
Leopard dace	*Rhinicthys falcatus*	SC
Lingcod	*Ophiodon elongatus*	SPHS
Longfin smelt	*Spirinchus thaleichthys*	SPHS
Margined sculpin	*Cottus marginatus*	FSC/SS
Mountain sucker	*Catostomus platyrhynchus*	SC
Olympic mudminnow	*Novumbra hubbsi*	SS
Pacific cod	*Gadus macrocephalus*	FSC/SC
Pacific hake	*Merluccius productus*	FSC/SC
Pacific herring	*Clupea harengus pallasi*	FC/SC
Pacific lamprey	*Lampetra tridentate*	FSC
Pacific sand lance	*Ammodytes hexapterus*	SPHS
Pink salmon	*Oncorhynchus gorbuscha*	SPHS
Pygmy whitefish	*Prosopium coulteri*	FSC/SS
Quillback rockfish	*Sebastes maliger*	FSC/SC
Redband trout	*Oncorhynchus mykiss*	FSC
Redstripe rockfish	*Sebastes proriger*	SC
River lamprey	*Lampetra ayresi*	FSC/SC
Sockeye salmon	*Oncorhynchus nerka*	FE/FT/SC
Steelhead	*Oncorhynchus mykiss*	FE/FT/SC
Surfsmelt	*Hypomesus pretiosus*	SPHS
Tiger rockfish	*Sebastes nigrocinctus*	SC
Umatilla dace	*Rhinicthys Umatilla*	SC
Walleye pollock	*Theragra chalcogramma*	FSC/SC
Western brook lamprey	*Lampetra richardsoni*	FSC
Westslope cutthroat trout	*Oncorhynchus (=Salmo) clarki lewisi*	FSC
White sturgeon	*Acipenser transmontanus*	SPHS
Widow rockfish	*Sebastes entomelas*	SC
Yelloweye rockfish	*Sebastes ruberrimus*	SC
Yellowtail rockfish	*Sebastes flavidus*	SC
California floater (mussel)	*Anodonta californiensis*	FSC/SC
Giant Columbia River limpet	*Fisherola nuttalli*	SC
Great Columbia River spire snail	*Fluminicola (=Lithoglyphus) Columbiana*	FSC/SC
Newcomb's littorine snail	*Algamorda subrotundata*	FSC/SC
Northern abalone	*Haliotis kamtschatkana*	FSC/SC
Olympia oyster	*Ostrea lurida*	SC
Western ridged mussel	*Gonidea angulata*	SC

FE = Federal Endangered
FT = Federal Threatened
FC = Federal Candidate

FSC = Federal Species of Concern
SC = State Candidate
SS = State Sensitive

SPHS = State Priority Habitat Species
FSAR = Federal Similarity of Appearance Rule

APPENDIX C

2006 MINERAL PROSPECTING HPA PERMITS

Table C-1
Summary of 2006 Mineral Prospecting HPA Permits

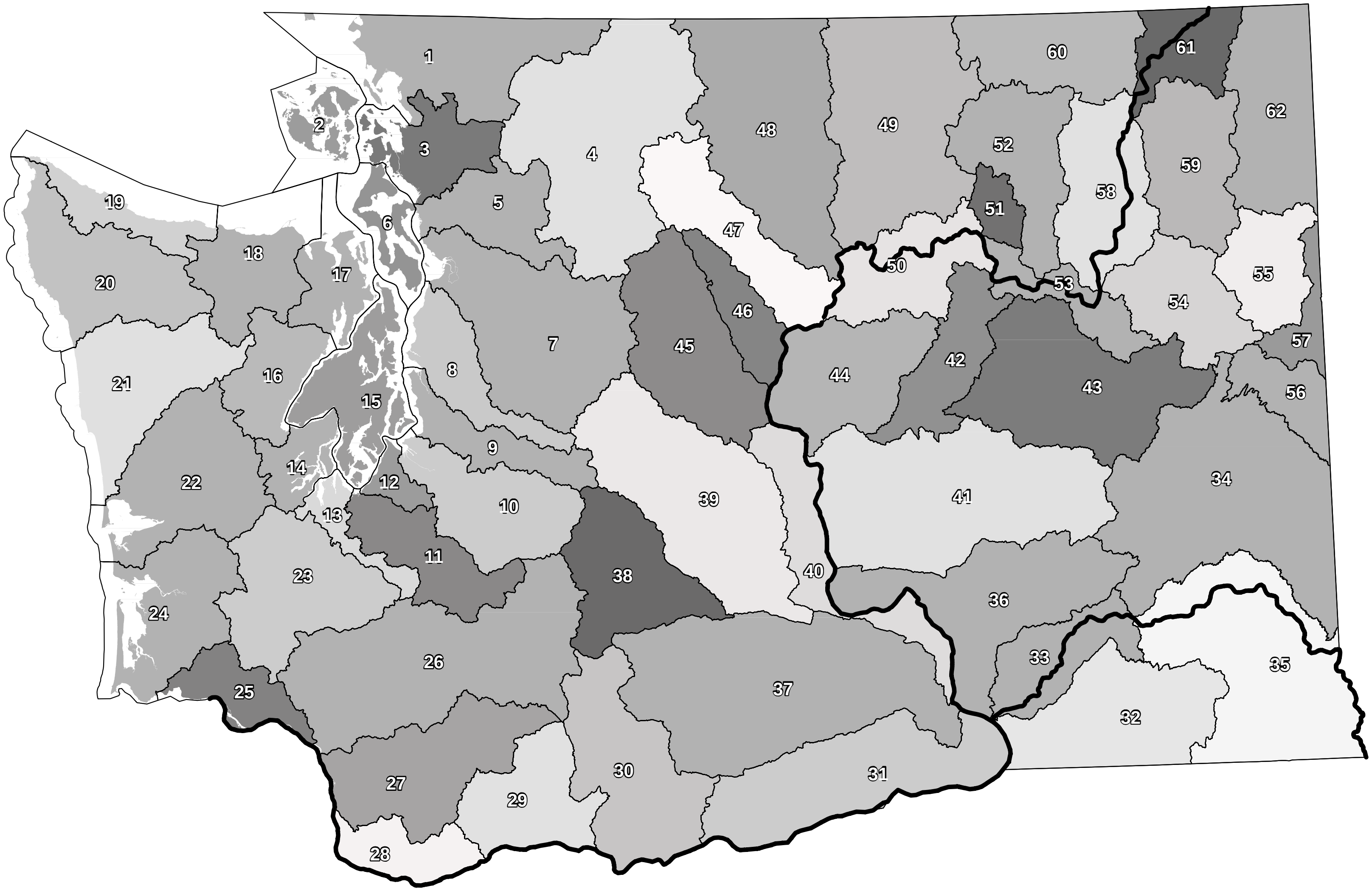
Permit Number	Location	Work Period	Description	Number of Locations per HPA Permit
00000F2638-4	Skagit River tributaries (Slate Creek, Bonita Creek, Park Creek, Canyon Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I or II mineral prospecting	4
00000F2639-4	Skagit River tributaries (Slate Creek, Bonita Creek, Park Creek, Canyon Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I or II mineral prospecting	4
00000F2645-4	Skagit River tributaries (Slate Creek, Bonita Creek, Park Creek, Canyon Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I or II mineral prospecting	5
00000F2646-4	Skagit River tributaries (Slate Creek, Bonita Creek, Park Creek, Canyon Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I or II mineral prospecting	5
104260-1	East Fork Lewis River (Copper Creek)	July 15-Sept 30, 2006	Suction dredge/highbanker combo	1
101867-2	Skagit River tributaries (Slate Creek, Bonita Creek,)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	3
102135-3	SF Nooksack River	July 15-Aug 10, 2006; July 15-Aug 10, 2007; July 15-Aug 10, 2008	Class 0, I, II and III equipment	7
102255-3	Skagit River tributaries (Slate Creek, Canyon Creek, Bonita Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, and II mineral prospecting	5
102262-2	Skagit River tributaries (Slate Creek, Bonita Creek, Canyon Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, and II mineral prospecting	5
102344-3	Skagit River tributary (Slate Creek)	July 1-Oct 31, 2006; Aug 1-Sept 15, 2006	Class 0, I, II mineral prospecting	2
102473-2	Skagit River tributaries (Bonita Creek, Slate Creek, Canyon Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, II mineral prospecting	5
102485-2	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	3
103450-1	Nooksack River	July 1, 2006-Sept 15, 2007	Class 0 and I only	1
103763-1	Yakima River	July 15-Aug 31, 2005; July 15-Aug 31, 2006; July 15-Aug 31, 2007	Class I and II	1
104015-1	EF Lewis River, Copper Creek	July 15, 2006-Oct 31, 2010	Use of metal detector to locate and retrieve fishing lead and other incidental items	2
104171-1	Nooksack River	July 1, 2006-Sept 15, 2007	Class 0 and I	1
104210-1	EF Lewis River (Copper Creek)	July 15-Sept 30, 2006	Suction dredging	2
104250-1	Skagit River tributary (Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	2
104251-1	Skagit River tributary (Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	2
104252-1	Skagit River tributary (Slate Creek, Canyon Creek, Bonita Creek)	July 1-Sept 30, 2006; Aug 1-Sept 30, 2006	Class 0, I, II mineral prospecting	5
105259-1	EF Lewis River (Copper Creek)	July 15-Sept 30, 2006	Dredge/highbanker combo	1
00000F2636-4	Skagit River tributary (Slate	July 1-Sept 30, 2006	Class 0, I, II, III mineral	1

Permit Number	Location	Work Period	Description	Number of Locations per HPA Permit
	Creek)		prospecting	
104915-1	Skagit River tributary (Slate Creek, Bonita Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	3
104527-1	Nooksack River, MF Nooksack River, SF Nooksack River	July 1-Sept 15, 2006; July 1-Sept 15, 2007	Class 0, I, II, III	3
104530-1	EF Lewis River (Copper Creek)	July 15-Sept 30, 2006	Suction dredge	1
104624-1	Skagit River tributary (Slate Creek)	July 1-Oct 31, 2006	Class 0, I, II, III mineral prospecting	4
104641-1	EF Lewis River	July 15-Sept 30, 2006	Pan and sluice box	1
104724-1	Columbia River	May 1-Oct 31, 2006	Suction dredging	1
104830-1	Yelm Creek	July 1-Sept 30, 2006; July 1-Sept 30, 2007; July 1-Sept 30, 2008; July 1-Sept 30, 2009; July 1-Sept 30, 2010;	Class 0, I	1
104902-1	Skagit River tributaries (Canyon Creek, Bonita Creek, Slate Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, II mineral prospecting	5
104903-1	Skagit River tributaries (Canyon Creek, Bonita Creek, Slate Creek)	July 1-Sept 30, 2006; Aug 1-Sept15, 2006	Class 0, I, II mineral prospecting	5
104904-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	3
104905-2	Skagit River tributaries (Canyon Creek, Bonita Creek, Slate Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, II mineral prospecting	5
104906-1	Skagit River tributaries (Canyon Creek, Bonita Creek, Slate Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, II, III mineral prospecting	5
104907-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1- Sept 30, 2006	Class 0, I, II mineral prospecting	3
104909-1	Skagit River tributary (Canyon Creek)	Aug 1-Sept 15, 2006	Class 0, I, II mineral prospecting	2
104910-1	Skagit River tributary (Canyon Creek)	Aug 1-Sept 15, 2006	Class 0, I, II mineral prospecting	2
104912-1	Skagit River tributary (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	3
104914-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	3
104362-4	Similkameen River	Aug 18-20, 2006; Aug 17-19, 2007; Aug 15-17, 2008; Aug 14-16, 2009; Aug 20-22, 2010	Education rally regarding small-scale mineral prospecting	1
104908-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II mineral prospecting	3
105003-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II, III mineral prospecting	3
105008-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II, III mineral prospecting	3
105009-1	Skagit River tributaries (Canyon Creek, Bonita Creek, Slate Creek)	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, II, III mineral prospecting	5
105010-1	Skagit River tributaries (Canyon Creek, Bonita Creek,	July 1-Sept 30, 2006; Aug 1-Sept 15, 2006	Class 0, I, II, III mineral prospecting	5

Permit Number	Location	Work Period	Description	Number of Locations per HPA Permit
	Slate Creek)			
105012-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II, III mineral prospecting	3
105013-1	Skagit River tributary (Canyon Creek)	Aug 1-Sept 15, 2006	Class 0, I, II, III mineral prospecting	2
105071-1	Jimmycomelately Creek	July 1-Aug 10, 2006	Gold dredging	2
105075-1	Jimmycomelately Creek, Jimmycomelately tributary, tributary to Dungeness	July 1-Aug 10, 2006	Class II mineral prospecting	3
105334-1	SF Nooksack River	June 8, 2006-June 8, 2008	Class 0 mineral prospecting	3
105533-1	Skagit River tributary (Canyon Creek)	Aug 1-Sept 15, 2006	Class 0, I, II, III mineral prospecting	2
105534-1	Skagit River tributaries (Bonita Creek, Slate Creek)	July 1-Sept 30, 2006	Class 0, I, II, III mineral prospecting	2
105535-1	Skagit River tributary (Slate Creek)	July 1-Sept 30, 2006; July 1-Oct 31, 2006	Class 0, I, II, III mineral prospecting	5
105572-1	Nooksack River, MF Nooksack River, SF Nooksack River, Saar Creek	July 15-July 31, 2006-2007; July 1-Oct 1, 2006-2007; July 15-Aug 10, 2006-2007; July 15-Oct 1, 2006-2007	Class 0, I, II mineral prospecting	4
105606-1	SF Nooksack River	July 15-Aug 10, 2006; July 15-Aug 10, 2007	Class 0, I mineral prospecting	1
105653-1	Swauk Creek	July 15-Sept 5, 2006	Dredging using 5-inch nozzle	1
104950-2	SF Nooksack River	May 19, 2006-May 10, 2008	Class 0, panning only	6

APPENDIX D

MAP OF WRIAS IN WASHINGTON STATE



ANCHOR
ENVIRONMENTAL, L.L.C.

0 25 50
Miles

N

Figure D-1
Water Resource Inventory Areas