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Hood River Basin Aquatic Habitat Restoration Strategy

Mt. Hood National Forest
Hood River Ranger District

Photo by Darcy Morgan

Hood River Basin
Aquatic Habitat Restoration Strategy

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November 2006

Mt. Hood National Forest
Hood River Ranger District
Mt. Hood – Parkdale, Oregon

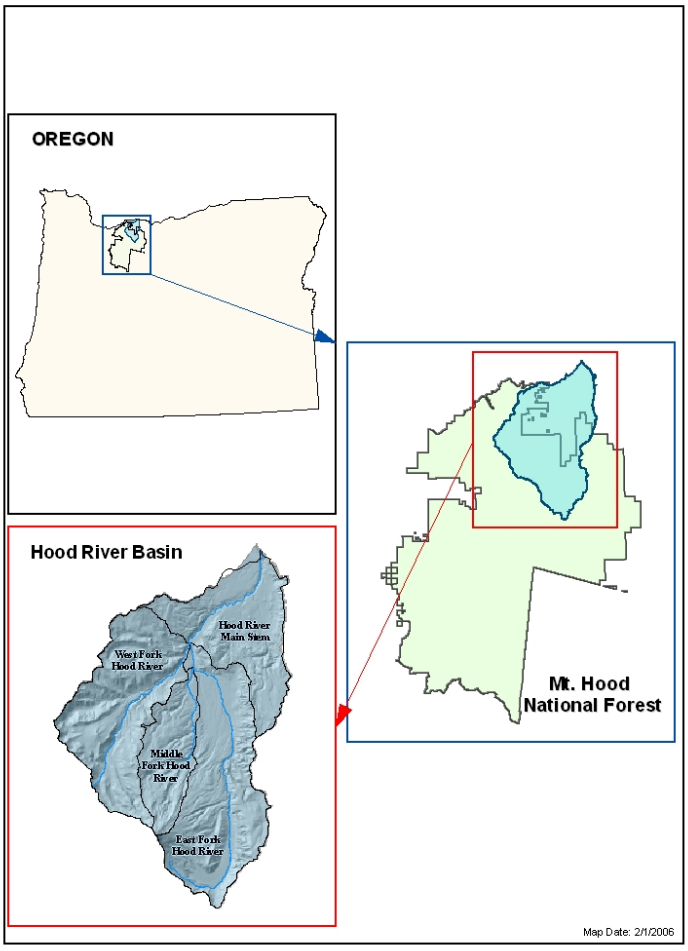
Executive Summary

Introduction

Basin Overview

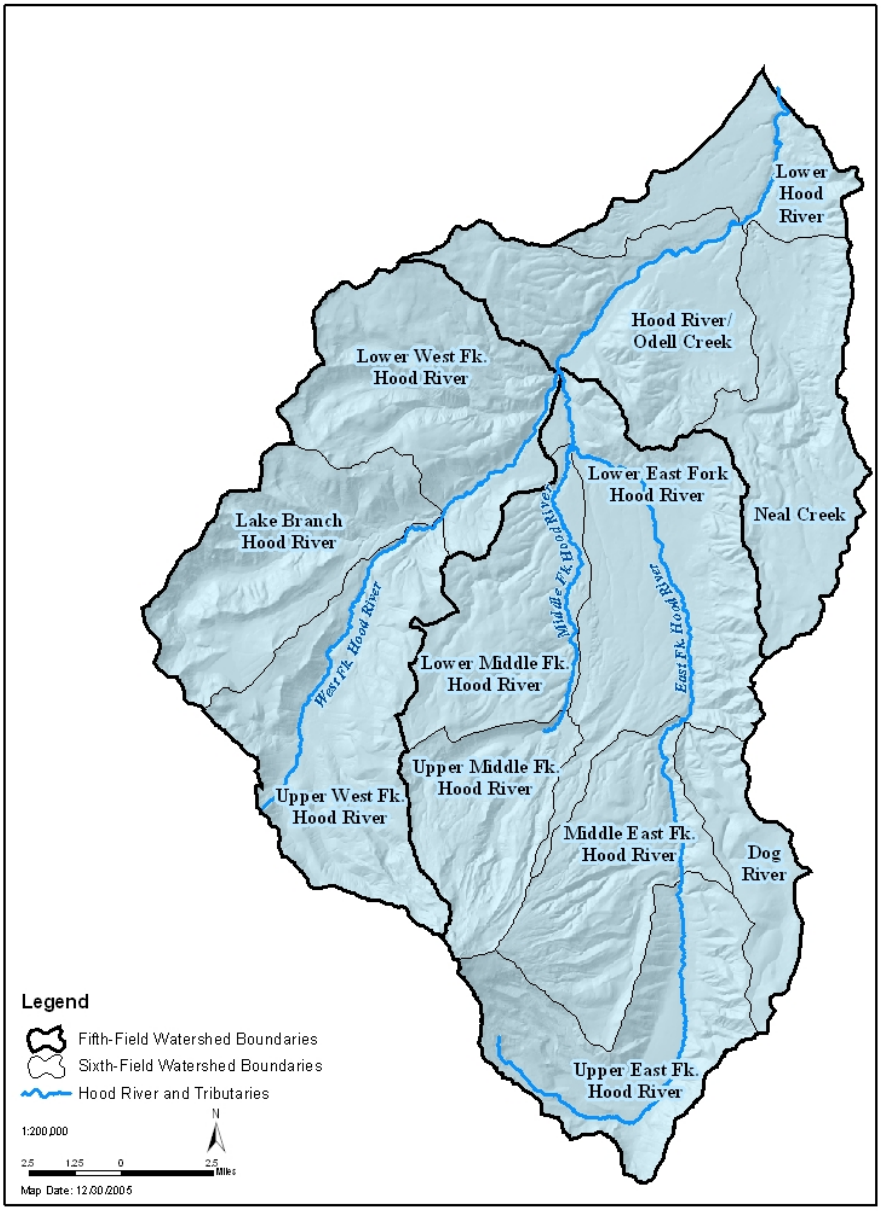
The Hood River Basin is located approximately 60 miles east of Portland, Oregon. The basin comprises part of the Middle Columbia-Hood 4th field watershed and is roughly 340 square miles (217,337 acres) in size. It contains three individual 5th field watersheds, and nested within those are 12 individual 6th field watersheds. The river is comprised of three main tributaries; East Fork, Middle Fork, and West Fork; and it enters the Columbia River 22 miles upstream from Bonneville Dam in the City of Hood River, Oregon. The basin lies entirely within Hood River County, and is largely comprised of public lands – roughly 65 percent of the basin. Roughly one-third of the remaining land is privately owned and occurs predominately in the lower elevations. The entire basin contains lands ceded to the Confederated Tribes of the Warm Springs Reservation of Oregon.

Native, anadromous fish populations are comprised of spring and fall Chinook, summer and winter steelhead, coho, and Pacific lamprey. Resident, native salmonid species include cutthroat trout, bull trout, rainbow trout, and mountain whitefish. Sea-run cutthroat trout are still present in low numbers. Many of these fish species have dwindled to very low numbers, and several Endangered Species Act listings were made by the National Marine Fisheries Service and U.S. Fish and Wildlife Service, affecting five of the six anadromous populations (spring and fall Chinook, summer and winter steelhead, and coho) and one resident species (bull trout).



Hood River Basin Vicinity Map.

In 2005, a collaborative working group comprised of key stakeholders representing 14 agencies and entities convened in a series of meetings and workshops to develop an aquatic habitat restoration strategy for the Hood River Basin. Prior to 2005, there had been many collaborative efforts in the basin focused on developing and implementing aquatic habitat restoration strategies and actions; however, a single basin-wide strategy identifying priority watersheds, limiting factors, and priority hilltop-to-valley-bottom restoration actions had not yet been compiled. The collaborative efforts and products described herein do just that. The primary *goal* of this strategy is to *address aquatic habitat restoration needs for resident and anadromous fish species, while at the same time addressing needs for streamflow and water quality improvements.* All stakeholders involved in the development of this strategy recognized from the outset that several recent efforts in the basin have come very close to delivering an overall end-product for which this effort was directed. Therefore, the working group relied heavily upon reviewing existing work and available products combined with some new synthesis and packaging in order to develop a stand-alone aquatic habitat restoration strategy for the entire basin.



Hood River Basin 5th and 6th Field Watershed Boundaries.

Participating agencies and entities included:

- Confederated Tribes of the Warm Springs Reservation of Oregon
- East Fork Irrigation District
- Farmer's Irrigation District
- Hood River Soil and Water Conservation District
- Hood River Watershed Group
- Middle Fork Irrigation District
- National Marine Fisheries Service
- Oregon Department of Environmental Quality
- Oregon Department of Fish and Wildlife
- Oregon Department of Forestry
- Oregon State University Extension Service
- Oregon Water Resources Department
- Oregon Watershed Enhancement Board
- U.S.D.A. Forest Service

Why is a Basin-wide Aquatic Habitat Restoration Strategy Needed?

Many institutions that provide funding for aquatic habitat restoration activities are beginning to require an overall basin-wide strategy that is closely linked to a comprehensive assessment of watershed conditions, water quality impairments, priority fish populations and geographic focus areas that identifies necessary high priority restoration actions. These institutions also require partnering, cost-leveraging, and demonstrable on-the-ground results. Some of the primary institutions that commonly fund watershed and aquatic habitat restoration efforts throughout the State of Oregon and Pacific Northwest are developing broad state-wide or regional strategies to focus financial investments where there is a demonstrated need, articulated priorities, and clear restoration benefit. As funding becomes scarce and competition in the region expands, a greater emphasis will be given to funding high priority restoration actions in priority watersheds. This is largely being brought about for two reasons:

1. To demonstrate accountability and show completion of high priority restoration actions for whole watersheds, and

2. To focus or concentrate available funding to specific areas in order to achieve tangible, aggregated restoration benefits at the watershed-scale as opposed to a "shotgun approach" where many different restoration actions are implemented over a broad landscape making it difficult to detect a restoration benefit.

While this effort was largely spearheaded by Forest Service staff from the Mt. Hood National Forest, it is intended to provide utility to all Hood River Basin stakeholders interested in aquatic habitat restoration and to foster further development and unification of an already strong and vigorous partnership base. The Hood River Basin is known statewide and regionally as a basin with a strong collaborative partnership base that gets high quality and innovative aquatic habitat restoration work completed on-the-ground. This strategy is intended to fortify the existing, strong collaborative partnership in the basin.

What is a Basin-wide Aquatic Habitat Restoration Strategy?

The basin-wide aquatic habitat restoration strategy provides a geographic focus and framework for directing future resources (staff time and funding) towards fulfilling high priority restoration needs for fish habitat and water quality improvements. Specifically, the strategy:

- Identifies priority 6^{th} field watersheds in the basin that provide the cornerstone for addressing freshwater habitat restoration needs of resident and anadromous fish as well as water quality improvements.

- Describes the limiting factors affecting fish production and water quality.

- Identifies known restoration actions previously identified that will address limiting factors in priority watersheds.

- Identifies types of high priority restoration actions within particular watersheds where they are highlighted through a limiting factors analysis but have yet to be fully scoped and verified on-the-ground.

- Establishes the sequence in which actions should be pursued in order to achieve the maximum benefit.

- Provides a rough estimate of the restoration needs (i.e., quantity) and implementation costs by activity type for each of the 6th field watersheds in the basin.

The strategy also displays a suite of restoration tools to accomplish identified opportunities; lays out a framework for developing a basin-specific technical assistance, outreach, and education plan; and highlights important information gaps from which to guide the development of future inventory and monitoring activities.

Relation to Watershed Analyses, TMDL Assessment, Subbasin Planning, and Other Analyses

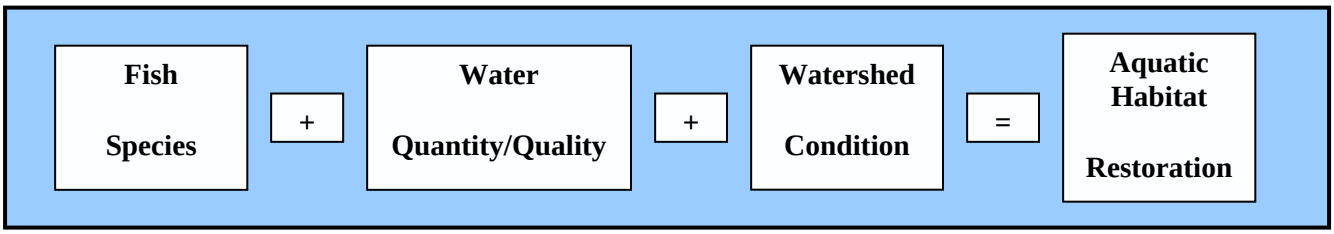
Several previous efforts have been made to assess and analyze stream channel, fish habitat, watershed, and water quality conditions in the basin. These include watershed analyses (both federal and state); the Western Hood Subbasin Total Maximum Daily Load Assessment; the Hood River Watershed Group's 2002 Watershed Action Plan (updated in 2005); the Hood River Basin Fish Passage Barrier Prioritization Strategy; and the Northwest Power and Conservation Planning Council's Subbasin Plan. Each of these efforts has been extremely useful in diagnosing conditions and restoration opportunities in various locations within the basin. The key findings and products from these previous efforts, particularly relating to identification of altered watershed process and limiting factors, were extracted and synthesized in the development of this comprehensive basin-wide, aquatic habitat restoration strategy integrating the needs for both fish population recovery and water quality improvements.

Aquatic Restoration Strategy

Geographic Framework

A model incorporating three components; *Fish Species Priority*, *Water Quantity/Quality*, and *Watershed Condition*; was developed to establish the relative restoration priority for each of the 6th field watersheds in the basin.

Conceptual Model Used to Establish Aquatic Habitat Restoration Priorities at the 6th Field Watershed Scale, Hood River Basin.

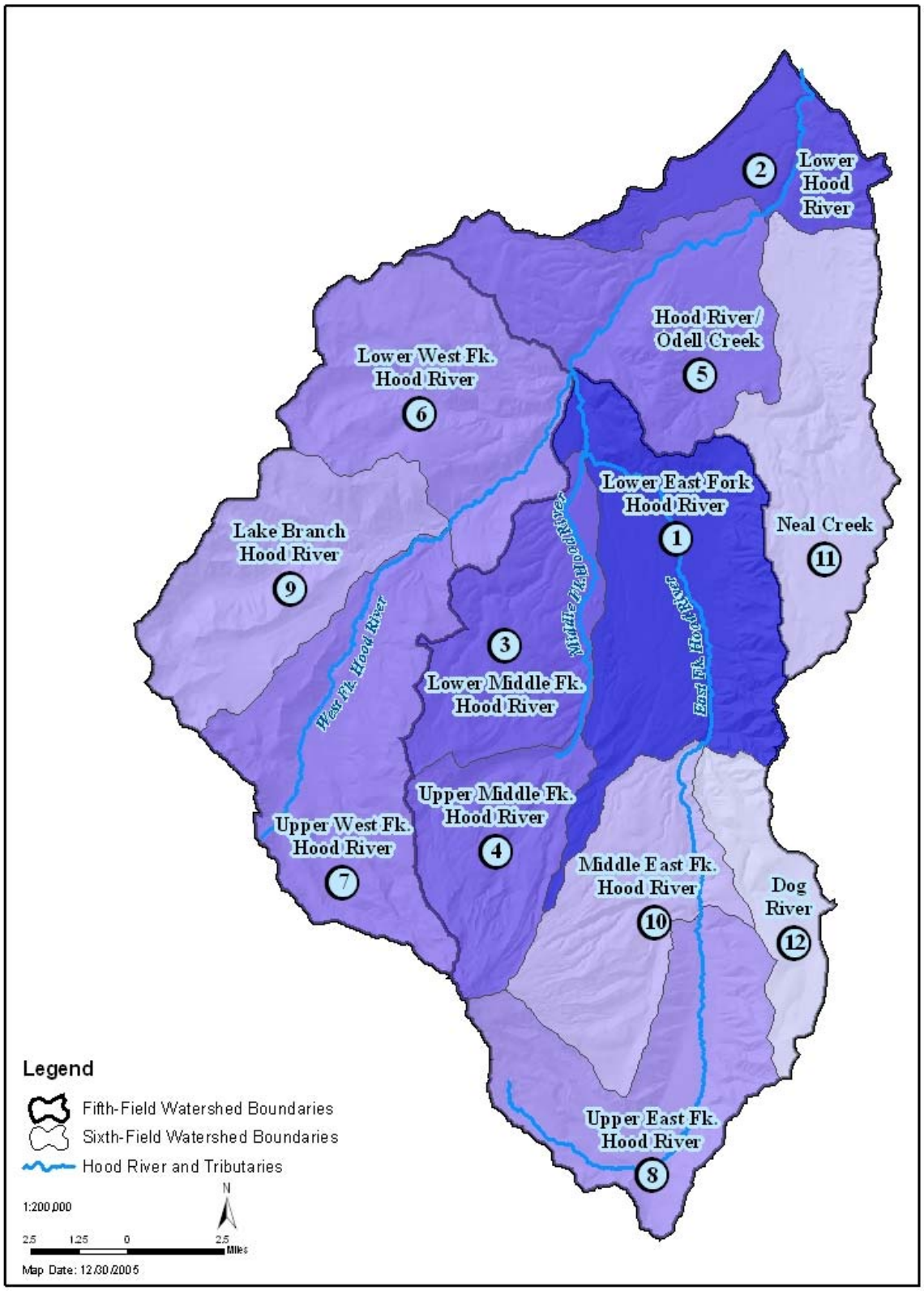


Fish Species Priority identifies important river and stream reaches for: summer steelhead, bull trout, winter steelhead, fall Chinook, coho, spring Chinook, cutthroat trout, rainbow trout, and Pacific lamprey. *Water Quantity/Quality* identifies reaches of concern due to lack of in-stream flow and water quality impairment. *Watershed Condition* identifies the relative condition of each 6th field watershed, integrating both inherent sensitivity as well as anthropogenic and natural perturbation history. Watersheds in better condition receive a higher priority for restoration. Integrating all three components, an aquatic habitat restoration score was derived for each watershed. Two watersheds tied for the highest score and three tied for the second highest score. The amount of fish habitat available determined by *Fish Species Priority* was used to break these ties and establish an overall relative ranking, 1 through 12.

Aquatic Habitat Restoration Priority for 6th Field Watersheds, Hood River Basin.

6th Field Watershed	Fish Species Priority[1]	Water Quantity & Quality Priority[2]	Watershed Condition[3]	Aquatic Habitat Restoration Score	Aquatic Habitat Restoration Priority based on Fish Species Priority Habitat Quantity
Lower East Fork	4	1	8	13	1
Lower Hood River	2	2	9	13	2
Lower Middle Fork	3	4	7	14	3
Upper Middle Fork	6	7	1	14	4
Hood River – Odell	1	3	10	14	5
Lower West Fork	5	6	6	17	6
Upper West Fork	7	11	2	20	7
Upper East Fork	10	10	1	21	8
Lake Branch	11	8	3	22	9
Middle East Fork	9	9	5	23	10
Neal Creek	8	5	11	24	11
Dog River	12	12	4	28	12

Note: Rankings are from 1 to 12, where 1 = highest priority and 12 = lowest priority.
[1] Highest priority given to watersheds with the most fish populations present.
[2] Highest priority given to watersheds with the most degraded water quantity/quality conditions.
[3] Highest priority given to watersheds in the best condition.



Overall Aquatic Habitat Restoration Priority for 6th Field Watersheds, Hood River Basin.

Restoration Philosophy

The working group reviewed and endorsed the restoration philosophy set forth in the Hood River Watershed Group's 2002 Watershed Action Plan. It was acknowledged that an effective restoration strategy must first focus on protecting the remaining high quality, productive aquatic habitats in the basin. This is believed to be the most effective and least costly means for ensuring healthy, intact aquatic habitat is maintained over the long term. Where human activities are degrading aquatic habitat, the next course of action would be to curtail those activities or ameliorate their impacts and allow conditions to recover naturally. In situations requiring long timeframes for recovery, active restoration is encouraged. Watersheds in a more healthy condition are considered priority over those that are more degraded. This philosophy is intended to ensure the maximum benefit for the investment made. While the working group agreed this is the best approach, a strong caveat was made – There will often be high priority restoration projects located in lower priority watersheds where funding and implementation in the near-term is justified. The working group acknowledged there will always be geographic-specific restoration opportunities, specific landowners or groups ready to take action, or unique funding sources that will direct active restoration investments in various portions of the basin irrespective of an overall prioritization strategy. The working group strongly supports the continuation of high priority restoration activities even in the lower priority watersheds as opportunities arise based on other factors and to maintain partnership relations that are critical for positive restoration momentum. It is the intent, over the long term, that restoration investments are focused on high priority actions in priority watersheds in order to move the majority of watersheds in the basin with high ecological value more readily towards restored conditions.

Altered Watershed Processes and Limiting Factors Analysis

A restoration framework was developed to identify and guide implementation of high priority restoration actions in a manner such that the primary and secondary altered processes for each 6th field watershed are first addressed, followed next by the limiting factors affecting fish production. The results from three separate watershed assessments, two federal and one state, were carefully reviewed to identify the primary and secondary altered watershed processes. Primary altered processes are those watershed processes and functions most greatly affected by past perturbations or existing conditions on the landscape. Watershed processes and functions that may also be altered, but not to as large a magnitude or geographic extent, are categorized as secondary. An understanding of these altered process and functions was important in order for the working group to identify specific restoration actions in specific locations that address the root-causes of impairment. Altered watershed processes considered include:

- Altered Flow via Agriculture Practices, Timber Harvesting, Roading, and Impervious Surfaces
- Altered Flow Regime via Diversions
- Altered Peak and Base Flows
- Increase in Sediment Production (road-related)
- Impeded Fish Passage (loss of aquatic connectivity)
- Impeded Sediment & Woody Debris Routing
- Elevated Chemical and Bacterial Concentrations in Water

- Increased Stream Temperature
- Lack of In-stream large woody debris (LWD)
- Lack of Riparian LWD Recruitment (current and future)
- Loss of Floodplain Connectivity, Channel Sinuosity, and Channelization

A comprehensive limiting factors analysis for Chinook salmon and steelhead populations was completed during the subbasin planning process that concluded in 2004. This limiting factors analysis utilized the Ecosystem Diagnosis and Treatment (EDT) model. Five environmental attributes were found to have the greatest effect on Chinook salmon and steelhead populations: channel stability, flow, habitat diversity, sediment load, and key habitat quantity. While there are additional species and life-stage specific limiting factors, these five environmental attributes, if addressed through restoration actions, would have the greatest restoration potential benefit for enhancing fish production in the majority of watersheds throughout the basin. The working group melded its assessment of altered watershed processes with the various corresponding EDT limiting factors in order to arrive at a single set or sets of restoration actions that address both. For example, a given watershed that has altered peak and/or base flows correspondingly would have sediment load (SL) and channel stability (CS) identified as key survival factors from the EDT model affecting fish production. Restoration actions would then identified to not only restore altered peak and/or base flows, but also simultaneously address increased sediment load and/or decreased channel stability from a fish habitat production perspective.

Aquatic Habitat Restoration Actions

A mix of restoration actions (i.e., fish passage, streamflow restoration, road decommissioning and/or storm-proofing, upland and riparian thinning, addition of in-stream woody debris, etc.) was then identified at the sub-watershed and/or stream reach scales to address both the altered watershed process and corresponding EDT limiting factors. In this manner, on a watershed-by-watershed basis, priority restoration actions were determined. Restoration actions are prioritized and sequenced to ameliorate the root causes of watershed and aquatic habitat impairment. Specific restoration actions, where known, are identified for specific locations to improve watershed conditions, water quality and fish production potential. Where unknown, types of restoration actions are identified for further planning and development. Results from the Mt. Hood National Forest's Roads Analysis completed in 2003 were utilized to estimate the quantity of road mileage in each watershed for restoration activity, including annual road maintenance, road storm-proofing, and road decommissioning. A table of actions was developed for each 6th field watershed in a top-down, watershed approach addressing all of the primary altered watershed processes, followed next by those addressing the remaining secondary altered watershed processes. A second table was compiled for each 6th field watershed categorizing actions into six restoration activity types: fish passage, flow restoration, road-related, riparian-related, in-stream related, and other/miscellaneous. Estimates of restoration activity need (i.e., quantity) and implementation costs are made and summarized for each 6th field watershed.

Summary of Aquatic Habitat Restoration Actions by 6th Field Watershed for the Hood River Basin.

6th Field Watershed	Overall Priority	Estimated Cost by Restoration Activity Type						
		Fish Passage Actions	Flow Restoration Actions	Road-Related Actions	Riparian-Related Actions	In-Stream Related Actions	Other/Misc. Actions	Est. Total Cost
Lower East Fork Hood River	1	$5,750,000	$191,612	$125,125	$230,000	$3,800,000	$40,000	$10,136,737
Lower Hood River	2	$1,350,000	per S.A.[1]	undetermined	$80,000	$1,200,000	$0	$2,630,000
Lower Middle Fork Hood River	3	1,770,000	undetermined	$915,742	$500,000	$3,020,000	$0	$6,205,742
Upper Middle Fork Hood River	4	$2,069,473[2]	$259,700[2]	$329,741	$475,000	$450,000[2]	$0	$3,583,914
Hood River/Odell	5	$1,000,000	$0	$97,257	$215,000	$1,400,000	$100,000	$2,812,257
Lower West Fork Hood River	6	$2,621,000	undetermined	$494,343	$800,000	$1,470,000	$0	$5,385,343
Upper West Fork Hood River	7	$1,750,000	$0	$620,108	$775,000	$1,875,000	$0	$5,020,108
Upper East Fork Hood River	8	$3,400,000	$0	$1,196,407	$205,000	$440,000	undetermined	$5,241,407
Lake Branch	9	$2,250,000	$0	$792,304	$775,000	$310,000	$0	$4,127,304
Middle East Fork Hood River	10	$2,150,000	$0	$463,406	$70,000	$150,000	undetermined	$2,833,406
Neal Creek	11	$3,000,000	$5,000,000	$347,688	$98,000	$2,170,000	undetermined	$10,615,688
Dog River	12	undetermined	undetermined	$446,992	$25,000	undetermined	$0	$471,992
							BASIN TOTAL	$59,063,898

[1] *per PacifiCorp Settlement Agreement to decommission Powerdale Dam in 2010.*

[2] *estimated costs do not include yet-to-be determined actions by Middle Fork Irrigation District in its Fisheries Management Plan that will update the U.S. Forest Service special use permit for its facilities and operations.*

Table of Contents

Appendices

List of Figures

List of Tables

Chapter 1 – Background

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Organization of Document

This document is comprised of five chapters. Chapter 1 provides a background on the development of the aquatic habitat restoration strategy for the Hood River Basin. It covers the scope of this effort – why it was initiated, the sideboards and constraints used, what the intent for this document is, and who was involved. Additionally, the first chapter identifies some important background information about the basin itself and its collaborative partners. Finally, Chapter 1 briefly summarizes other preceding assessment and strategy efforts and how elements of these were incorporated herein.

Chapter 2 delves into the establishment of a geographic focus for directing future investments in aquatic habitat restoration actions in the basin. The process used for developing a geographic focus for the basin at the 6th field watershed scale is explained. The chapter concludes with a description of the restoration philosophy for the basin developed by the collaborative partners. Important caveats to the application of the restoration philosophy are highlighted.

Chapter 3 lays out the aquatic habitat restoration framework for the basin. This chapter describes the limiting factors analysis method used for each 6th field watershed in the basin and how that translates into the identification of high priority aquatic habitat restoration actions, or types of actions, in specific locations. Results for each of the 6th field watersheds are presented. Altered watershed processes and factors limiting fish production are identified for each watershed, followed by specific high priority restoration actions by project type and location. Where known restoration project opportunities exist for each 6th field watershed, they are highlighted. Otherwise, specific types of restoration actions needed to address altered watershed processes and limiting factors are suggested.

Chapter 4 presents the suite of restoration tools available to implement high priority actions within the basin. This chapter provides a review of the various state, federal, and other programs available to assist in funding aquatic habitat restoration actions focusing on watershed, fish habitat, and water quality improvements. Furthermore, this chapter outlines an initial framework to guide the further development of a technical assistance, outreach, and education strategy specific to the basin.

Chapter 5 summarizes the critical information gaps that surfaced during the development of the aquatic habitat restoration strategy. Identification of these information gaps is important for directing future monitoring, inventory, and refined assessment efforts by the collaborative partners in the basin.

Purpose and Need

While there has been a considerable amount of collaborative effort in the Hood River Basin in both developing and implementing aquatic habitat restoration strategies and actions, a single basin-wide strategy identifying priority watersheds, limiting factors, and priority hilltop-to-valley-bottom restoration actions has not yet been compiled. The collaborative efforts and products described in this document do just that. The primary emphasis of this strategy is to address aquatic habitat restoration needs for resident and anadromous fish species, while at the same time addressing needs for streamflow and water quality improvements. From the outset of this effort beginning in July of 2005, it was fully recognized by all stakeholders involved that several recent efforts have come very close to delivering an overall end-product for which this effort was directed at. Therefore, the collaborative working group relied heavily upon reviewing existing work and available products combined with some new synthesis and packaging in order to develop a stand-alone aquatic habitat restoration strategy for the entire basin.

Why is a Basin-wide Aquatic Habitat Restoration Strategy Needed?

Many of the institutions that provide funding for aquatic habitat restoration are beginning to require demonstration of an overall basin-wide strategy closely linked to a comprehensive assessment of watershed conditions, water quality impairments, priority fish populations and geographic focus areas that identifies necessary high priority actions. These institutions also require partnering, cost-leveraging, and demonstrable on-the-ground results. Many of the primary institutions that commonly fund watershed and aquatic habitat restoration efforts throughout the State of Oregon and within the Pacific Northwest are developing strategies to focus financial investments where there is a demonstrated need, articulated priorities, and clear restoration benefit. As funding becomes scarce and competition in the region expands, a greater emphasis will be given to funding high priority restoration actions in priority watersheds. This is largely being brought about for two reasons: 1) to demonstrate accountability and show completion of high priority restoration actions for whole watersheds and 2) to focus or concentrate available funding to specific areas in order to achieve tangible, aggregated restoration benefits at the watershed-scale as opposed to a “shotgun approach” where many different restoration actions are implemented over a broad landscape making it difficult to detect a restoration benefit.

While this effort was largely spearheaded by Forest Service staff from the Mt. Hood National Forest, it is intended to provide utility to all Hood River Basin stakeholders interested in aquatic habitat restoration and to foster further development and unification of an already strong and vigorous partnership base. The Hood River Basin is known statewide and regionally as a basin with a strong collaborative partnership base that gets high quality and innovative aquatic habitat restoration work completed on-the-ground. This strategy is intended to fortify the existing, strong collaborative partnership in the basin.

What is a Basin-wide Aquatic Habitat Restoration Strategy?

A basin-wide aquatic habitat restoration strategy provides a geographic focus and framework for directing future resources (staff time and funding) towards fulfilling high priority restoration needs for fish habitat and water quality improvements. Specifically, the strategy:

- Identifies priority 6th field watersheds in the basin that provide the cornerstone for addressing freshwater habitat restoration needs of resident and anadromous fish as well as water quality improvements.

- Describes the limiting factors affecting fish production and water quality.

- Identifies known restoration actions previously identified that will address limiting factors in priority watersheds.

- Identifies types of high priority restoration actions within particular watersheds where they are highlighted through a limiting factors analysis but have yet to be fully scoped and verified on-the-ground.

- Establishes the sequence in which actions should be pursued in order to achieve the maximum benefit.

- Provides a gross estimate of the costs associated with planning, designing, implementing, and monitoring high priority restoration actions.

Furthermore, the strategy displays a suite of restoration tools to accomplish identified opportunities; lays out a framework for developing a basin-specific technical assistance, outreach, and education plan; and highlights important information gaps from which to guide the development of future inventory and monitoring activities.

Background Information on the Basin

The Hood River Basin is located approximately 60 miles east of Portland, Oregon (Figure 1). The basin comprises part of the Middle Columbia-Hood 4th field watershed and is roughly 340 square miles (217,337 acres) in size. It contains three individual 5th field watersheds, and nested within those are 12 individual 6th field watersheds (Figure 2) as amended by the Regional Ecosystem Office in December 2002 (REO 2002). The river itself is comprised of three main tributaries – East Fork, Middle Fork, and West Fork. The forks originate from the north and eastern flanks of Mt. Hood at an elevation of 11,239 feet and flows northerly, entering the Columbia River 22 miles upstream from Bonneville Dam in the City of Hood River, Oregon. A large portion of the basin is shaped and influenced by both past and present glacial activity on Mt. Hood.

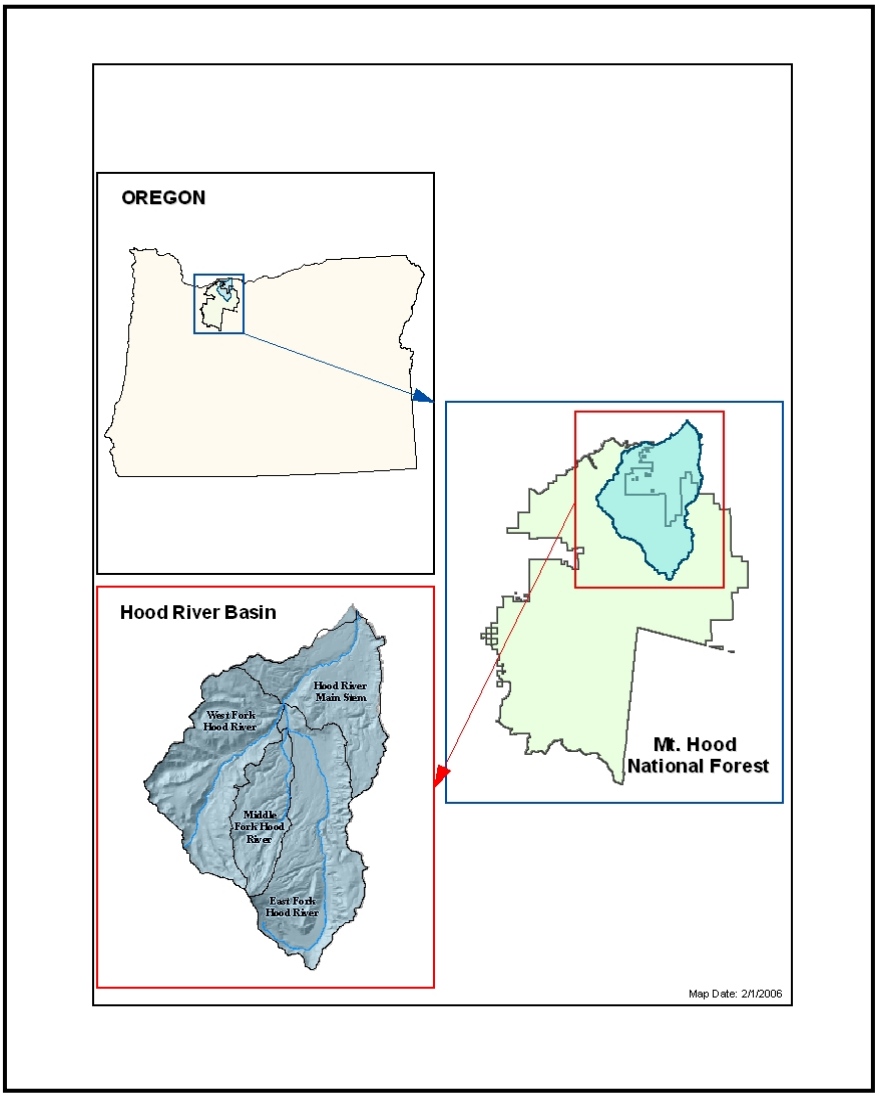

Figure 1. Hood River Basin Vicinity Map.

The Hood River Basin is commonly referred to as a "transitional" basin, since it is situated between the much wetter west-side Cascades Range and the drier east-side Cascades Range. The basin exhibits both west-side and east-side characteristics in precipitation, hydrology, geomorphology, vegetation, and fauna (Coccoli 1999, Pater et al. 1998). The basin lies entirely within Hood River County, and is largely comprised of public lands – roughly 65 percent of the basin. Roughly one-third of the remaining land is privately owned and is situated predominately in the lower elevations. These privately owned lands are zoned as exclusive farm use lands (approximately 25,000 acres) or forest lands (approximately 38,000 acres) (Coccoli 1999). Agricultural fruit production in the basin is a primary component of the local economy that contributes significantly at the county, state, regional, and national levels. As such, there exists an extensive network of water withdrawal facilities, ditches, and canals throughout the basin supplying irrigation water to croplands in the middle and lower valley. The entire basin contains lands ceded to the United States in the Treaty of 1855 between the U.S. and American Indians recognized today as the Confederated Tribes of the Warm Springs Reservation of Oregon.

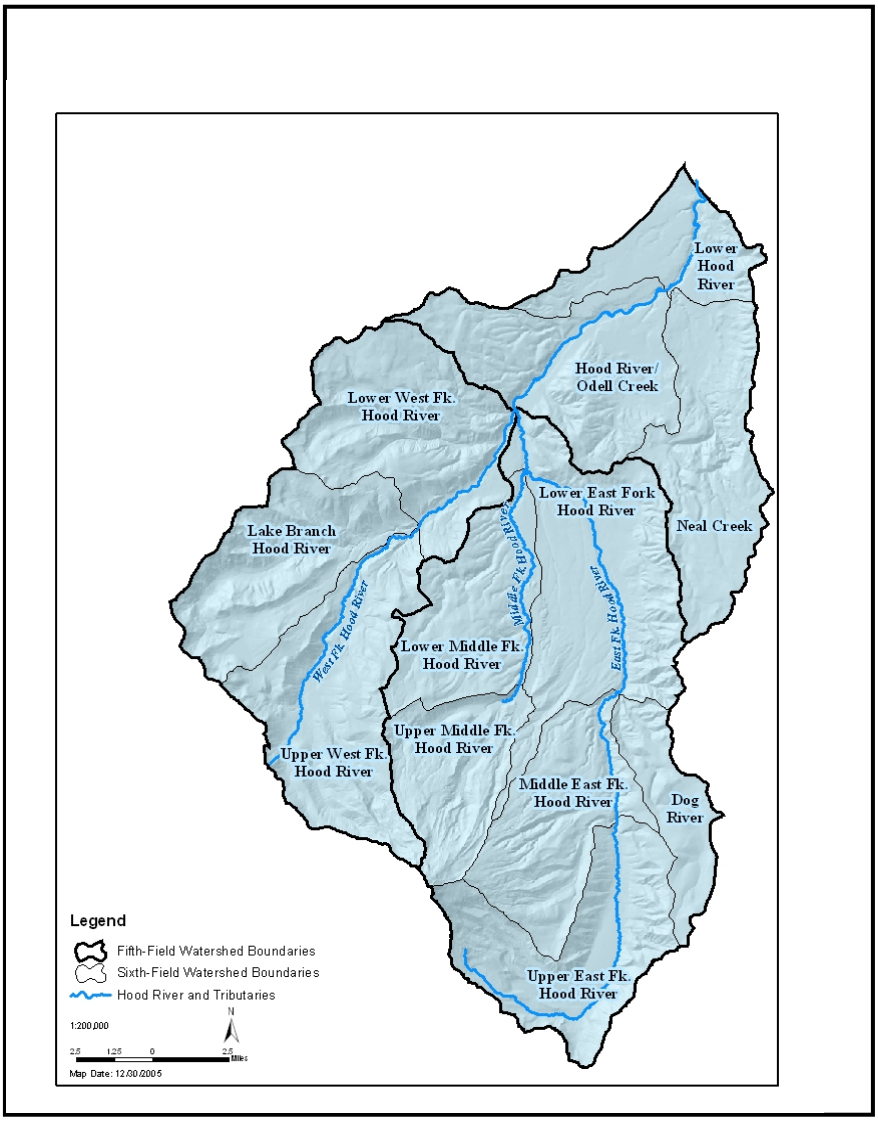

Figure 2. Hood River Basin 5th and 6th Field Watershed Boundaries.

Native, anadromous fish populations are comprised of spring and fall Chinook, summer and winter steelhead, coho, and Pacific lamprey. Resident, native salmonid species include cutthroat trout, bull trout, rainbow trout, and mountain whitefish. Sea-run, or anadromous, cutthroat trout are still present in low numbers. Once abundant in large numbers throughout the basin, many of these fish species have dwindled to very low numbers. The decline in native, anadromous fish runs was witnessed throughout the 1900s and may be attributed to over-fishing, hydroelectric impacts, habitat degradation, and to a lesser extent hatchery influences. In the late 1990s and in 2005, several Endangered Species Act (ESA) listings were made by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, affecting five of the six naturally spawned anadromous fish populations and one resident fish species (Table 1).

Table 1. Endangered Species Act Determinations for Naturally Spawned Fish Species in the Hood River Basin.

Population	Species	ESU/DPS[1]	ESA Status	Responsible Agency	Date
Spring Chinook	*Oncorhynchus tshawytscha*	Lower Columbia River Chinook	Threatened	NOAA Fisheries	June 28, 2005
Fall Chinook	*Oncorhynchus tshawytscha*	Lower Columbia River Chinook	Threatened	NOAA Fisheries	June 28, 2005
Summer Steelhead	*Oncorhynchus mykiss*	Lower Columbia River Steelhead	Threatened	NOAA Fisheries	January 5, 2006
Winter Steelhead	*Oncorhynchus mykiss*	Lower Columbia River Steelhead	Threatened	NOAA Fisheries	January 5, 2006
Coho	*Oncorhynchus kisutch*	Lower Columbia River Coho	Threatened	NOAA Fisheries	June 28, 2005
Bull Trout	*Salvelinus confluentus*	Columbia River	Threatened	U.S. Fish and Wildlife Service	June 10, 1998
Pacific Lamprey	*Lampetra tridentada*	Not able to define	Not eligible for listing	U.S. Fish and Wildlife Service	Dec 27, 2004
Coastal Cutthroat Trout	*Oncorhynchus clarki*	Southwest Washington/Columbia River	Improved Understanding; Listing Not Warranted	U.S. Fish and Wildlife Service	July 5, 2002

[1]An Evolutionarily Significant Unit (ESU) as defined by NOAA Fisheries is considered "distinct" (and hence a "species") under the Endangered Species Act in that it is reproductively isolated from other conspecific population units and represents an important component in the evolutionary legacy for the species (Waples 1991). A Distinct Population Segment (DPS) is a subdivision of a vertebrate species that is treated as a species for the purposes of listing under the ESA per the Department of Interior Fish and Wildlife Service and Department of Commerce National Oceanic and Atmospheric Administration "Policy Regarding the Recognition of Vertebrate Population Segments under the ESA" (Federal Register Notice, February 7, 1996).

Collaborative Partners

The partners in the Hood River Basin have a strong history of collaboration. Many diverse interests are represented by the various stakeholders throughout the basin, and there continue to be several competing natural resources and economic forces at the forefront of controversy. Despite this potentially volatile environmental, economic, and political setting, the partners in the basin have continuously held a strong commitment towards working together and meeting challenges to resolve natural resource conflicts. Time and time again over the last two decades, this group of partners with diverse interests has worked collaboratively to build a healthy and sustainable community and environment through education, cooperation, and stewardship as is embraced in the Hood River Watershed Group's mission statement (Coccoli 2002).

This particular effort was launched in the same collaborative spirit, and was made open to all interested partners in the basin to participate and contribute. The development of this strategy was inspired and spearheaded by Forest Service staff from the Mt. Hood National Forest. However, it was continually emphasized at the series of meetings and workshops that took place July through October 2005 that all stakeholders and partners involved in aquatic habitat restoration in the basin should contribute to the development of this strategy and its end products.

Without such broad participation, it was recognized the overall strategy would have limited support and durability over the long term. The organizations and individual participants that contributed to the development of this strategy are listed in Table 2. Five organizations (Hood River County, Oregon Department of Environmental Quality, Oregon Water Resources Department, Natural Resources Conservation Service, and U.S. Fish and Wildlife Service) were invited to attend and participate in working group meetings and workshops but were unable to commit their staff due to competing work priorities and scheduled field work during the busy summer months.

Table 2. List of organizations and individuals that contributed to the development of the Hood River Basin Aquatic Habitat Restoration Strategy.

Organization/Individual	Participant(s)	Contribution
Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS)	Alexis Vaivoda Joseph McCanna	Working Group Participant Working Group Participant
East Fork Irrigation District (EFID)	John Buckley	Working Group Participant
Farmers Irrigation District (FID)	Mike Kleinsmith Katie Skakel	Working Group Participant Working Group Participant
Holly Coccoli (previous HRWG coordinator)		Expert Panel Participant
Hood River Soil & Water Conservation District (HRSWCD)	Anne Saxby Brian Nakamura	Working Group Participant Working Group Participant
Hood River Watershed Group (HRWG)	Steve Stampfli Greg Short	Working Group Participant Working Group Participant
Ken Davis (retired USFS resource assistant)		Expert Panel Participant
Ken Galloway (retired Hood River County Forester)		Expert Panel Participant
Middle Fork Irrigation District (MFID)	Dave Compton	Working Group Participant
National Marine Fisheries Service	Rob Markle	Working Group Participant
Oregon Department of Environmental Quality (ODEQ)	Bonnie Lamb	Provided Technical Information/Data
Oregon Department of Fish and Wildlife (ODFW)	Rod French Jason Seals	Working Group Participant Working Group Participant
Oregon Department of Forestry (ODF)	Doug Thiesies	Working Group Participant
Oregon State University Extension Service	Steve Castagnoli	Working Group Participant
Oregon Water Resources Department (OWRD)	Bob Wood	Provided Consultation/Input
Oregon Watershed Enhancement Board (OWEB)	Rick Craiger	Working Group Participant
Mike Brunfelt (previous USFS hydrologist)		Expert Panel Participant
Steve Pribyl (retired ODFW fish biologist)		Expert Panel Participant
U.S. Forest Service (USFS)	Gary Asbridge John Dodd Chuti Fiedler Darcy Morgan Rick Ragan Dan Shively	Working Group Participant Working Group Participant and Expert Panel Participant Provided Consultation/Input Working Group Participant Expert Panel Participant Working Group Facilitator

Tie to Other Related Efforts

Several previous efforts have been made to assess and analyze stream channel, fish habitat, watershed, and water quality conditions in the basin. Each of these efforts has been extremely useful in diagnosing conditions and restoration opportunities in various locations within the basin. Taken individually, however, none of these previous efforts have culminated in a comprehensive basin-wide, aquatic habitat restoration strategy integrating the needs for both fish population recovery and water quality improvements. The following is a chronological summary of prior efforts relied upon for developing this basin-wide strategy.

USDA Forest Service Watershed Analyses

Summary of Previous Effort

In 1994, the U.S.D.A. Forest Service and Bureau of Land Management implemented the Northwest Forest Plan (USDA and USDI 1994) to guide management of lands within their jurisdiction across the range of the northern spotted owl, primarily from the crest of the Cascades west to the Pacific Ocean in Oregon, Washington, and northern California. A key component of this plan designed to address the needs of many at-risk Pacific Salmon stocks at that time is the Aquatic Conservation Strategy (ACS). The ACS set forth four components to maintain and restore healthy watersheds for at risk fish stocks, other aquatic organisms, and municipal water supplies: key watersheds, riparian reserves, watershed analysis, and watershed restoration. The watershed analysis component of the ACS directed the development of comprehensive, interdisciplinary examinations of watersheds at the 5th field HUC scale. Watershed analysis objectives are to: 1) describe the current and historical physical, biological, and social characteristics of the watershed, 2) identify and analyze specific management issues, and 3) develop recommendations to assist in moving the watershed from its current condition towards its desired future condition (USDA 1995). These analyses, while conducted at the 5th field HUC scale, mostly evaluated conditions on federal lands only. In 1996, Forest Service staff from the Mt. Hood National Forest completed two watershed analyses encompassing all of federal lands within the basin: 1) West Fork Hood River Watershed Analysis (USFS 1996a) and 2) East Fork Hood River and Middle Fork Hood River Watershed Analyses (USFS 1996b).

Specific Tie(s) to Development of This Strategy

Information and key findings from the two watershed analysis reports assessing the condition of federal lands in the basin were used to: 1) bolster our current understanding and knowledge of important fish populations present and habitat conditions, 2) assist in determining watershed condition and health, 3) assist in evaluating limiting factors for individual 6th field watersheds and particular areas within them, and 4) assist in identifying specific restoration actions or types of restoration actions needed to address limiting factors. One complication limiting the working group's ability to utilize specific data from these reports was the re-defining of 6th field watershed boundaries in 2002 from 50 watersheds to 12. Furthermore, not only were some of the data outdated (i.e., road density, aggregate recovery percentage, etc.), virtually none of it could be matched with data on non-federal lands, where it exists, and it was virtually impossible to summarize it based on the newer 6th field watershed boundaries.

HRWG Hood River Watershed Assessment

Summary of Previous Effort

At the direction of the OWEB, the Hood River Watershed Group and Hood River Soil and Water Conservation District completed a watershed assessment of the entire basin in December 1999 (Coccoli 1999). Much of the data and information from the two previous Forest Service watershed analyses were incorporated into this assessment. In addition, lands in non-federal ownership were assessed and evaluated much in the same way. The assessment describes and analyzes the following elements:

- Watershed History (characteristics, social and economic background, historical conditions, settlement history, and current land uses)
- Channel Habitat Types
- Fish Population Status and Distribution (anadromous, resident, habitat conditions, and fish passage problems)
- Channel Modifications (historic and existing)
- Hydrology and Water Use (climate, streamflow, water rights, and water use)
- Water Quality (summary of available data and concerns)
- Riparian and Wetland Conditions (mainstem riparian assessment and wetlands assessment)
- Sediment Sources (natural and anthropogenic)
- Upland Vegetation and Wildlife Habitat (landscape changes and opportunities for enhancement and protection)
- Watershed Condition Evaluation (summary of key findings)

Specific Tie(s) to Development of This Strategy

Much like the watershed analyses on federal lands, this watershed analysis effort provided useful information to: 1) bolster our current understanding and knowledge of important fish populations present and habitat conditions, 2) assist in determining watershed condition and health, 3) assist in evaluating limiting factors for individual 6th field watersheds and particular areas within them (primarily for portions of the basin in non-federal ownership), and 4) assist in identifying specific restoration projects and types of restoration actions needed to address limiting factors.

ODEQ Western Hood Subbasin Total Maximum Daily Load (TMDL)

Summary of Previous Effort

Often referred to as the TMDL Assessment, the Western Hood Subbasin Total Maximum Daily Load was completed by ODEQ in December 2001 (ODEQ 2001). Prior to its completion, several river and stream segments in the Hood River Basin were listed as water quality limited for either temperature or pH by ODEQ as required under Section 303(d) of the Clean Water Act (CWA). The Western Hood Subbasin TMDL was developed based on information included on the 1998 303(d) List. Specific water quality limitations, or impairments, are based on defined standards relating directly to specific beneficial uses such as fisheries, aquatic life, drinking water, recreation, irrigation, and others. Section 303(d) also requires ODEQ to establish a total maximum daily load for all listed waterbodies designated as water quality limited, where total maximum daily load is defined as "a determination of the total amount of a pollutant (from all sources) that can be present in a specific waterbody and still meet water quality standards" (ODEQ 2001).

The TMDL Assessment primarily addressed temperature. It contains a thorough analysis of water temperature impairments in the basin and documents a water quality management plan to ensure listed waterbodies will eventually meet and maintain water temperature standards. The water quality management plan was developed to focus on three areas: 1) establishing and protecting riparian area vegetation, 2) temperature control in permitted discharges, and 3) temperature control relative to flow management. Designated management agencies are identified, and each one is required to develop an individual implementation plan.

The other water quality impairment listed on the 1998 Oregon 303(d) List pertains to elevated pH levels for one stream segment – Hood River below Powerdale Dam. During the TMDL development process, data was collected which indicated that there were no longer pH impairments in that reach of the river. This reach was thus removed from the 303(d) List in 2002.

Additional data has been collected in the Hood River Watershed which has resulted in additional 303(d) listings in 2002. The identified water quality problems include: chlorpyrifos, Guthion (azinphos methyl), zinc, and iron. TMDL assessments will be required for these parameters at some point in the future.

Specific Tie(s) to Development of This Strategy

The primary component from this previous effort used was its analysis of data and identification of river and stream segments that are water temperature limited. The TMDL Assessment modeled stream temperatures throughout the entire basin under a natural flow condition assuming no diversions. Additionally, estimates of in-stream flow diversions (i.e., average cubic feet per second withdrawn) were made for August 1998, cataloging all anthropogenic diversions. Even though the ODEQ water temperature standards were just recently revised in 2004 (ODEQ 2004) therefore outdating some of the comparative analyzes in this previous effort, a substantial amount of that data and information was useful in identifying specific river and stream reaches of concern for both water quantity and quality.

HRWG Hood River Watershed Action Plan and Update

Summary of Previous Effort

Building from the 1999 HRWG Hood River Watershed Assessment, the Hood River Watershed Group developed a watershed action plan in June 2002 (HRWG 2002) as part of two state-wide initiatives: 1) the Oregon Plan for Salmon and Watersheds and 2) the Healthy Streams Partnership. The plan "identifies cooperative projects, strategies, and priorities to improve water quality and fish populations …" It was developed in a collaborative manner, involving all of the primary stakeholders representing the full array of interests in the basin. It lays out specific action plan goals, catalogs completed projects as of that date, and identifies a restoration philosophy and project prioritization process. The plan focuses on areas and restoration needs primarily on non-federal lands. The plan stratifies specific strategies and actions as follows:

- **Fish Passage (19 proposed actions)**

  → **Goal** – "Improve fish passage conditions where affected by artificial impediments."

- **Water Quality (19 proposed actions)**

  → **Goal** – "reduce contaminants to protect human health, aquatic life, and beneficial water uses; meet or surpass water quality standards/guidelines consistent with natural conditions."

- **Streamflow Restoration (8 proposed actions)**

  → **Goal** – "improve streamflows where opportunities exist that also protect senior water rights; meet in-stream water rights where established by the state and where possible to do so; minimize alteration of natural hydrology; and protect and restore the hydrologic functioning of upland, wetland, and riparian areas."

- **Fish Habitat Protection and Restoration (14 proposed actions)**

  → **Goal** – "Protect, restore, or enhance complex stream structure (e.g., large in-stream wood supply, side channels, pools); restore channel interaction with historic floodplains where compatible with existing land use; protect and restore streamside vegetation and the natural hydrology of upland, wetland, and riparian areas."

- **Public Awareness and Education (7 proposed actions)**

  → **Goal** – "Recommend ongoing education and awareness projects to educate the public about watershed issues and promote improved stewardship of land and water."

- **Recommended Projects for Wildlife (5 proposed actions)**

The specific list of actions proposed in 2002 was updated in 2005, removing those actions from the list that had been completed, changing some of the original proposed actions, and adding a few new actions.

Specific Tie(s) to Development of This Strategy

The HRWG's Action Plan for the basin was an extremely useful product in the development of this strategy. It provided much of the basis for participants' knowledge and understanding of the basin and particular restoration needs. More specifically, it laid out the restoration philosophy that was reviewed and endorsed in this effort. It also provides an inventory and prioritization of specific restoration actions throughout the basin, many of which were affirmed to address specific limiting factors within particular 6th field watersheds. Finally, it provided much of the basis for Chapter 4 in this strategy, outlining many of the programs and funding sources for restoration actions, technical assistance programs, and outreach and education needs and opportunities.

Hood River Basin Fish Passage Barrier Prioritization

Summary of Previous Effort

In April 2002, key stakeholders convened to prioritize 6th field watersheds in the basin to correct known human-related fish passage barriers (Asbridge et al. 2002). At that time, the new 6th field watershed boundaries had not been established, so a total of 50 watersheds were evaluated. Participants from CTWS, HRWG, ODFW, OWEB, and USFS developed a prioritization approach with four sideboards:

1. ESA listed and/or unique fish species or races are the most important (evaluated in terms of both present capability and future potential).
2. Anadromous species are priority over resident species.
3. Reconnection of isolated habitats would be done using a "corridor concept" whereby reconnecting migratory corridors and habitat at the watershed-scale was desired over ranking individual barriers at the site-scale.
4. All upstream and downstream barriers were to be evaluated, not just road crossings.

The process first identified the relative importance or priority of individual fish populations. Next, those 6th field watersheds that either lacked or contained low abundances of the higher ranking fish populations, had a low amount of available or potential habitat, or lacked human-related fish passage barriers altogether were separated and identified as Low priority. All remaining 6th field watersheds were then grouped by the total number of fish populations present. Participants then used a Delphi system to rate the habitat quality and production potential for each remaining watershed as Low, Medium, or High. Finally, an integration of the total number of fish populations present together with the habitat quality and production potential ratings was made and a final criterion considering the presence of important strong hold areas (i.e., areas of exceptionally high quality habitat and/or unique or high concentrations of important fish populations) was factored in to arrive at three priority categories:

Group A, Group B, and Group C watersheds. While participants recognized the importance of restoration actions to correct known fish passage barriers in all three categories, Group A watersheds were considered first priority, Group B second priority, and Group C third priority. A later category, Group D, was established for those remaining watersheds that contain one or more high priority fish populations, provide medium or high quality habitat/production potential, or are considered an important strong hold area but contain no known fish passage barriers. Pinnacle Creek is an example of a Group D watershed containing a high quality spawning and rearing tributary for the Clear Branch bull trout sub-population (Figure 3).

Figure 3. Pinnacle Creek, a Group D Watershed in the Asbridge et al. (2002) Basin-wide Fish Passage-Culvert Prioritization, Shown Before and After Fish Passage was Restored. ***Photos by Gary Asbridge.***

***Photo Left*: A culvert at the mouth of Pinnacle Creek entering Laurance Lake during low reservoir pool elevation creating a fish passage impediment for bull trout.**

***Photo Right*: Mouth of Pinnacle Creek just after fish passage improvement project was implemented in 2002.**

Specific Tie(s) to Development of This Strategy

Information from this previous effort was helpful in one primary way. The manner in which fish populations were prioritized relative to one another in this earlier effort served as the starting point for the working group to revisit and fine-tune priority areas in the basin for fish populations in the basin. The specific results from this previous effort for prioritizing watersheds to correct known fish passage barriers were not revisited. From a watershed perspective of reconnecting isolated habitat using a "corridor concept," it was felt this earlier effort provides that focus and guidance for future fish passage barrier restoration actions in the basin.

NPCPC Subbasin Planning

Summary of Previous Effort

The most recent Hood River Subbasin Plan was completed May 28, 2004 by a working group comprised of the Columbia River Inter-Tribal Fish Commission, CTWS, HRSWCD, ODEQ, ODFW, and USFS (Coccoli 2004). The plan was submitted to the Northwest Power and Conservation Planning Council (formerly the Northwest Power Planning Council) and adopted as part of the council's Fish and Wildlife Program. The plan identifies specific goals and biological objectives for fish and wildlife populations in the Hood River Basin and strategies to attain those goals and objectives over the next 10 to 15 years. The Hood River Subbasin Plan is one of several throughout the entire Columbia River Basin and is intended to assist the Bonneville Power Administration in fulfilling part of its mission by funding priority mitigation actions that benefit fish and wildlife populations adversely affected by the Federal Columbia River Power System (FCRPS) Hydroelectric Projects. The subbasin plan: 1) Contains an assessment of current and historic biological and physical conditions, 2) Outlines specific limiting factors suppressing fish and wildlife populations, 3) Identifies current programs and activities in place, and 4) Defines a management plan for the basin. The management plan for the basin outlines a vision with specific goals and biological objectives, prioritizes strategies to achieve those objectives, addresses consistencies with ESA and CWA requirements, and outlines research and monitoring needs. Specific strategies address habitat, hydroelectric, hatchery, and harvest impacts to fish populations.

Focal fish populations included bull trout, spring Chinook, fall Chinook, summer steelhead, and winter steelhead. Actual assessments of current and historic conditions were made for fall and spring Chinook and winter steelhead using the Ecosystem Diagnosis and Treatment (EDT) Model developed by Mobrand Biometrics, Inc. The primary limiting factors identified are: flow, channel stability, habitat diversity, key habitat quantity, and sediment load. The plan acknowledges a substantial survival increase for focal fish species in the basin with the scheduled 2010 decommissioning of Powerdale Dam and improvements in fish passage and reconnection of habitats at other dams and diversions in the basin. A total of six restoration scenarios were evaluated for fall and spring Chinook and winter steelhead using the EDT model. Restoring large woody debris to rivers and streams throughout the basin is predicted to provide the largest increase in spawner and juvenile outmigrant production. Other restoration scenarios evaluated predict that both in-stream flow restoration and fish passage improvements will also substantially benefit population abundances.

Specific Tie(s) to Development of This Strategy

The component of the subbasin plan primarily used in the development of this strategy pertains to the aquatic habitat related factors identified as limiting fish production predicted by the EDT model. Specific biological objectives for focal fish populations were not revisited. The subbasin plan addresses other critical factors aside from just habitat conditions (i.e., hydroelectric, hatchery, and harvest) affecting current fish populations.

Chapter 2 -
Geographic Framework

Chapter 2 – Geographic Framework

Process Used to Determine Aquatic Habitat Restoration Priority

The working group identified three key components to be used in developing a restoration geographic focus for the basin. All three of these components were deemed equally important. The first component, Fish Species Priority, addresses the various focal fish species or populations in the basin, their distributions, and important habitats for spawning, rearing, and migration. The second component, Water Quantity/Quality, addresses stream reaches in the basin with known limited in-stream flows and water quality impairments. The third component, Watershed Condition, addresses overall condition and health of the 12 individual 6th field watersheds in the basin. These three components were integrated, as described below under the Synthesis section, to develop an overall restoration geographic focus for the basin. Figure 4 displays a diagram depicting the conceptual model used in the Synthesis section described below.

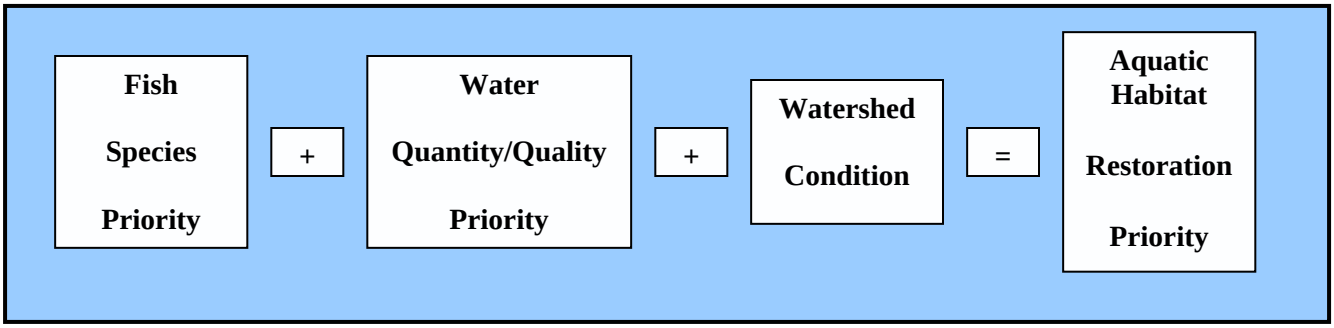

Figure 4. Conceptual Model Used to Integrate Fish Species, Water Quantity/Quality, and Watershed Condition to Establish Aquatic Habitat Restoration Priorities at the 6th Field Watershed Scale, Hood River Basin.

Fish Species Priority

The working group desired to identify aquatic habitat restoration needs in the basin that would address all native anadromous and resident salmonid species (excluding mountain whitefish) and Pacific lamprey. Native species were defined as offspring from adult fish spawning in natural habitat (rivers and streams). Non-native species, such as brook trout, were not included. At first, the working group attempted to establish an overall prioritization of the focal fish species for this effort, mirrored somewhat after the previous effort to prioritize portions of the basin for remedying fish passage impediments (Asbridge et al. 2002). The end-product in mind was to establish an overall ranking of the importance of the various fish populations. After thorough discussion of new information and findings for each population, the working group revised the earlier ranking effort by Asbridge et al. (2002) and developed a final fish population prioritization (Table 3).

Table 3. Relative Priority of Fish Populations for Basin-wide Aquatic Habitat Restoration Geographic Focus.

Fish Population	Relative Priority	Comments
Summer Steelhead	1	Only population of summer steelhead within ESU on Oregon-side of Columbia River.
Bull Trout	2	Last known self-sustaining population of bull trout in the Mt. Hood National Forest.
Winter Steelhead	3	Current population is self-sustaining, but has been at low to very low abundance levels over the past decade.
Fall Chinook	4	Present only in very low numbers in the lower portion of the basin.
Coho	5	Recently listed in 2005 under Federal ESA.
Spring Chinook	6	Very important species to CTWS for harvest, spiritual, and cultural reasons. Also important to non-tribal stakeholders for sport and commercial harvest. Heavy influence by out-of-basin Deschutes stock used for extensive hatchery-supplementation program in the basin.
Cutthroat Trout (resident and anadromous)	7	Aquatic habitat restoration needs for anadromous component assumed to be addressed by all of the other overlapping anadromous species.
Rainbow Trout (resident)	8	A past genetic sampling effort suggests the presence of the redband subspecies in a lower basin tributary. There is some uncertainty and lack of consensus around the conclusiveness of the previous sampling effort. Thus, rainbow trout were simply considered as resident *O. myiss* without further refining it.
Pacific lamprey	9	Poorly known species. Current distribution blocked at Powerdale Dam. Likely to occupy lower portions of basin overlapping in distribution with fall Chinook once dam is decommissioned. Aquatic habitat restoration needs not well know for this species, but assumed to be addressed by all of the other species overlapping in the same river and stream reaches.

Two main sources of data, available as geographic information system (GIS) coverages, were used to identify fish population distributions throughout the basin. The first data source came from ODFW; the second from the USFS. Fish population distribution maps were developed using GIS for each species from both data sources, highlighting consistencies and inconsistencies between the two data sources. The working group reconciled the inconsistencies in distributions for each fish population, and also attempted to identify or describe known spawning and/or rearing "hot spots." A "hot spot" was defined as a particular reach of river or stream (or portion of the basin) where one or both of the following applies: 1) there is a consistently high concentration of spawning adults on a year-to-year basis or 2) the population is known to be present only in that particular stream, river, or a portion of the basin. Very little data or information were available from which to identify hot spots for particular species. The working group was only able to identify a few hot spot areas for two species; bull trout and spring Chinook. Hence, the limited information on hot spots was not used to identify priority areas in the basin for various fish populations with the exception of bull trout. The working group relied primarily on fish distributions.

Distribution maps for all of the fish populations listed in Table 3, above, are presented in Appendix A.

Summer Steelhead

Summer steelhead are limited in their distribution within the basin, and are known to occur only in the West Fork Hood River, including its accessible tributaries (Appendix A, Map A1). Summer steelhead occur in very low numbers, and there is very limited data and information thus identification of spawning and/or rearing "hot spots" was not possible. Summer steelhead have been observed spawning in the lower half mile of McGee Creek, headwaters of the West Fork Hood River, during spring spawning surveys (CTWS unpublished spawning survey data).

Bull Trout

Bull trout are also limited in their known distribution within the basin (Appendix A, Map A2). An isolated, self-sustaining sub-population of bull trout occurs in the Clear Branch of the Middle Fork Hood River and Pinnacle Creek upstream of Clear Branch Dam. This isolated, sub-population is considered to be genetically similar to the bull trout sub-population known to occur downstream of Clear Branch Dam throughout the Middle Fork Hood River. The working group identified the entire portion of the Clear Branch of the Middle Fork Hood River upstream of Clear Branch Dam as a hotspot for bull trout in the basin, elevating this area to a special status. Additionally, the working group identified the Middle Fork Hood River for its entire length as important rearing habitat with intermittent spawning. The remainder of the river system downstream from the Middle Fork – East Fork confluence including the mainstem Hood River to its confluence with the Columbia River was also identified as an important migratory corridor for both adults and sub-adults.

Winter Steelhead

Winter steelhead occur primarily in the mainstem Hood River, East Fork Hood River, Middle Fork Hood River and accessible tributaries to all three (Appendix A, Map A3). Winter steelhead do not overlap in their distribution with summer steelhead. The two populations are believed to segregate themselves in different portions of the basin in order to coexist. The primary separating mechanism for these two populations over the long period of their coexistence in the basin is Punch Bowl Falls on the West Fork Hood River at river mile 0.25. Prior to human modification of this partial migration barrier in 1957, it is believed that summer steelhead could ascend the falls during more moderate river flows in the spring and early summer months whereas winter steelhead were unable pass during the higher winter flows (Dan Rawding, Washington Department of Fish and Wildlife, personal communication). This pattern of summer and winter steelhead segregation is also seen on several rivers on the Washington-side of the Lower Columbia River drainage, such as the Wind and East Fork Lewis rivers.

The winter steelhead population in the Hood River Basin is recognized as both a "core" and "genetic legacy" population by the Willamette/Lower Columbia Technical Recovery Team charged with developing technical guidance and analysis to aid in salmon recovery planning efforts (McElhany et al. 2003). A *core population* is defined as one that either represented substantial portions of the ESU's historical abundance or contained life-history strategies specific to the ESU. Core populations are considered to be important for maintaining the evolutionary legacy of the ESU, and managers are encouraged to give priority to these populations in recovery planning. A *genetic legacy population* is defined as one that either had minimal influence from nonendemic fish through artificial propagation practices or exhibits important life-history traits no longer found throughout the majority of the ESU's historical range. Managers are encouraged to give recovery planning priority to genetic legacy populations since they retain the most intact representatives of the genetic composition of the ESU.

Fall Chinook

Fall Chinook are limited in distribution to the lower portions of the basin (AppendixA, Map A4). The primary production area for fall Chinook is within the mainstem Hood River and lower West Fork Hood River upstream to Punch Bowl Falls. Fall Chinook are found only in very low numbers and surveys are lacking to identify specific spawning "hot spots."

Coho

Coho are more widespread in distribution than Fall Chinook, but much less so than the combined portions of the basin occupied by summer and winter steelhead (Appendix A, Map A5). Coho have appeared in the river system sporadically over the last several decades, and most individuals are believed to be of hatchery origin straying from hatchery facilities downstream on the Columbia River at Bonneville Dam. The original native Hood River coho stock is believed to have been eradicated. Few spawning surveys have been conducted for coho, and it is believed their distribution is more widespread than currently documented. Side channels along the lower mainstem Hood River are believed to provide important rearing habitat and could be considered as potential "hot spots." However, the working group acknowledged there is insufficient data and information available on coho to adequately characterize the population's distribution and "hot spots" for spawning and rearing.

Spring Chinook

Spring Chinook are believed to be more heavily distributed in the West Fork Hood River drainage upstream of Punch Bowl Falls. While they have recently been documented present as far upstream as river mile 6.0 on the Middle Fork Hood River during a radio-telemetry study (CTWS unpublished spawning survey data), their distribution in the both the Middle and East forks is poorly understood. Map A6 in Appendix A shows the distribution of spring Chinook throughout the basin. The section of the West Fork Hood River from Ladd Creek upstream to McGee Creek is identified as a "hot spot" for spring Chinook spawning based on surveys conducted by CTWS.

Cutthroat Trout

Cutthroat trout distribution is extensive throughout much of the basin (Appendix A, Map A7). However, they are known to be concentrated primarily in three portions of the basin: 1) upper portions of the East Fork Hood River and its tributaries, 2) upper portions of the Middle Fork Hood River and it tributaries, and 3) Green Point Creek. Cutthroat trout have never been documented in the West Fork Hood River system upstream of Punch Bowl Falls. The population status of the anadromous, sea-going form of cutthroat trout in the Hood River Basin remains largely unknown, although it is believed the sea-run form was historically present.

Rainbow Trout

Rainbow trout distribution is also extensive throughout much of the basin (Appendix A, Map A8). There was considerable discussion within the working group whether or not redband trout (*O. mykiss gairdneri*) are present in the basin. A genetics study conducted by Spruell et al. (1998) provides results that may indicate the presence of redband trout in North Fork Green Point Creek, one of the 17 sites evaluated in the basin. However, given the study was not replicated or conducted on a basin-wide systematic sampling framework, the working group came to agreement to consider the resident form of *O. mykiss* simply as rainbow trout. The group did not attempt to differentiate between coastal and inland forms. It was noted that lower Neal Creek is known to contain high numbers of rainbow trout.

Pacific Lamprey

Pacific lamprey distribution is currently blocked by Powerdale Dam (Appendix A, Map A9). With the planned decommissioning of Powerdale Dam in 2010 (PacifiCorp and Others, June 6, 2003 Settlement Agreement Concerning the Interim Operation and Decommissioning of Powerdale Hydroelectric Project, FERC Project No. 2659), fish biologists in the basin believe that Pacific lamprey will be able to distribute throughout much of their historical range. It is believed that their primary distribution and concentration will be within the lower portion of the basin after the removal of Powerdale Dam, tending to overlap in distribution mostly with fall Chinook. However, it was readily recognized that we know very little about Pacific lamprey habitat use in the basin. An assumption was made that with so many important species overlapping in their distributions within the lower portion of the basin, the aquatic habitat restoration needs for Pacific lamprey would be met.

Integration of Fish Population Priorities and Distributions

Once the distribution for each fish population was determined, the working group pursued two alternative methods for identifying important river and stream reaches to determine the Fish Species Priority. Both methods were intended to: 1) identify stream reaches that contain multiple populations and 2) highlight other stream reaches critically important to a single fish population not included in reaches with multiple populations. The two alternative methods developed are "Number of Fish Species" and "Weighted Priority by Species." They are described as follows:

Number of Fish Species Present – this method identifies all reaches in the basin where one, two, three, … or nine populations overlap in their distributions. This method only identifies reaches where known population distributions overlap. Furthermore, this method does not assign importance of one species over another. For example, a reach would receive the same overall rating whether it contained the highest three priority fish populations in Table 3, above, or the lowest three priority fish populations. Figure 5 shows the results of this method for evaluating the importance of river and stream reaches in the basin for fish populations.

Weighted Priority by Species – this method assigns a weighted score to each reach for all fish populations present based on their priority rating in Table 3. Fish populations that were identified as higher priority were given a higher number of points in the weighted ranking. Hence, summer steelhead were assigned a weight of "9," bull trout "8," winter steelhead "7," … Pacific lamprey "1." Therefore, theoretically, if all fish populations are known to be distributed within the same reach, then it would receive a total weighted score of 45. A reach with a higher score denotes a higher priority for aquatic habitat restoration focus. Results from this method are shown in Figure 6.

The results for each method were mapped with a similar color-coding scheme based on three tiers of the results from each method (Table 4). There is a considerable amount of convergence between the two different methods when examining their independent results at the three tiers established.

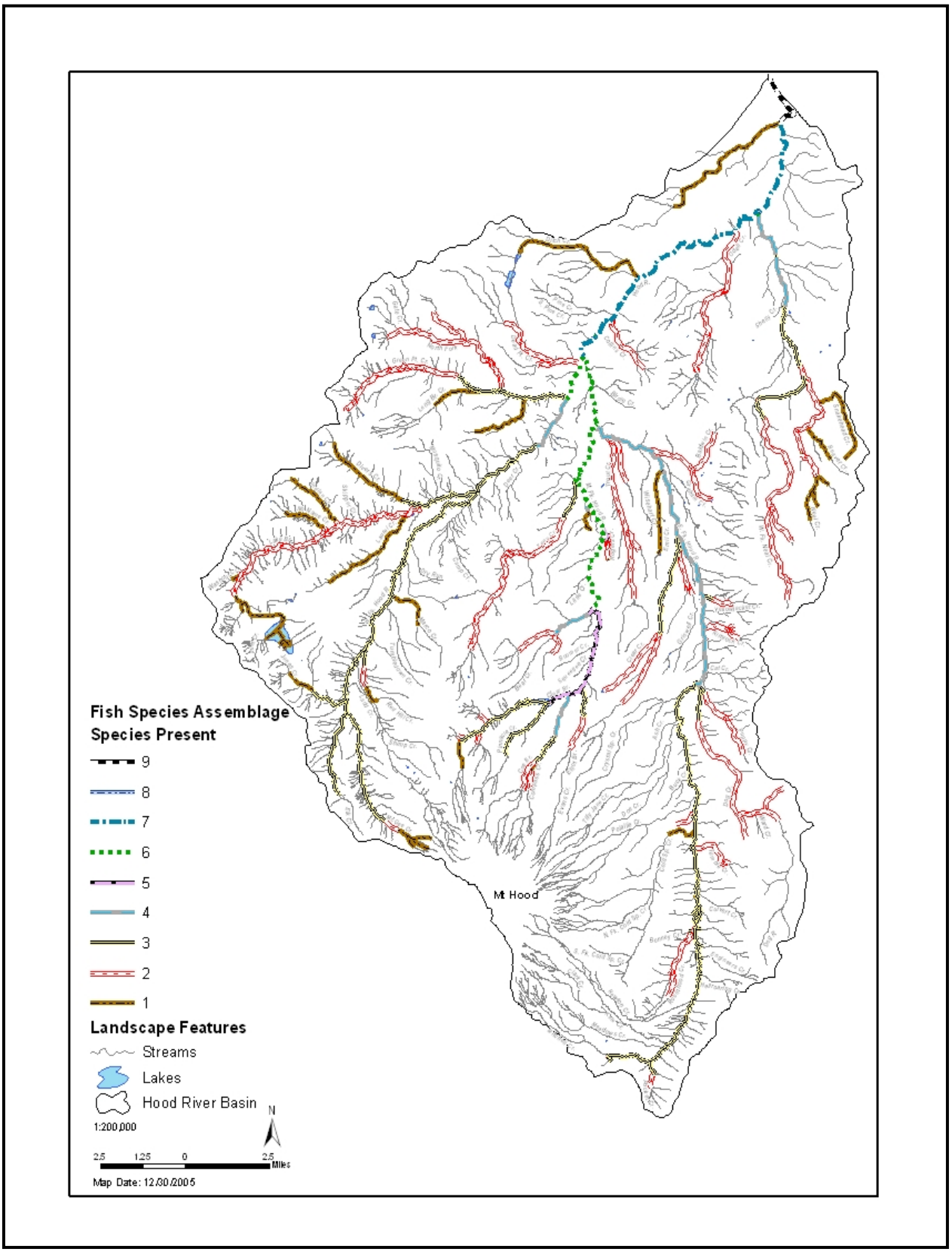

Figure 5. Number of Fish Species Present Method for Determining Fish Species Priority, Hood River Basin.

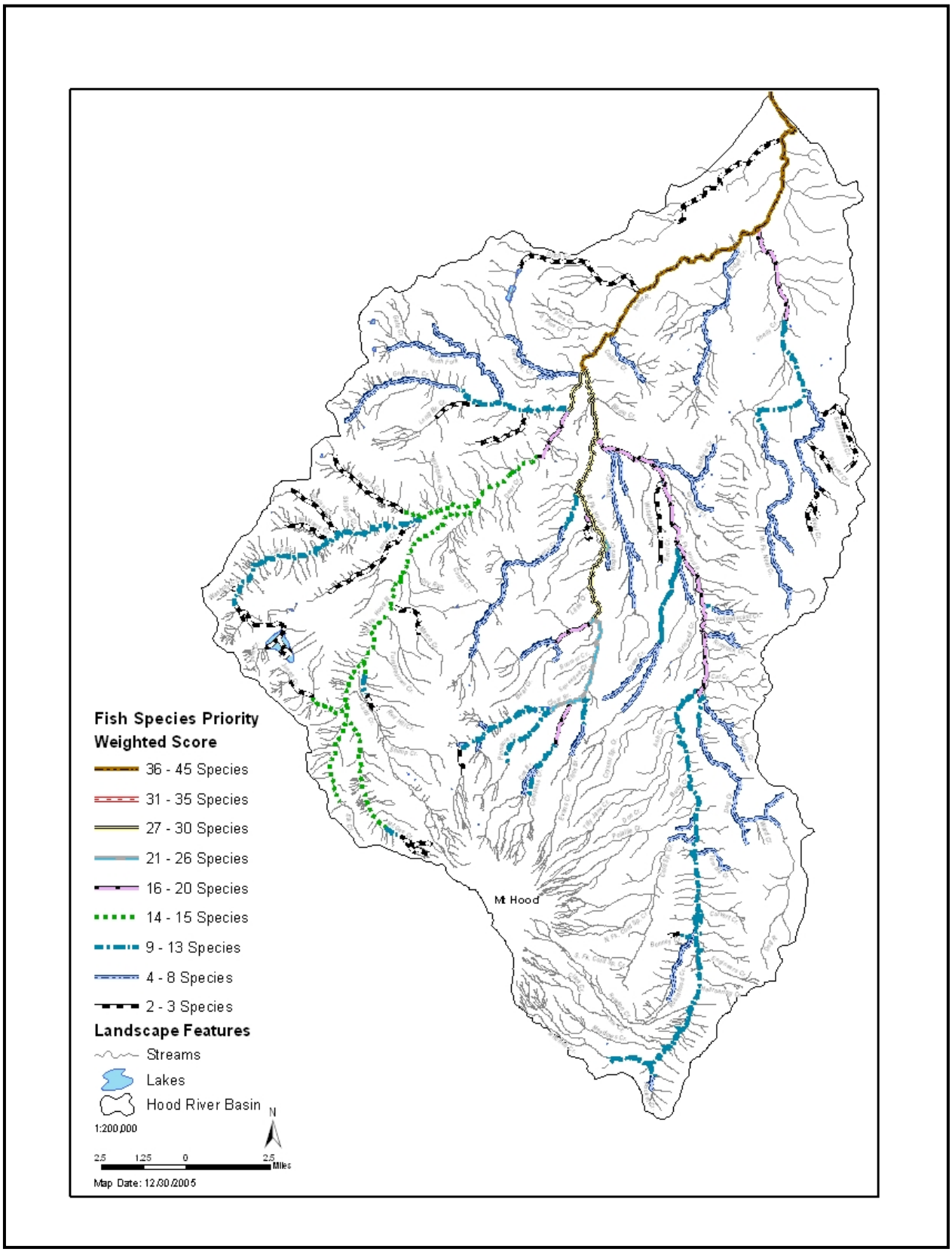

Figure 6. Weighted Priority by Species Method for Determining Fish Species Priority, Hood River Basin.

Table 4. Results from the Number of Fish Species Present and Weighted Priority by Species Methods for Identifying Important River and Stream Reaches to Focus Aquatic Habitat Restoration Needs.

	Reach Score Results based on Number of Fish Species Present	Reach Score Results based on Weighted Priority by Species
Tier 1	8 6 5 4	44, 43 30, 29, 27 25, 22 21, 20
Tier 2	3	18, 17 13, 12
Tier 3	2 1	10, 9 5 3, 2

After examining the results of both methods and their strengths and weaknesses, the working group adopted a "hybrid" between the two approaches. The "hybrid" approach was developed from Figures 5 and 6 by integrating the three tiers from Table 4 and identifying reaches where the two methods converge and don't converge. The working group determined this "hybrid" approach would be used to define the Fish Species Priority component in the overall conceptual model for the prioritization strategy shown in Figure 4. The results from this "hybrid" approach are shown in Figure 7. The criteria used in developing the "hybrid" approach shown in Figure 7 are as follows:

> **Overlap 1** = all reaches where the Tier 1 results overlap between the two methods (Table 4), plus the addition of Clear Branch and Pinnacle Creek since this area is recognized as a hot spot for the bull trout population.
>
> **Overlap 2** = all reaches where the Tier 1 results did not overlap between the two methods (Table 4), plus all remaining tiers for both methods excluding reaches that contain only cutthroat and rainbow trout.
>
> **Overlap 3** = all remaining reaches containing only cutthroat and rainbow trout.

The working group next assessed the amount of habitat known to be occupied in each of the 6th field watersheds based on the results from the "hybrid" approach shown in Figure 7. Based on habitat availability (i.e., total area of Overlap 1, Overlap 2, and Overlap 3 reaches) and the working group's desire to establish a mainstem corridor in the lower basin deemed important for all fish species, the individual 6th field watersheds were assigned a Fish Species Priority Rank. Table 5 displays the Fish Species Priority rankings for all of the 6th field watersheds in the Hood River Basin.

Table 5. Fish Species Priority Rankings for 6th Field Watersheds, Hood River Basin.

6th Field Watershed	Fish Species Priority Rank	Figure 7 "Hybrid" Approach Composite Distribution	Comments
Hood River – Odell	1	Overlap 1	Establishment of mainstem corridor.
Lower Hood River	2	"	Establishment of mainstem corridor.
Lower Middle Fork	3	"	
Lower East Fork	4	"	
Lower West Fork	5	"	
Upper Middle Fork	6	"	
Upper West Fork	7	Overlap 2	
Neal Creek	8	"	
Middle East Fork	9	"	
Upper East Fork	10	"	
Lake Branch	11	Overlap 3	
Dog River	12	"	

Note: *Rankings are from 1 to 12, where 1 = highest priority and 12 = lowest priority.*

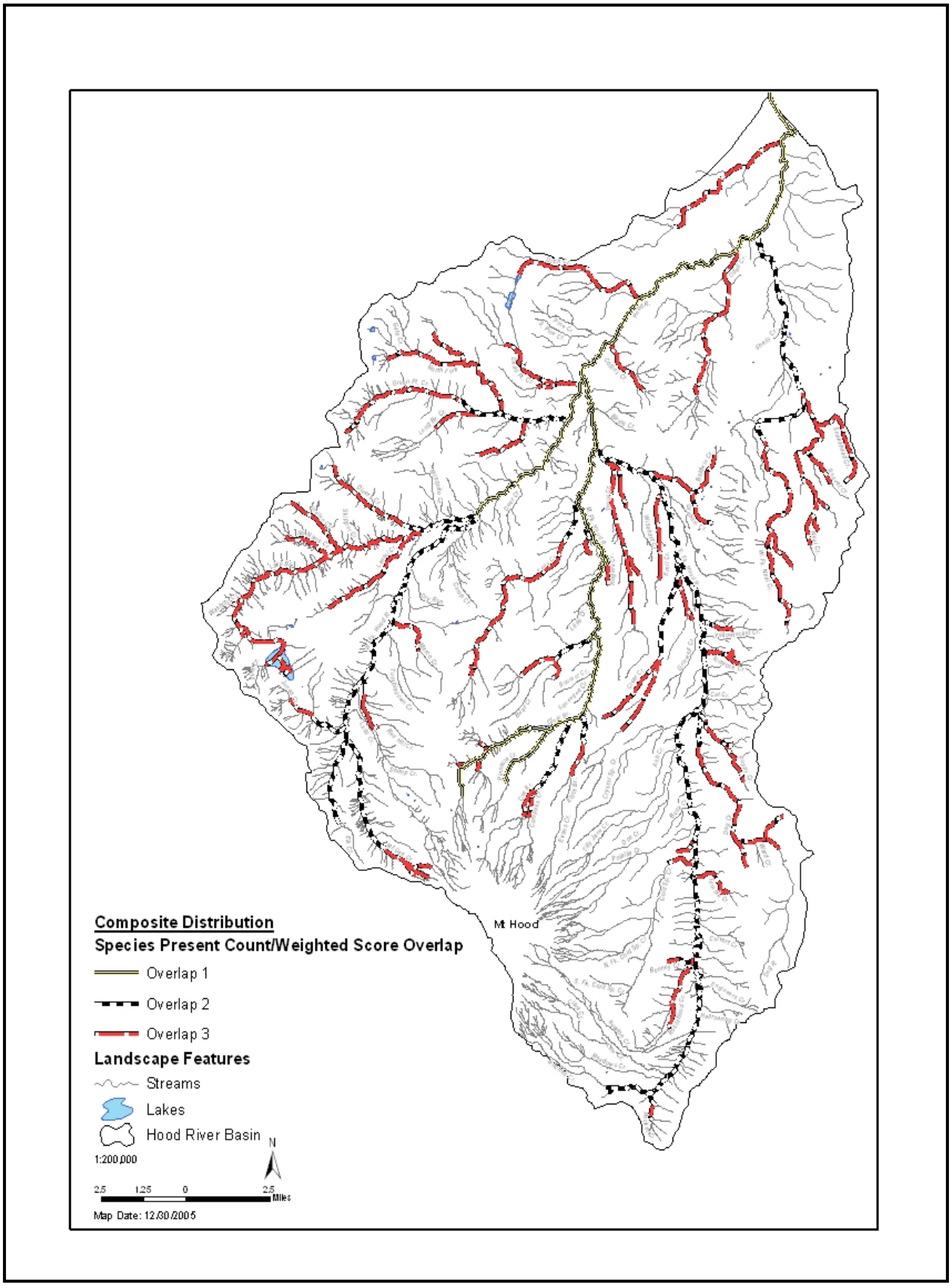

Figure 7. Fish Species Priority based on the "Hybrid" Approach, Hood River Basin.

Water Quantity/Quality

The working group recognized that an aquatic habitat restoration strategy for the basin must address availability of in-stream flows and water quality. Substantial concerns exist with regard to the availability of in-stream flows primarily during low flow summer months in particular reaches throughout the basin. The Hood River Basin is very well known for its fruit crop production, estimated as an $80 million per year industry on average (Dave Compton, General Manager of Middle Fork Irrigation District, personal communication). A large portion of the water withdrawals in the basin directly support irrigation needs for the fruit production industry. While many water withdrawal improvements have been made already to restore in-stream flows and several more are in progress, opportunities for implementing additional improvements exist. Water quality concerns in the basin relate to elevated stream temperatures, chemical pollutants, biological pollutants, and turbidity/sediment. In almost all cases, concerns regarding lack of in-stream flows and elevated stream temperatures coincide within the same river or stream reach.

Water Quantity

The working group reviewed all available streamflow data and information previously collected and summarized in the basin. A summary of point-source withdrawals is provided in the ODEQ 2001 Western Hood Subbasin TMDL; however, specific data and information providing insight to reach-specific impacts are not available. There has yet to be a basin-wide streamflow assessment that accurately quantifies the impacts from multiple water withdrawals and diversions. Given this, the working group commissioned a sub-group to develop a map for entire basin to serve as a "best estimate" of water withdrawal and diversion impacts at the reach scale. The sub-group, comprised of participants knowledgeable and experienced in irrigation practices in the basin including the managers of the three major irrigation districts in the basin, prepared a basin-wide map depicting reach-specific affects from average or normal water withdrawal and diversion operations during an average flow year at summer low-flow conditions (i.e., August to early September). Four broad categories were selected to represent in-stream flow impacts at the reach-scale: 1) <25% of in-stream flows withdrawn or diverted, 2) 25-50%, 3) 50-75%, and 4) >75%. Figure 8 shows the results of this "best estimate" mapping effort. Small diversions where only a couple cfs are known to be diverted were not shown in this mapping effort, since it was intended to highlight reaches of concern where there are substantial amounts of water diverted. The reaches of greatest concern are lower East Fork Hood River and the mainstem Hood River. The lower mainstem Hood River depicting >75% in-stream flow diverted downstream of Powerdale Dam will revert to 50-75% in-stream flow diverted when the dam is decommissioned in 2010 since flows diverted for hydroelectric power generation will be reverted to in-stream uses.

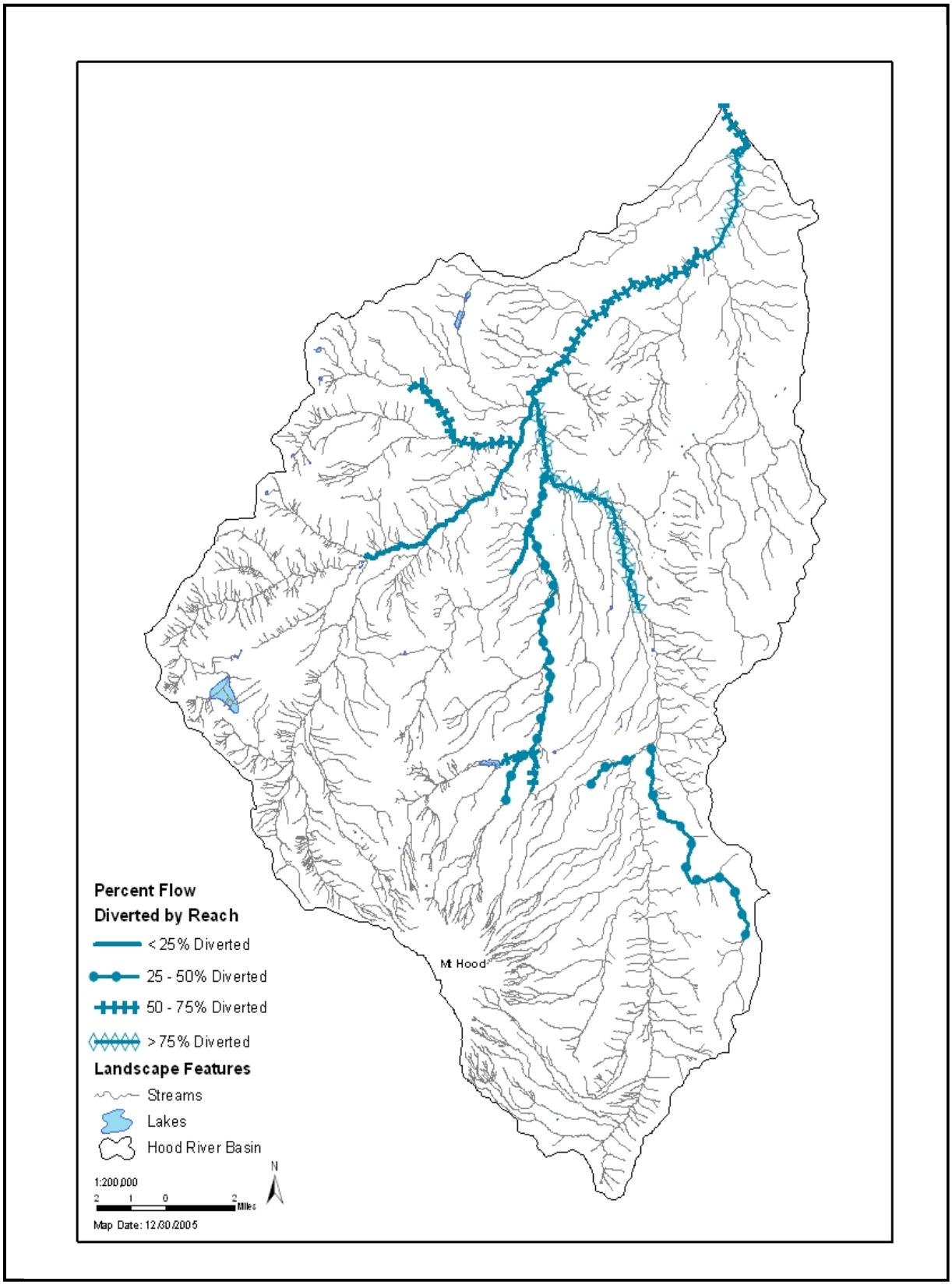

Figure 8. Percent In-stream Flow Diverted by Reach, Hood River Basin.

Water Quality

The working group reviewed all available data and information relevant to identifying river and stream reaches for water quality concerns. Initially, the group focused on a full suite of water quality parameters including water temperature, chemical pollutants, biological contaminants, physical impairments (i.e., dissolved oxygen and pH), and turbidity/sediment. Chemical pollutants include such things as chlorpyrifos, azinphos methyl, heavy metals, and nitrogens and phosphates. Biological contaminants often include waste and fecal coliform from livestock and human sources. After reviewing available data collected and published within the basin, it became readily apparent that there have been few basin-wide, systematic sampling efforts to assess the magnitude or extent of water quality impairments associated with chemical pollutants, biological contaminants, physical impairments, or turbidity/sediment. ODEQ conducted some baseline water quality monitoring in 1998 at about 40 sites throughout the basin (ODEQ, unpublished data). The study did not indicate any exceedances of State water quality standards, although it did indicate some potential concerns. There has been little follow-up of that study, however. There is also an on-going pesticide monitoring program which has been in place since 1999. This study has assessed water chemistry, as well as the health of both the fish and macroinvertebrate populations. From the results of these studies, as well as several other smaller studies, it appears that there are water quality issues for pesticides and bacteria, primarily focused in the lower portion of the basin (Baldwin, Indian, Lenz, Odell, and Neal creeks).

Evans Creek is only stream sampled in the lower portion of the basin that has not revealed a chemical pollutant water quality concern to date. After further deliberation, the working group decided to rely solely on the use of stream temperature data as a surrogate to address overall water quality concerns at the basin-scale for two reasons:

1) With the exception of Evans Creek, all streams exhibiting water quality concerns other than temperature are believed to be representative of those that have been sampled, and these were not randomly chosen, and

2) Streams with other non-water temperature impairments were also highlighted for temperature concerns (Lenz Creek is an exception).

Figure 9 shows the river and stream reaches of concern with regard to water temperature. This figure highlights those reaches not meeting recently revised ODEQ water temperature standards for bull trout and salmon and other trout species based on their spawning and rearing life stage standards. The working group relied mostly on stream temperature data collected in 1998 used in the ODEQ 2001 Western Hood Subbasin TMDL that were reanalyzed based on the 2004 ODEQ standards (see Appendix B, Map B1 and Map B2; analysis completed by Bonnie Lamb, ODEQ). Other available water temperature data collected after 1998 were obtained for Lenz Creek, Baldwin Creek, and East Fork Hood River. These data were also incorporated into the assessment displayed in Figure 9. The working group believes Figure 9 is representative of the stream reaches of concern for most water quality parameters with the exception of Lenz Creek, of course, as mentioned above.

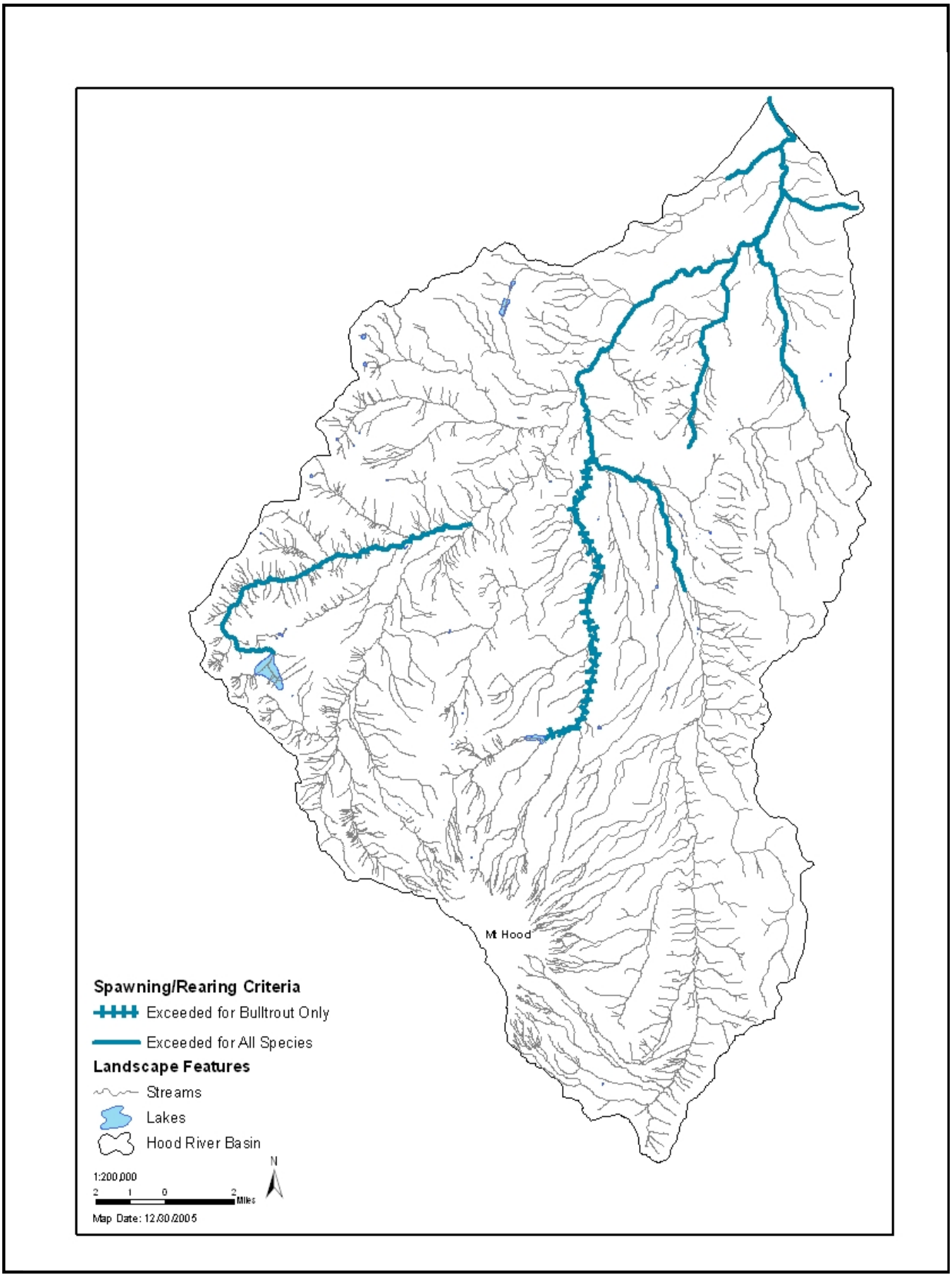

Figure 9. Water Temperature Reaches of Concern, Hood River Basin.

Synthesis of Water Quantity/Quality Information

Many of the stream reaches identified with a concern for in-stream flows (Figure 8) are also identified for concerns in regard to water quality impairments (Figure 9). The working group utilized both water quantity and water quality assessments at the basin-scale to develop a relative ranking of 6th field watersheds (Table 6). A rank of "1" for the Lower East Fork Hood River 6th Field Watershed means it has the highest level of concern with regard to both water quantity and water quality relative to all other 6th field watersheds in the basin. Conversely, a rank of "12" for the Dog River 6th Field Watershed means that it has the least level of water quantity/quality concerns relative to the others. Key rational for the relative ranking outcomes is identified in Table 6.

Table 6. Water Quantity/Quality Rankings for 6th Field Watersheds, Hood River Basin.

6th Field Watershed	Water Quantity/ Quality Rank	Rational
Lower East Fork	1	>75% in-stream flows diverted within a large portion of the watershed
Lower Hood River	2	>75% in-stream flows diverted within a large portion of the watershed
Hood River – Odell	3	50-75% in-stream flows diverted within a large portion of the watershed
Lower Middle Fork	4	50-75% and 25-50% in-stream flows diverted within a large portion of the watershed
Neal Creek	5	Overall impairment (in-stream flows and water quality)
Lower West Fork	6	50-75% and 25-50% in-stream flows diverted within a large portion of the watershed
Upper Middle Fork	7	50-75% and 25-50% in-stream flows diverted within a large portion of the watershed
Lake Branch	8	Mostly water temperature impairment
Middle East Fork	9	All available in-stream flows are appropriated
Upper East Fork	10	All available in-stream flows are appropriated
Upper West Fork	11	
Dog River	12	

Note: *Rankings are from 1 to 12, where 1 = worst condition and 12 = best condition.*

Watershed Condition

Watershed condition is a function of a given watershed's inherent sensitivity to perturbation and its past management and natural disturbance histories. Watershed scientists and specialists often derive long lists of specific metrics to evaluate watershed condition. Examples of these metrics include geomorphic character, geologic composition, soil types, road density, aggregate recovery percentage or equivalent clearcut acreage, number of road/stream crossings, percentage of riparian area in early seral stand condition, channel stability, amount of in-stream woody debris, percent of fine sediment in riffles or spawning gravels, etc. A fundamental problem exists, however, when it comes to comparing these metrics for a given watershed against a set of standards or thresholds to classify its health as "excellent" or "poor" and anywhere in between on this spectrum. Further complicating this matter, is the recently emerging concept in watershed science that watersheds tend to fluctuate in their condition over the long term based on the cyclical nature of large-scale natural disturbances such as floods, fire, or volcanic eruptions.

A watershed that may be in "excellent" condition today may suddenly be in a "poor" condition after it experiences a large-scale natural disturbance a year from now. Granted those watersheds that tend to be in a more healthy condition should be more resilient to these disturbances, the fact remains that it is extremely challenging to empirically evaluate watershed condition based on the types of metrics commonly used. Given this dilemma together with the fact that all previous watershed assessment data for the basin (USFS 1996a, USFS 1996b, and Coccoli 1999) were summarized at the old 6th field watershed boundaries and were not summarized against a set of consistent metrics, the working group utilized an expert panel approach to rank relative watershed health for the 12 6th field watersheds.

Utilizing the expert panel approach, the working group identified nine specialists, each one having extensive knowledge and field experience within the basin over a substantial amount of his/her professional career. The professional backgrounds of the panelists include hydrology, geology, stream geomorphology, forestry, aquatic ecology, and fish biology. Many of the panelists have retired or moved out of the basin to another job location. In order to minimize the time impact on each panelist, the working group decided to present them with an initial watershed condition ranking completed by one of the group's own watershed specialists – John Dodd, a USFS soil scientist with over 15 years experience in the basin. A request was sent out to each of the nine panelists who were asked whether or not they agree with the initial ranking and if not, then how would they re-rank the 6th field watersheds and for what reasons. Six of the nine panelists responded; however, one panelist responded in a manner not useful for the purpose of this effort. The relative condition of each watershed was ranked relative to others in the basin on a scale of "1" to "12." A rank of "1" indicates that watershed determined to be in the best relative condition, and conversely a rank of "12" indicates that watershed in the worst relative condition. The ranking values were established in this manner, inverse to those for Fish Species Priority and Water Quantity/Quality, in order to emphasize a restoration philosophy of restoring those watersheds in better condition first [see Chapter 3 for a more detailed discussion of this restoration philosophy and its caveats.] Two of the five responding panelists agreed with the initial ranking, one differed slightly, and two re-ranked watersheds in the top two tiers (Table 7). Individual expert panelists are identified in Table 7, below, by his or her initials and are also acknowledged above in Table 2 which lists the contributing organizations and individuals to this effort.

After reviewing the results from the individual panelists, the working group determined the best approach would be to average their results and establish an "expert panel" combined rank as shown below in Table 7 in the far right column. Upper Middle Fork Hood River and Upper East Fork Hood River 6th field watersheds tied for a combined rank of "1." The panelists agreed on the relative rankings for the lower tier (lowest 1/3) watersheds: Lower East Fork, Lower Hood River, Hood River – Odell, and Neal Creek. There was almost full agreement on the relative rankings for the top and middle tier watersheds amongst four of the six panelists. Two of the panelists differed substantially from the others in their rankings of the top and middle tier watersheds. Results from Table 7 are presented in a map of the basin shown in Figure 10.

Table 7. Watershed Condition Rankings for 6th Field Watersheds, Hood River Basin.

6th Field Watershed	Expert Panel Member Rankings						Combined Average	Combined Rank
	JD	HC	RR	MB	KD	SP		
Upper Middle Fork	1	4	6	1	1	1	2.3	1
Upper East Fork	2	5	1	2	2	2	2.3	1
Upper West Fork	3	1	2	3	3	3	2.5	2
Lake Branch	4	2	3	4	4	4	3.5	3
Dog River	5	3	5	5	5	5	4.7	4
Middle East Fork	6	6	8	6	6	6	6.3	5
Lower West Fork	7	7	4	8	7	7	6.7	6
Lower Middle Fork	8	8	7	7	8	8	7.7	7
Lower East Fork	9	9	9	9	9	9	9.0	8
Lower Hood River	10	10	10	10	10	10	10.0	9
Hood River – Odell	11	11	11	11	11	11	11.0	10
Neal Creek	12	12	12	12	12	12	12.0	11

Note: *Rankings are from 1 to 12, where 1 = best condition and 12 = worst condition.*

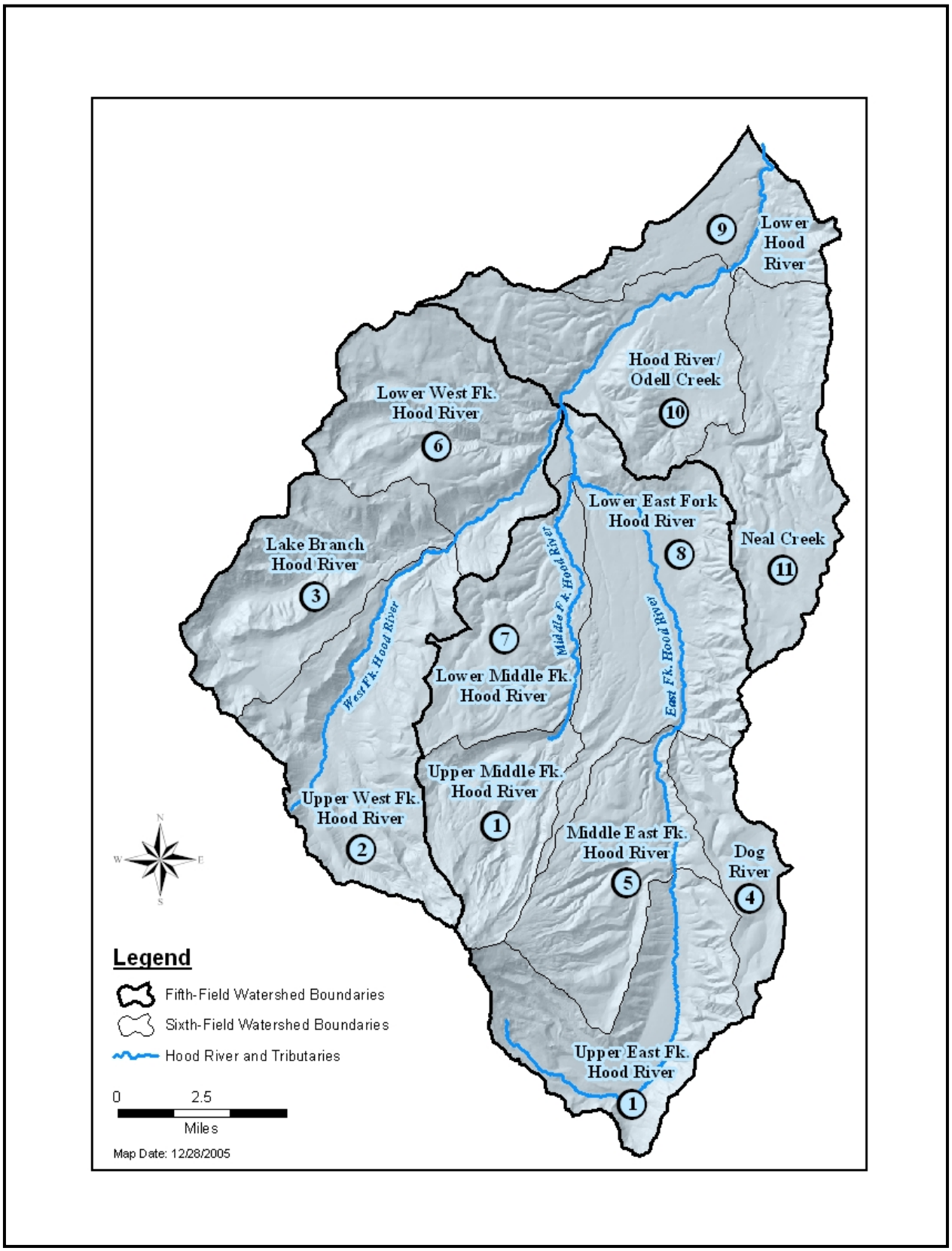

Figure 10. Relative Watershed Condition Rankings at the 6th Field Watershed Scale, Hood River Basin [Note: Rankings are from 1 to 12, where 1 = best condition and 12 = worst condition].

Synthesis & Results – Overall Aquatic Habitat Restoration Focus for the Basin

All three components; Fish Species Priority, Water Quantity/Quality, and Watershed Condition; were integrated to develop the Aquatic Habitat Restoration Score for each 6th field watershed (Table 8). The lower a 6th watershed's Aquatic Habitat Restoration Score is, then the higher priority it would receive at the basin-scale. Theoretically, if a 6th field watershed ranked "1" for all three components (Fish Species Priority, Water Quantity/Quality, and Watershed Condition), then it would receive an Aquatic Habitat Restoration Score of "3."

Two 6th field watersheds tied for the lowest aquatic habitat restoration score; Lower East Fork and Lower Hood River. Three 6th field watersheds tied for the second lowest aquatic habitat restoration score; Lower Middle Fork, Upper Middle Fork, and Hood River – Odell. The working group used the amount of fish habitat known to be occupied in each of the 6th field watersheds tied for first and second lowest scores to establish the final priorities shown in the far right column in Table 8. Watersheds with the greatest amount of "overlap 1 & overlap 2" stream miles (shown in Figure 7) received higher priority. Figure 11 displays the final results for the overall Aquatic Habitat Restoration Priority at the 6th field watershed scale for the Hood River Basin.

Table 8. Aquatic Habitat Restoration Priority for 6th Field Watersheds, Hood River Basin.

6th Field Watershed	Fish Species Priority[1]	Water Quantity/Quality Priority[2]	Watershed Condition[3]	Aquatic Habitat Restoration Score	Aquatic Habitat Restoration Priority based on Overlap 1 & 2 Fish Habitat Quantity
Lower East Fork	4	1	8	13	1
Lower Hood River	2	2	9	13	2
Lower Middle Fork	3	4	7	14	3
Upper Middle Fork	6	7	1	14	4
Hood River – Odell	1	3	10	14	5
Lower West Fork	5	6	6	17	6
Upper West Fork	7	11	2	20	7
Upper East Fork	10	10	1	21	8
Lake Branch	11	8	3	22	9
Middle East Fork	9	9	5	23	10
Neal Creek	8	5	11	24	11
Dog River	12	12	4	28	12

Note: *Rankings are from 1 to 12, where 1 = highest priority and 12 = lowest priority.*
[1] Highest priority given to watersheds with the most fish populations present.
[2] Highest priority given to watersheds with the most degraded water quantity/quality conditions.
[3] Highest priority given to watersheds in the best condition.

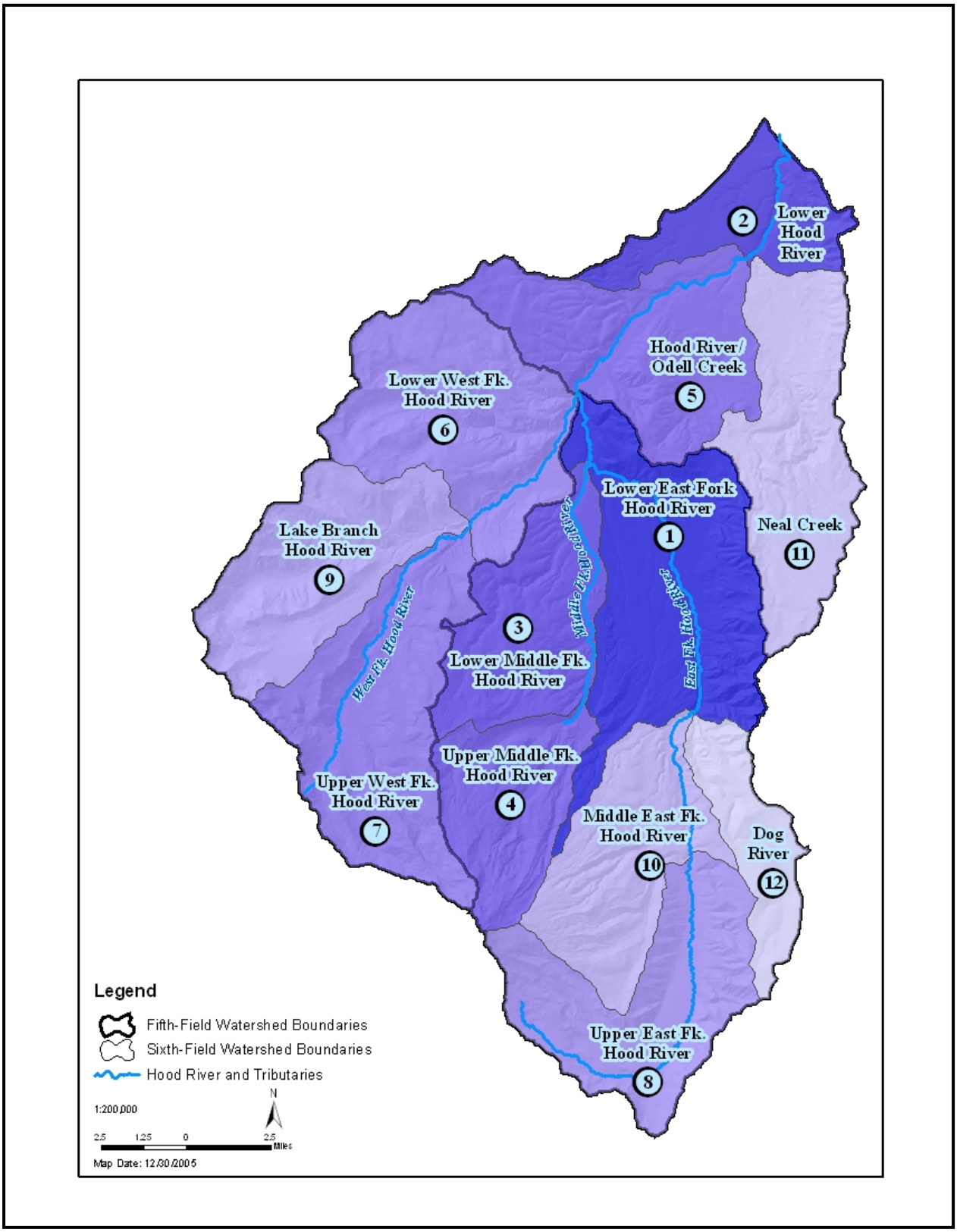

Figure 11. Overall Aquatic Habitat Restoration Priority for 6th Field Watersheds, Hood River Basin.

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Chapter 3 -
Restoration Framework

Chapter 3 – Restoration Framework

In this chapter, a restoration philosophy is presented along with a summary of the process utilized, considering both altered watershed processes and corresponding factors limiting fish production, to arrive at the identification of specific restoration activities. Next, a series of tables are presented for each 6th field watershed identifying priority aquatic habitat restoration actions that address the altered watershed processes and corresponding limiting factors. Finally, a second set of tables are presented, also on a 6th field watershed by watershed basis, providing an estimate of restoration action need (i.e., quantity) and cost for implementation.

Restoration Philosophy

The working group reviewed the restoration philosophy set forth in the HRWG's 2002 Hood River Watershed Action Plan. In that previous effort, it was acknowledged and accepted that any effective restoration strategy must first focus on protecting the remaining high quality, productive aquatic habitats in the basin. This is widely accepted as the most effective and least costly means for ensuring healthy, intact aquatic habitat is maintained over the long term. Where human activities are degrading aquatic habitat, the next course of action would be to curtail those activities or ameliorate their impacts and allow conditions to recover naturally. In situations requiring long timeframes for recovery, then active restoration is encouraged to return those areas to healthy functioning conditions.

When considering commitments to active restoration, those watersheds in a more healthy condition should be considered priority over those that are heavily degraded. This philosophy is intended to ensure the maximum benefit for the investment made. With limited staff and funding to allocate towards active restoration needs in the basin, it is believed that greater benefits can be attained by focusing first on high priority restoration actions in those watersheds that are in better condition. This is in contrast to a strategy that would focus limited resources first to those watersheds most heavily degraded, requiring larger investments over longer timeframes to attain desired results. After discussing both approaches, the working group agreed the best approach is the former:

Emphasize active restoration needs in watersheds that are in better condition!

However, this restoration philosophy was endorsed with a strong caveat:

There will always be high priority restoration needs in lower priority watersheds!

The working group acknowledged there will always be geographic-specific restoration opportunities, specific landowners or groups ready to take action, or unique funding sources that will direct active restoration investments in various portions of the basin irrespective of an overall prioritization strategy. The group strongly supports the continuation of high priority restoration activities even in the lower priority watersheds (Figure 11) as opportunities arise based on other factors and to maintain partnership relations that are critical for positive restoration momentum. The intent of the endorsed restoration philosophy is that over the long term where active restoration investments are discretionary in nature, high priority restoration actions will be funded and implemented in priority watersheds in order to move the majority of watersheds in the basin with high ecological value more readily towards restored conditions.

Altered Watershed Processes

The working group developed a restoration framework that starts with identifying the primary and secondary altered processes for each watershed. The results from watershed assessments (USFS 1996a, USFS 1996b, and Coccoli 1999) were carefully reviewed for each 6th field watershed to identify the primary and secondary altered processes. Examples of altered watershed processes include:

- Altered Flow via Agriculture Practices, Timber Harvesting, Roading, and Impervious Surfaces
- Altered Flow Regime via Diversions
- Altered Peak and Base Flows
- Elevated Chemical and Bacterial Concentrations in Water
- Impeded Fish Passage (i.e., loss of aquatic connectivity)
- Impeded Sediment & Woody Debris Routing
- Increase in Sediment Production (road-related)
- Increased Stream Temperature
- Lack of In-stream LWD
- Lack of Riparian LWD Recruitment (current and future)
- Loss of Floodplain Connectivity, Channel Sinuosity, and Channelization

Primary altered processes are those watershed processes and functions most greatly affected by past perturbations or existing conditions on the landscape. Watershed processes and functions that may also be altered, but not to as large a magnitude or geographic extent, are categorized as secondary. An understanding of these altered process and functions is important in order to identify specific restoration actions in specific locations within the watershed that address the root-causes of impairment. Next, the working group identified the limiting factors affecting fish production.

Summary of Limiting Factors

Limiting factors affecting fish production were determined in 2004 from a thorough basin-wide assessment utilizing the EDT model (Coccoli 2004). The working group utilized the results from this previous effort and worked through each 6th field watershed identifying the specific EDT limiting factors that correspond to each category of altered watershed process. At the same time, the specific geographic areas of concern within each 6th field watershed (i.e., sub-watershed and/or stream reach) were identified such that high priority restoration actions could then be determined.

The remainder of this section summarizes the limiting factors analysis completed as part of the 2004 subbasin planning effort that utilized the Ecosystem Diagnosis and Treatment Model (see http://www.mobrand.com/MBI/edt.html for a description of the model). The key limiting factors are those where we have seen a large decrease, or loss, in that attribute compared to the template condition. For most life stages all of the five primary limiting factors (channel stability, flow, habitat diversity, sediment load, and key habitat quantity) played a role but there were differences by species and life-stage.

Limiting Factor Definitions/Descriptions

Channel Stability *– The effect of stream channel stability (within reach) on the relative survival or performance of the focus species; the extent of channel stability is with respect to its streambed, banks, and its channel shape and location.*

Channel stability affected all focal species from the egg incubation life stage through juvenile rearing. Channel stability is tied primarily to the bed scour attribute – the more bed scour the larger the effect[1] on the various life stages for each focal species. The most deleterious effect appeared to be during the egg incubation stage with moderate effects on the fry colonization and inactive rearing (i.e. overwintering) stages. These effects are not surprising due to the glacial nature of the mainstem tributaries in the subbasin (where much of the spawning occurs), as well as the flashy hydrograph and relatively frequent occurrence of rain on snow events that likely lead to relatively high levels of bed scour.

[1] In EDT the limiting factors, or survival factors, are described in terms of the relative loss or gain compared to the template condition. In the case of channel stability, which is driven primarily by bed scour, a "loss" of stability actually means there is more bed scour currently than historically and hence the effects are more deleterious.

Channel stability, or rather instability, is largely the normal state in this subbasin – the Hood River is a dynamic and volatile system. However, area managers do believe that past land management has led to increases in channel instability. Timber harvest, roads, and other impervious surfaces have likely increased the flashiness of the system and the frequency and occurrence of peak flows. This has, in turn, increased bed scour in the subbasin.

Flow *– The effect of the amount of stream flow, or the pattern and extent of flow fluctuations, within the stream reach on the relative survival or performance of the focus species. Effects of flow reductions or dewatering due to water withdrawals are to be included as part of this attribute.*

Flow effects ranged primarily from small to moderate for all focal species. Life stages affected varied but were primarily the juvenile portion of the overall species life histories although adult migrating and pre-spawning holding chinook were often affected. Flow effects depend on the time of year and life stage, for example, the chinook fry colonization life stage is affected by high flows (as they are colonizing in late winter or spring) whereas 0-age rearing chinook are affected by low flows in summer and fall.

Virtually every stream modeled was affected by flow. High flows have been exacerbated relative to the template condition by an increase of impervious surfaces, increases in the drainage network (more roads and ditches), and timber harvest. The primary impact to low flows has been water withdrawals for irrigation and power production. In some areas past timber harvest may have also reduced base flow levels by increasing runoff rates with a concurrent reduction in infiltration resulting in less water stored for the summer and fall. The fact that flow rarely had a high affect on any given species or life stage, and was in fact often a low affect, indicates that despite past land management and withdrawals the impact in any given reach may not be as important to species survival compared with other limiting factors such as channel stability and habitat diversity. However, although sometimes small, flow effects were widespread across the subbasin and are an important contributor to the decline of focal species since the template condition.

Habitat Diversity *– The effect of the extent of habitat complexity within a stream reach on the relative survival or performance of the focus species.*

Habitat diversity, as defined by EDT, is the effect of the extent of habitat complexity within a stream reach on the relative survival or performance of the focal species. Essentially, the more diverse the habitat in any given reach the greater the chance the species will survive and flourish in that reach. Habitat diversity was a limiting factor in most streams modeled and it affected both chinook (to a greater extent) and steelhead (to a lesser extent). Virtually all life stages were impacted although in most reaches it was the younger life stages (fry colonization until smolt outmigration) that were affected most.

Habitat diversity is a function of gradient, channel confinement, riparian function, and large woody debris. Large wood levels are lower today than historically due to logging and stream clean out. This is one of the primary reasons habitats are less complex today compared to the template condition. In some reaches the stream is more confined due to roads, railroads, or other infrastructure. Other reaches are more confined because of past splash damming, which incised the channel, or the stream has downcut due to confinement and wood removal.

Sediment Load *– The effect of the amount of fine sediment present in, or passing through, the stream reach on the relative survival or performance of the focal species.*

The EDT model treats focal species life stages differently in terms of the sediment load attribute[2] that is most limiting. Turbidity and/or embeddedness are more important in terms of survival or performance (i.e. they "drive" the model results) than the overall amount of fine sediment in streambed for all life stages except egg incubation when eggs and sac-fry are in the gravel. Embeddedness is more of a factor during inactive life stages when juveniles need to find refuge in the substrate and turbidity is more limiting during active life stages.

Sediment load was a limiting factor in virtually all streams and reaches modeled and it affected all focal species. By far the largest impact was on the egg incubation stage, usually rating as a high or even extreme impact on survival in the EDT reach diagnostic summary. Juvenile life stages, most notably age 0 and 1 inactive (overwintering) and fry colonization were often negatively impacted as well, which relates primarily to the level the larger substrate particles are embedded by fine sediment. Older life stages were impacted in some stream reaches and high levels of turbidity appear to decrease survival or performance but not nearly to the degree younger life stages are affected.

The sediment load in the Hood River subbasin is naturally high due primarily to glacial streams that feed the three main forks of the system. Volcanic ash soils, which are highly erosive, also contribute to the overall sediment load. Our template ratings in the EDT model reflect this naturally high sediment load and this is likely one of the reasons the subbasin is not as productive in terms of fish numbers compared to other subbasins of similar size in the Pacific Northwest. Despite this we believe the sediment load is currently higher than the template condition due to land management practices that have increased runoff and erosion rates including high road densities in some areas, removal of large wood and riparian vegetation from stream systems, and in some portions of the watershed large timber harvest units.

[2] The three attributes that make up the sediment load limiting factor are fine sediment (as in the amount of fine sediment), turbidity, and embeddedness.

Key Habitat Quantity *– The relative quantity of the relative habitat type(s) utilized by the focus species during a life stage; quantity is expressed the percent of the wetted surface area of the stream channel.*

A key habitat is the primary habitat used by a particular focal species life stage. For example, the key habitats for adult spawning are pool tails and small cobble riffles whereas pools and glides are the key habitats for age 0 and 1 rearing. The EDT model compares the current amount of the various habitat types against the template condition, tracks whether there has been a loss or gain, and alters survival and performance of particular life stages accordingly. Although linked with habitat diversity, key habitat quantity is a focused assessment of those habitats particularly important to various life stages.

Key habitat quantity was likely the most prevalent limiting factor across the subbasin as it affected all focal species and impacted at least one life stage in virtually every reach modeled. Primary impacts (those most often rated high) for all focal species were tied to the following life stages:

- Pre-spawning adult holding (primary pools),
- Spawning and egg incubation (pool tails and small cobble riffles),
- Fry colonization (backwater and primary pools),
- 0-age active rearing (primary and backwater pools), primarily for spring chinook.

The loss of key habitat is very likely due to similar factors that have contributed to the loss of habitat diversity – reductions in the amount of large wood and increased channel confinement due to infrastructure and/or down cutting as a result of land management or channel alteration. Natural events, such as debris torrents and floods, have certainly contributed to key habitat loss (and gain) but we believe in many cases the negative effects of natural events has been exacerbated by land management.

Identification of Restoration Actions

Once each 6th field watershed was carefully examined by the working group to document the primary and secondary altered watershed processes and corresponding factors limiting fish production within specific locations, then priority restoration actions were identified. Where specific restoration actions are known (i.e., planned or in progress), they are referenced, relying largely on the cataloging of restoration actions in the 2002 and updated 2005 Hood River Watershed Group's Watershed Action Plan (Coccoli 2002, updated 2005). Otherwise, types of restoration activities in specific locations were identified to remedy altered watershed processes and ameliorate limiting factors. Where types of restoration activities were identified, they will need to be further investigated in order to determine project feasibility.

Results by 6th Field Watershed

Results from the application of the restoration framework are presented in tabular format for each 6th field watershed in order of restoration priority below.

6th Field Watershed: Lower East Fork Hood River (1)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Altered Flow Regime via Diversions	Fl, T, HD, HQ	East Fork Hood River at EFID Diversion, Trout Creek	Continue implementation of HRWAP Project S-3 East Fork Hood River Flow Restoration and HRWAP Project S-5 Volmer Ditch Replacement. Provide technical assistance, education, and outreach to irrigators. Explore voluntary methods for increasing in-stream flows, both in the short- and long-term.
Increased Stream Temperature	T, Fl	[1]East Fork Hood River, Baldwin, Graham, Tieman, Evans, and Emil creeks	HRWAP Project WQ-8 Lower East Fork Trib's Water Quality Improvement. Implement riparian planting projects on key stream reaches where shade is lacking or insufficient, flow restoration projects, and in-channel projects that increase sub-surface flow/storage.
Loss of Floodplain Connectivity, Loss of Channel Sinuosity, and Channelization	CS, HD, HQ, SL	East Fork Hood River from Dog River downstream to Baldwin Creek; segments of Evans and Baldwin creeks; other small tributaries	Implement stream restoration projects to improve channel connectivity with floodplains and side-channels. Implement improvements along Highway 35 that will improve floodplain functions and increase channel sinuosity.
Lack of In-stream LWD	HD, HQ, CS	Watershed-wide	HRWAP Project H-6 East Fork Hood River Restoration/LWD Placement. Implement stream restoration projects to increase LWD densities and improve habitat diversity/complexity.
Impeded Fish Passage	O	East Fork Hood River during summer low flow diversions and numerous culvert-fish passage barriers on Emil, Evans, Trout, Baldwin, Graham, and Rimrock creeks	Implement HRWAP Project FP-11 EFID Diversion Intake Design Alternative and increase streamflows in the affected diversion reach via Project S-3 above. Implement culvert-fish passage barrier remediation projects on tributary streams to East Fork Hood River.
Altered Peak and Base Flows	SL, CS	Watershed-wide	Continue education and outreach programs identified in the HRWAP. Implement road-related activities (i.e., maintenance, storm-proofing, and decommissioning) on all land ownerships.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]
Footnotes: [1] Denotes an upper basin limiting factor.

6th Field Watershed: Lower East Fork Hood River (1) – Continued

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Secondary			
Elevated Chemical and Bacterial Concentrations in Water	C, HQ	Nitrogen, Phosphorus, and Fecal Coliform levels above standards in Baldwin, Graham, Trout, and Wisehart creeks.	HRWAP Project WQ-8 above. Develop and implement Best Management Practices and rules from the Hood River Agricultural Water Quality Area Management Plan and Rules. Work to expand streamside vegetation buffers. Improve domestic on-site sewage system management and residential chemical use. Continue education and outreach programs identified in the HRWAP.
Lack of Riparian LWD Recruitment (current and future)	HD, HQ, CS	Watershed-wide	Facilitate improvements in riparian stand conditions through fencing, planting, thinning, and other silvicultural applications.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Lower Hood River (2)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Altered Flow Regime via Diversions	Fl, T, HD, HQ	Powerdale Dam (below RM 4.5), Indian Creek at Barrett Road	Complete actions described in 2002 PacifiCorp Settlement Agreement (i.e., project decommissioning in 2010).
Impeded Fish Passage	O	Powerdale Dam (mainstem Hood River at RM 4.5); Indian Creek at Diamond Fruit Dam (RM 1.0), diversion at Barrett Road, and several culverts	Complete actions described in 2002 PacifiCorp Settlement Agreement (i.e., project decommissioning in 2010). Implement fish passage improvement projects on Indian Creek.
Loss of Floodplain Connectivity and Channelization	CS, HD, HQ, SL	Mainstem Hood River and Indian Creek	Remove sections of railroad fill. Implement stream restoration projects to reconnect isolated side channels.
Lack of In-stream LWD	HD, HQ, CS	Watershed-wide, primarily mainstem Hood River	Implement stream restoration projects that increase LWD densities and improve habitat diversity and complexity.
Increased Stream Temperature	T, FL	Whiskey and Indian creeks; Hood River between Powerdale Dam and powerhouse	Complete actions described in 2002 PacifiCorp Settlement Agreement (i.e., project decommissioning in 2010). Implement flow restoration projects. Implement riparian planting projects on key stream reaches where shade is lacking or insufficient.
Elevated Chemical and Bacterial Concentrations in Water	C, HQ	Chlorpyrifos levels above standards in Indian Creek; Azinphos Methyl in Indian Creek and Hood River. Elevated nitrogen, phosphorus and fecal coliform in Indian and Whiskey creeks	Develop and implement Best Management Practices and rules from the Hood River Agricultural Water Quality Area Management Plan and Rules. Work to expand streamside vegetation buffers. Improve domestic on-site sewage system management and residential chemical use. Continue education and outreach programs identified in the HRWAP.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Lower Hood River (2) – Continued

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Secondary			
Impeded Sediment & Woody Debris Routing	SL, HQ, HD, CS	Powerdale Dam (mainstem Hood River at RM 4.5)	Complete actions described in 2002 PacifiCorp Settlement Agreement (i.e., project decommissioning in 2010).
Altered Flow via Agriculture Practices, Timber Harvesting, Roading, and Impervious Surfaces	SL, CS	Watershed-wide	Develop and implement Agricultural Management Plans. Implement reforestation and thinning projects on all land ownerships to promote watershed-wide vegetative recovery. Implement projects to minimize the total cumulative acres in impervious surfaces.
Lack of Riparian LWD and Shade Recruitment Potential	HD, HQ, CS	Watershed-wide	Thinning of alder and small hardwoods; riparian planting projects.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Lower Middle Fork Hood River (3)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Increased Stream Temperature	T, FL	[1]Middle Fork Hood River, Lower Tony Creek below Dee Diversion	Implement HRWAP Project S-2 Middle Fork Hood River Flow Restoration (develop and implement Fisheries Management Plan as part of USFS Special Use Permit). Implement flow restoration projects. Implement riparian planting projects on key stream reaches where shade is lacking or insufficient.
Lack of In-stream LWD	HD, HQ, CS	Middle Fork Hood River (between Tony Cr. and Little Cr.), Tony Creek, Bear Creek	Implement stream restoration projects that increase LWD densities and improve habitat diversity and complexity.
Altered Flow Regime via Diversions	Fl, T, HD, HQ	[1]Middle Fork Hood River, Tony Creek	Implement HRWAP Project S-2 Middle Fork Hood River Flow Restoration (develop and implement Fisheries Management Plan as part of USFS Special Use Permit). Implement flow restoration projects on Tony Creek.
Altered Peak and Base Flows	SL, CS	Tony Creek, Bear Creek	Implement road-related restoration activities (i.e., storm-proofing, decommissioning), upland and riparian thinning, and in-stream LWD projects.
Secondary			
Impeded Fish Passage	O	Tony Creek – Dee and Aldrich diversions and two culvert barriers; Bear Creek – one culvert barrier	HRWAP Project FP-5 Dee Mill Tony Creek Fish Screen and HRWAP Project FP-12 Aldridge Ditch Diversion Fish Screen. Implement fish passage improvement projects on Tony and Bear creeks.
Impeded Sediment & Woody Debris Routing	SL, HQ, HD, CS	[1]Middle Fork Hood River	Develop and implement Woody Debris Management Plan for Laurance Lake. Provide for continuous sediment routing at Coe and Eliot diversions.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]
Footnotes: [1] Denotes an upper basin limiting factor.

6th Field Watershed: Lower Middle Fork Hood River (3) – Continued

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Secondary			
Lack of Riparian LWD Recruitment (current and future)	HD, HQ, CS	Watershed-wide, mainstem Tony Creek, upper Bear Creek	Implement riparian silviculture projects to promote late seral stand conditions.
Loss of Floodplain Connectivity and Channel Sinuosity	CS, HD, HQ, SL	Lower Middle Fork Hood River (between Tony Cr. and Little Cr.).	Improve floodplain connectivity and increase channel sinuosity through implementation of stream restoration project that increase LWD loading.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Upper Middle Fork Hood River (4)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Altered Flow Regime via Diversions	Fl, T, HD, HQ	Clear Branch below dam, Middle Fork Hood River, Coe Branch, Eliot Branch	Improve spring and summer base flows for spawning and rearing. More closely match natural streamflows. HRWAP Project S-2 Middle Fork Hood River Flow Restoration and HRWAP Project S-6 Eliot Ditch Replacement.
Impeded Fish Passage	O	Clear Branch at dam, Coe Branch, Eliot Branch	Improve both upstream and downstream fish passage facilities at Clear Branch Dam, Coe diversion, and Eliot diversion. HRWAP Project FP-6 Coe Branch Diversion and Fish Screen Improvement and HRWAP Project FP-13 Eliot Diversion and Fish Screen Improvement.
Increased Stream Temperature	T, FL	Clear Branch below dam and Middle Fork Hood River	Investigate and implement facility improvements and operational changes at Clear Branch Dam and Eliot Diversion. Implement flow restoration projects. Implement riparian planting projects on key stream reaches where shade is lacking along Middle Fork Hood River.
Secondary			
Impeded Sediment & Woody Debris Routing	SL, HQ, HD, CS	Clear Branch below dam, Middle Fork Hood River, Coe Branch, Eliot Branch	HRWAP Project H-12 Monitor Spawning Gravel Supply Below Clear Branch Dam. Develop & implement LWD Mgmt. Plan. Provide continuous sed. routing at Coe and Eliot diversions.
Lack of In-stream LWD	HD, HQ, CS	Upper Clear Branch, Middle Fk Hood R from Coe to Eliot	HRWAP Project H-5 Complete Upper Clear Branch LWD Placement. Implement LWD stream restoration projects.
Lack of Riparian LWD Recruitment (current and future)	HD, HQ, CS	Watershed-wide (esp. Upper Clear Branch and along old harvest units on main trib's)	Implement riparian silvicultural projects (planting, thinning, hardwood conversion, fertilization, etc.) where feasible (i.e., older harvest units along Pinnacle Creek).
Loss of Floodplain Connectivity and Channel Sinuosity	CS, HD, HQ, SL	Upper and Lower Clear Branch, possibly Middle Fk Hood R below Clear Branch	Implement LWD stream restoration projects and other in-channel and floodplain restoration projects.
Increase in Sediment Production (road-related)	SL	Roads identified in Watershed Analysis	Implement road obliteration and/or storm proofing projects.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Hood River/Odell (5)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Altered Flow Regime via Diversions	Fl, T, HD, HQ	At FID diversions on mainstem Hood River, Pine Creek, and Ditch Creek	Implement water conservation measures to increase available in-stream flows (e.g., improve irrigation practices, piping, etc.)
Increased Stream Temperature	T, FL	Odell Creek, Hood River	HRWAP Project WQ-7 Odell Creek Water Quality Improvements. Implement riparian planting projects and other such riparian improvements to improve shade along key stream reaches. Provide NRCS technical assistance to private landowners. Implement flow restoration projects.
Lack of In-stream LWD	HD, HQ, CS	Watershed-wide	Implement LWD stream restoration projects.
Secondary			
Elevated Chemical and Bacterial Concentrations in Water	C, HQ	Odell Creek and tributaries	HRWAP Project WQ-7 above. Develop and implement Best Management Practices and rules from the Hood River Agricultural Water Quality Area Management Plan and Rules. Work to expand streamside vegetation buffers. Improve domestic on-site sewage system management and residential chemical use. Continue education and outreach programs identified in the HRWAP.
Loss of Floodplain Connectivity and Channelization	CS, HD, HQ, SL	Odell Creek	Improve floodplain connectivity and increase channel sinuosity by implementation of stream restoration projects that increase LWD loading and reconnect side channels, where feasible.
Altered Flow via Ag Practices, Timber Harvesting, Roading, and Impervious Surfaces	SL, CS	Watershed-wide	Develop and implement Agricultural Management Plans. Implement reforestation and thinning projects on all land ownerships to promote watershed-wide vegetative recovery. Implement projects to minimize the total cumulative acres in impervious surfaces.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Hood River/Odell (5) – Continued

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Secondary			
Lack of Riparian LWD and Shade Recruitment Potential	HD, HQ, CS	Watershed-wide except mainstem Hood River	HRWAP Project WQ-7 above. Implement planting and thinning projects to improve riparian stand components.
Impeded Fish Passage	O	Resident fish-culvert barriers on Odell, Ditch, and Pine creeks	Implement culvert-fish passage improvement projects at known locations.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Lower West Fork Hood River (6)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Lack of In-stream LWD	HD, HQ, CS	West Fork Hood River, upper Green Point and North Fork Green Point	HRWAP Project H-4 West Fork Hood River Large Wood Placement. Implement in-stream LWD restoration projects.
Increase in Sediment Production (road-related)	SL	Green Point and Dead Point, and West Fork Hood River	Implement road maintenance activities and road decommissioning, road closures, and/or storm-proofing. Investigate opportunities along Road 2810 and 2820 (and spurs).
Altered Flow Regime due to timber harvesting and road construction	SL, CS	Green Point and Dead Point, and mainstem West Fork Hood River[1]	Upland and riparian thinning and other appropriate silviculture projects. Road decommissioning projects.
Secondary			
Lack of Riparian LWD Recruitment (current and future)	HD, HQ, CS	Green Point (except lower 2 miles), North Fork Green Point, and Dead Point	Implement riparian thinning and planting projects.
Altered Flow Regime via Diversions	Fl, T, HD, HQ	North Fork Green Point and Dead Point diversions	HRWAP Project S-1 West Fork Hood River Flow Restoration. Implement water conservation actions per FID district-wide efforts, increase capacity for upper Kingsley Reservoir, investigate water right purchasing/leasing/donation options.
Impeded Fish Passage	O	North Fork Green Point Diversion, several culvert barriers on Green Point and North Fork Green Point	Improve up- and downstream fish passage facilities at North Fork Green Point Diversion. Assess condition and future maintenance for "moving falls" on West Fork Hood River. Implement fish-friendly culverts at road barriers. HRWAP Project FP-7 Punchbowl Falls Fishway Access Ladder. HRWAP Project FP-8 Dee Diversion Fish Passage Investigation
Loss of Floodplain Connectivity and Loss of Channel Sinuosity	CS, HD, HQ, SL	Green Point Creek	No foreseeable restoration action that would restore floodplain connectivity. Channel is 20-30 feet downcut from past splash damming.

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Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]
Footnotes: [1] Denotes an upper basin limiting factor.

6th Field Watershed: Upper West Fork Hood River (7)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Lack of In-stream LWD	HD, HQ, CS	West Fork Hood River under BPA powerlines and from Ladd Creek to Dry Run Bridge, McGee Creek, Elk Creek, Red Hill, possibly other tributaries	Implement LWD stream restoration projects.
Lack of Riparian LWD Recruitment (current and future)	HD, HQ, CS	Watershed-wide (esp. along old harvest units adjacent to major tributaries)	Implement riparian silvicultural projects where feasible.
Loss of Floodplain Connectivity	CS, HD, HQ, SL	West Fork Hood River, possibly some tributaries	Implement LWD stream restoration projects.
Secondary			
Impeded Sediment & Woody Debris Routing	SL, HQ, HD, CS	18 Road at Ladd, McGee, Elk, Marco, and Red Hill creeks	Replace under sized culverts with bridges to route sediment and woody debris.
Impeded Fish Passage	O	Red Hill Creek, McGee Creek, Marco Creek, and several small tributaries to Elk and McGee creeks	Implement culvert-fish passage improvement projects at known locations.
Increase in Sediment Production (road-related)	SL	Watershed-wide	Implement road obliteration and/or storm proofing projects.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Upper East Fork Hood River (8)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Lack of In-stream LWD	HD, HQ, CS	Watershed-wide	Implement in-channel LWD projects on East Fork Hood River from Sahalie Falls to the Narrows, Robinhood Creek, and lower Pocket Creek, where feasible. HRWAP Project H-13 Robbinhood Creek Riparian Restoration.
Lack of Riparian LWD Recruitment	HD, HQ, CS	Watershed-wide	Implement riparian silvicultural treatments on Robinhood Creek, Pocket Creek, and East Fork Hood River, where feasible. HRWAP Project H-13 above.
Secondary			
Loss of Floodplain Connectivity and Channel Sinuosity	CS, HD, HQ, SL	East Fork Hood River from Sahalie Falls to the Narrows and Robinhood Creek.	Where feasible, implement stream restoration projects via addition of LWD to improve floodplain connectivity and increase channel sinuosity. Implement improvements along Highway 35 that will improve floodplain functions and increase channel sinuosity.
Impeded Woody Debris Routing	SL, HQ, HD, CS	At road crossings on Tumble, Culvert, Engineers, Hellroaring, Pocket, Meadows, Mitchell, Clark, Newton, and Robinhood creeks	Design and implement road-stream crossings that will allow for uninterrupted transport of woody debris during flood and debris torrent events. Move trapped and/or stranded woody debris downstream of road crossings during cleanup and road repair operations.
Altered Peak and Base Flows	SL, CS, FL	Meadows Creek sub-watershed, Culvert Creek sub-watershed, and mainstem Upper East Fork Hood River sub-watershed above Robinhood Creek	Implement thinning projects to aid in vegetative recovery in sub-watersheds that are hydrologically impaired. Implement road improvement and/or decommissioning projects to improve the road system and reduce overall road densities in heavily impacted sub-watersheds.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Upper East Fork Hood River (8) – Continued

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Secondary			
Impeded Fish Passage	O	Tumble, Engineers, Hellroaring, Pocket, and Meadows creeks have known resident fish culvert barriers	Implement culvert-fish passage improvement projects.
Altered Flow Regime via Diversions	Fl, T, HD, HQ	Upper East Fork Hood River and Mitchell Creek	Investigate opportunities for and implement actions that will increase in-stream flows.
Increase in Sediment Production (road-related)	SL	Meadows Creek sub-watershed, Culvert Creek sub-watershed, and Upper East Fork Hood River sub-watershed above Robinhood Creek	Implement erosion control measures to ameliorate delivery of fines from Highway 35 and Access Road sanding operations. Implement road improvements along road segments with chronic erosion problems. Implement road decommissioning and/or storm-proofing projects to reduce overall high road densities in heavily impacted sub-watersheds.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Lake Branch (9)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Lack of In-stream LWD	HD, HQ, CS	Watershed-wide, esp. Lake Branch (below Raker Pit) and Laurel Creek	HRWAP Project H-14 Lake Branch Fish Habitat Improvement. Implement LWD stream restoration projects.
Lack of Riparian LWD Recruitment	HD, HQ, CS	Watershed-wide, esp. along old harvest units adjacent to major tributaries	Implement riparian thinning and silvicultural projects where feasible.
Secondary			
Impeded Sediment & Woody Debris Routing	SL, HQ, HD, CS	Stream crossings along Road 13	Replace under sized culverts with bridges to route sediment and woody debris.
Increased Stream Temperature	T	Below Lost Lake for approximately 4 miles	Investigate further and identify potential restoration actions for implementation.
Impeded Fish Passage	O	Laurel, No Name, Divers, and Indian creeks have resident fish culvert barriers (lower culvert on Laurel Creek may impede anadromous fish passage.)	Implement culvert-fish passage improvement projects.
Altered Peak and Base Flows	SL, CS, FL	Watershed-wide	Implement thinning projects to aid in vegetative recovery in sub-watersheds that are hydrologically impaired. Implement road improvement and/or decommissioning projects to improve the road system and reduce overall road densities in heavily impacted sub-watersheds.
Increase in Sediment Production (road-related)	SL	Watershed -wide	Implement road obliteration and/or storm proofing projects.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Middle East Fork Hood River (10)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Loss of Floodplain Connectivity, Loss of Channel Sinuosity and Channelization	CS, HD, HQ, SL	East Fork Hood River along Highway 35.	Where feasible, implement stream restoration projects via addition of LWD to improve floodplain connectivity and increase channel sinuosity. Implement improvements along Highway 35 that will improve floodplain functions and increase channel sinuosity.
Lack of In-stream LWD	HD, HQ, CS	East Fork Hood River along Highway 35 and Tilly Jane, Doe, Cold Springs creeks	Where feasible, restore in-stream LWD in East Fork Hood River upstream from Pollalie Creek and from Tilly Jane Creek to Dog River. [Tilly Jane, Doe, and Cold Springs creeks likely not feasible for LWD additions.]
Secondary			
Lack of Riparian LWD Recruitment (current and future)	HD, HQ, CS	East Fork Hood River	Implement riparian silvicultural projects where feasible.
Impeded Woody Debris Routing	SL, HQ, HD, CS	At road crossings on Tilly Jane and Pollalie creeks	Design and implement road-stream crossings that will allow for uninterrupted transport of woody debris during flood and debris torrent events. Move trapped and/or stranded woody debris downstream of road crossings during cleanup and road repair operations.
Impeded Fish Passage	O	Pollalie, Tilly Jane, and Crystal Springs creeks have known resident fish culvert barriers along Highway 35	Implement culvert-fish passage improvement projects at known locations.
Altered Flow Regime via Diversions	Fl, T, HD, HQ	Crystal Springs	Investigate opportunities for and implement actions that will increase in-stream flows.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Neal Creek (11)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Altered Flow Regime via Conveyance (+) & Diversions (-)	Fl, T, HD, HQ	Below EFID conveyance input at Middle Valley (RM 7.5).	Implement projects that aid in restoring the natural flow regime (e.g., HRWAP Project FP-3 Central Canal Pipeline/Neal Creek Siphon, future piping projects, Conserved Water Program, landowner technical assistance, etc.).
Increased Sediment Routing from inter-basin transfer, roads, Ag practices, lumber mill	CS, SL, HQ	EFID Eastside conveyance input, private and county forest roads, and mill at Middle Valley	HRWAP Project FP-3 above, private and county road decommissioning and gating, Develop and implement Agricultural Management Plans.
Impeded Fish Passage	O	Lower Eastside Diversion at RM 5.4. Several culvert barriers for fish passage	HRWAP Project FP-3 above. Implement culvert-fish passage improvement projects.
Increased Stream Temperature	T, FL	Watershed wide, except for 2.1 mile conveyance reach. Multiple point sources	HRWAP Project WQ-9 Lower Neal Creek Riparian Area Improvement. Implement riparian improvement projects that restore streamside shade. Landowner technical assistance. Implement flow restoration opportunities.
Elevated Chemical and Bacterial Concentrations in Water	C, HQ	Neal Creek (RM 0 to 5) and Lenz Creek; chlorpyrifos, Azinphos Methyl, and heavy metals. Zinc in Lenz Creek. Iron in Neal Creek. Nitrogen, phosphorus and fecal coliform in Neal and Lenz creeks	HRWAP Project WQ-9 above. HRWAP Project WQ-14 QVL/Hanel Mill Settling Pond/Drainage Improvements. Develop and implement Best Management Practices and rules from the Hood River Agricultural Water Quality Area Management Plan and Rules. Work to expand streamside vegetation buffers. Improve domestic on-site sewage system management and residential chemical use. Continue education and outreach programs identified in the HRWAP.
Secondary			
Loss of Floodplain Connectivity and Channelization	CS, HD, HQ, SL	West Fork and mainstem Neal Creek below Upper Eastside Lateral input at RM 7.5	HRWAP Project H-8 West Fork Neal Creek Floodplain and Channel Restoration. Where feasible, implement stream restoration projects via addition of LWD to improve floodplain connectivity and increase channel sinuosity.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Neal Creek (11) – Continued

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Secondary			
Lack of In-stream LWD	HD, HQ, CS,	Watershed-wide	HRWAP Project H-8 above. Implement stream restoration projects that increase LWD loading.
Altered Flow via Timber Harvesting, Roading, and Impervious Surfaces	SL, CS, T	Watershed-wide	Implement reforestation and thinning projects on all land ownerships to promote vegetative recovery. Implement projects to minimize road densities and cumulative acres in impervious surfaces.
Lack of Riparian LWD and Shade Recruitment Potential	HD, HQ, CS, C	Watershed-wide	Implement riparian silvicultural projects (i.e., planting, thinning, hardwood conversion, fertilization, etc.) where feasible.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

6th Field Watershed: Dog River (12)

Altered Watershed Process (from WA)	Corresponding Level 3 Survival Factors (from EDT)	Specific Location/Area	Restoration Actions
Primary			
Altered Flow Regime via Diversions	Fl, T, HD, HQ	Dog River at the City of The Dalles Diversion	Investigate opportunities for and implement actions that will increase in-stream flows.
Secondary			
Lack of In-stream LWD	HD, HQ, CS	Puppy Creek and Dog River	Investigate opportunities for and implement stream restoration projects that increase LWD loading.
Lack of Riparian LWD Recruitment	HD, HQ, CS	Puppy Creek	Investigate opportunities for and implement riparian silvicultural projects (i.e., thinning) that improve riparian stand conditions.
Impeded Fish Passage	O	Dog River at the City of The Dalles Diversion and Road 44	Investigate opportunities for and implement fish passage improvements.
Altered Peak and Base Flows	SL, CS, FL	Puppy Creek sub-watershed	Implement thinning projects to aid in vegetative recovery. Implement road improvement and/or decommissioning projects to improve the road system and reduce overall road densities.
Impeded Sediment & Woody Debris Routing	SL, HQ, HD, CS	Dog River at the City of The Dalles Diversion	Develop plan to pass woody debris downstream that may be captured at water diversion structure during high flow events.

Abbreviations of EDT Survival Factors for the Hood River Basin:
Channel Stability = CS; Chemicals = C; Flow = Fl; Food = Fo; Habitat Diversity = HD; Harassment/Poaching = H/P; Obstructions = O; Predation = P; Sediment Load = SL; Temperature = T; Withdrawals = W; Key Habitat Quantity = HQ. [HRWAP = Hood River Watershed Action Plan (Coccoli 2002)]

Estimation of Restoration Needs and Implementation Cost

Once specific restoration actions were identified for each 6th field watershed, estimates were made to identify the total need (i.e., quantity) and implementation costs of various projects. Restoration actions were grouped by activity type as follows:

- Fish Passage

  Culvert-fish passage barriers
  Irrigation diversion barriers

- Flow Restoration

  Stream-flow restoration

- Road-Related

  Potential roads for decommissioning and/or storm proofing
  Annual road maintenance

- Riparian-Related

  Riparian planting
  Riparian thinning (pre-commercial)
  Riparian thinning (commercial)
  Other

- In-stream Related

  Fish habitat improvement/LWD addition
  Other

- Other/Miscellaneous

Where specific projects are known from the 2002 and updated 2005 Hood River Watershed Group's Watershed Action Plan, specific cost estimates as reported in the original 2002 plan are provided. State, county, tribal, and Forest Service surveys were reviewed to estimate the quantity and location of specific culvert-fish passage projects in each 6th field watershed. In most cases, an average cost of $250,000 per site was used to estimate the cost of implementing culvert-fish passage projects throughout the basin. Results from the Mt. Hood National Forest's Roads Analysis completed in 2003 (USFS 2003) were utilized to estimate the quantity of road mileage in each watershed for restoration activity, including accelerated road maintenance, road storm-proofing, and road decommissioning. The roads analysis effort rated various road segments in each 6th field watershed for their levels of use on a scale from zero to 10, least to greatest. For the purposes of estimating road-related restoration activities, roads with a Use Access Rating of ≤4 were considered for either storm-proofing and/or decommissioning at an average cost of $20,000/mile while roads with a Use Access Rating of >4 were considered for annual maintenance at an average cost of $2,500/mile/year. Rough estimates were made to assess the quantity of riparian-related activities (i.e., planting, pre-commercial thinning, and commercial thinning) in each 6th field watershed by watershed specialists John Dodd (USFS) and Steve Stampfli (HRWG) and silvicultural technician Larry Rector (USFS). Average unit costs for implementation of riparian-related activities were assumed as follows: riparian planting ($500/acre), pre-commercial thinning ($300/acre), and commercial thinning ($3,000/acre). Rough estimates were also made to assess the quantity of in-stream related restoration activities, particularly fish habitat improvements/LWD additions, for each 6th field watershed by fisheries biologist Gary Asbridge (USFS). Ground-based operations were assumed for stream reaches with nearby road access, and an average implementation cost (including acquisition of logs and boulders) of $60,000/mile was assumed. A much higher average unit cost of $400,000/mile was assumed for remote stream reaches where aerial operations (i.e., by helicopter) would be required and/or for larger river reaches (primarily off-Forest) where detailed surveys, design, and construction by a qualified stream restoration construction company is likely to be required.

Average cost estimates for the various types of restoration activities are for project implementation (i.e., contract costs), and were based on known current costs for similar activities. Estimates for project planning (i.e., NEPA analysis, ESA consultation, permit acquisition, etc.), survey data collection and analysis (when and where needed), project design, landowner coordination, project administration, contingency, and monitoring (both pre- and post-) are not included. Prior to the submittal of any proposal for project funding, a more detailed assessment will be needed to accurately estimate these associated costs in addition to a more refined estimate of that particular project's implementation costs.

Results by 6th Field Watershed

The estimate of restoration need (i.e., quantity) together with an estimate of implementation costs by restoration activity type are summarize for each 6th field watershed in priority order below.

6th Field Watershed: Lower East Fork Hood River (Priority = 1)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Evans Creek – County CMP Fish Passage Projects (County Roads 421, 424, and 429)	Evans Creek RM 0.6, 1.6, and 3.0; respectively	3 sites	$750,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: StW, coho
Evans Creek – County CMP Fish Passage Projects (County Roads 421 and 426)	Evans Cr/ Griswell RM 1.0 and 1.5; respectively	2 sites	$500,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: StW, coho
West Evans Creek – County CMP Fish Passage Project (Laurance Lake Road)	West Evans Creek, RM 14.0	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: StW, coho
East Fork Hood River – County CMP Fish Passage Project (County Road 414)	East Fk Hood River, RM 0.2	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: StW, coho
Emil Creek – County CMP Fish Passage Project (County Road 415)	Emil Creek RM 0.8	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: StW, coho
Baldwin Creek – State Hwy 35 CMP Fish Passage Project	Baldwin Cr/Tieman RM 2.0	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: cutthroat
Baldwin Creek – County CMP Fish Passage Projects (County Roads 428, 411, and 412)	Baldwin Creek RM 0.3, 0.6, and 0.6; respectively	3 sites	$750,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: StW, coho, cutthroat
Baldwin Creek – Private Road CMP Fish Passage Projects (Identified in CTWS Survey 7/25/2001)	Baldwin Creek RM 0.9 and 1.2; respectively	2 sites	$500,000	"Group A – First Priority" from Asbridge et al. (2002)

6th Field Watershed: Lower East Fork Hood River (Priority = 1) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS - CONTINUED				
Culvert-Fish Passage Barriers				
Graham Creek – County Road CMP Fish Passage Project (Leasure Road, Identified in CTWS Survey 7/25/2001)	Graham Creek RM 0.1	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002)
Wisehart Creek – County CMP Fish Passage Projects (County Roads 405, 406, and 411)	Wisehart Creek RM 0.3, 0.5, and 0.9; respectively	3 sites	$750,000	"Group A – First Priority" from Asbridge et al. (2002) Fish species: StW, coho
Birdie Creek – State Hwy 35 CMP Fish Passage Project	Birdie Creek RM 2.6	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002)
Trout Creek – County CMP Fish Passage Projects (County Roads 421, 418, 423, and 401)	Trout Creek RM 0.5, 1.6, 3.2, and 5.4; respectively	4 sites	$1,000,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Irrigation Diversion Barriers				
HRWAP Project FP-11 EFID Diversion Intake Design Alternative	~RM 6.5 East Fk Hood River	1 site	undetermined	"medium" priority in updated 2005 HRWAP, scheduled for 2009
Fish Passage Actions Sub-Total			$5,750,000	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
HRWAP Project S-3 East Fork Hood River Flow Restoration	Lower East Fork Hood River	EFID system	undetermined	"high" priority in updated 2005 HRWAP, ongoing action
HRWAP S-5 Volmer Ditch Replacement	Trout Creek	7,500 feet	$191,612	"low" priority in updated 2005 HRWAP, scheduled for 2006
Flow Restoration Actions Sub-Total			**$191,612**	

6th Field Watershed: Lower East Fork Hood River (Priority = 1) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	4.2 miles	$84,696	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	13.1 miles	$32,750/year	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	3.1 miles	$7,679/year	
Road-Related Actions Sub-Total			**$125,125**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	100 acres	$50,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	100 acres	$30,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	50 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$230,000**	

6th Field Watershed: Lower East Fork Hood River (Priority = 1) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
HRWAP Project H-6 East Fork Hood River Restoration/LWD Placement	Lower East Fork Hood River	5.0 miles	$2,200,000	"high" priority in updated 2005 HRWAP, scheduled for 2007-09. Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Evans Creek Restoration/LWD Placement (New)	Evans Creek	2.0 miles	$800,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Baldwin Creek Restoration/LWD Placement (New)	Baldwin Creek	2.0 miles	$800,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$3,800,000**	
OTHER/MISCELLANEOUS ACTIONS				
HRWAP Project WQ-8 Lower East Fork Tributaries Water Quality Improvement	Baldwin, Graham, Tieman, Evans, and Emil creeks	not specified	$40,000	"high" priority in updated 2005 HRWAP, ongoing action
Other/Miscellaneous Actions Sub-Total			**$40,000**	
TOTAL EST. COST			**$10,136,737**	

6th Field Watershed: Lower Hood River (Priority = 2)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Indian Creek – County CMP Fish Passage Projects (County Roads 101 Brookside and 129)	Indian Creek RM 1.4 and 2.4; respectively	2 sites	$500,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Whiskey Creek – County CMP Fish Passage Projects (County Roads 202 and 201)	Whiskey Creek RM 0.2 and 2.1; respectively	2 sites	$500,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Whiskey Creek – State Hwy 35 CMP Fish Passage Project	Whiskey Creek RM 2.0	1 site	$350,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Irrigation Diversion Barriers				
None Identified				
Hydroelectric Diversion Barrier				
Implement 2002 PacifiCorp & Others Settlement Agreement (SA)for Decommissioning of Powerdale Dam (restore upstream and downstream fish passage)	Powerdale Dam & Facilities	site	per SA	Dam decommissioning scheduled for 2010.
Fish Passage Actions Sub-Total			**$1,350,000**	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
Implement 2002 PacifiCorp & Others Settlement Agreement (SA) for Decommissioning of Powerdale Dam (restore streamflows)	Powerdale Dam & Facilities	site	per SA	Dam decommissioning scheduled for 2010.
Flow Restoration Actions Sub-Total			**per SA**	

6th Field Watershed: Lower Hood River (Priority = 2) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
ROAD-RELATED ACTIONS				
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	unknown	undetermined	Road mileage data unavailable.
Road-Related Actions Sub-Total			**undetermined**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	100 acres	$50,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
None Identified				
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	10 acres	$30,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$80,000**	

6th Field Watershed: Lower Hood River (Priority = 2) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
Mainstem Hood River Restoration/LWD Placement (New)	Hood River	3.0 miles	$1,200,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
Implement 2002 PacifiCorp & Others Settlement Agreement (SA) for Decommissioning of Powerdale Dam (restore woody debris and sediment routing)	Powerdale Dam & Facilities	site	per SA	Dam decommissioning scheduled for 2010.
In-Stream Related Actions Sub-Total			**$1,200,000**	
OTHER/MISCELLANEOUS ACTIONS				
None Identified				
Other/Miscellaneous Actions Sub-Total			**$0**	
TOTAL EST. COST			**$2,630,000**	

6th Field Watershed: Lower Middle Fork Hood River (Priority = 3)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Rodgers Spring Creek – County CMP Fish Passage Project (County Road 417)	Rodgers Spring Creek RM 0.2	1 site	$250,000	"Group D" from Asbridge et al. (2002)
Little Creek – USFS CMP Fish Passage Project	Rd 1610 MP 0.7	1 site	$250,000	"Group D" from Asbridge et al. (2002); fish species: rainbow and cutthroat trout, potential bull trout (0.25 mi)
Bear Creek 2 Trib – USFS CMP Fish Passage Project	Rd 1610 MP 5.1	1 site	$250,000	"Group A First Priority" from Asbridge et al. (2002); fish species: rainbow and cutthroat trout, potential bull trout (0.50 mi)
Tony Creek – USFS CMP Fish Passage Project	Rd 16 MP 6.9	1 site	$250,000	"Group A First Priority" from Asbridge et al. (2002); fish species: rainbow & cutthroat trout (2.5 mi)
Tony Creek Trib A – USFS CMP Fish Passage Project	Rd 16 and 1600014, MP 8.4 and 0.1 respectively	2 sites	$500,000	"Group A First Priority" from Asbridge et al. (2002); fish species: rainbow & cutthroat trout (0.10 mi each)
Tony Creek Trib B – USFS CMP Fish Passage Project	Rd 16 MP 7.6	1 site	$250,000	"Group A First Priority" from Asbridge et al. (2002); fish species: rainbow & cutthroat trout (0.10 mi)
Irrigation Diversion Barriers				
HRWAP Project FP-5 Dee Mill Tony Creek Fish Screen	Tony Creek	1 site	undetermined	"high" priority in updated 2005 HRWAP
HRWAP Project FP-12 Aldridge Ditch Diversion Fish Screen	Tony Creek	1 site	$20,000	"medium" priority in updated 2005 HRWAP
Fish Passage Actions Sub-Total			**$1,770,000**	

6th Field Watershed: Lower Middle Fork Hood River (Priority = 3) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
HRWAP Project S-2 Middle Fork Hood River Flow Restoration	Middle Fork Hood River	MFID diversion points in upper MFHR	undetermined	Develop & implement flow restoration actions under Fisheries Mgmt. Plan per USFS Special Use Permit update
Flow Restoration Actions Sub-Total			**undetermined**	
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	43.9 miles	$877,791	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	7.4 miles	$18,500/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	7.8 miles	$19,451/yr	
Road-Related Actions Sub-Total			**$915,742**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	100 acres	$50,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	500 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)

6th Field Watershed: Lower Middle Fork Hood River (Priority = 3) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
RIPARIAN-RELATED ACTIONS - CONTINUED				
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	100 acres	$300,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$500,000**	
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
Middle Fork Hood River Restoration/LWD Placement(New)	Mainstem Middle Fork Hood River	4.0 miles	$1,600,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Bear Creek Restoration/LWD Placement (New)	Bear Creek	2.0 miles	$120,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Tony Creek Restoration/LWD Placement (New)	Tony Creek	5.0 miles	$1,300,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
Develop & Implement Woody Debris Management Plan for MFID facilities (i.e., Clear Branch Dam) in Upper Middle Fork Hood River 6th Field Watershed	Middle Fork Hood River	3 sites	undetermined	Develop & implement flow restoration actions under Fisheries Mgmt. Plan per USFS Special Use Permit update (In Progress)

6th Field Watershed: Lower Middle Fork Hood River (Priority = 3) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS - CONTINUED				
Other				
Develop & Implement Sediment Routing and/or Gravel Supplementation Programs for MFID facilities in Upper Middle Fork Hood River 6th Field Watershed	Clear Branch Dam; Coe & Eliot Diversions	3 sites	undetermined	Develop & implement restoration actions under Fisheries Mgmt. Plan per USFS Special Use Permit update (In Progress)
In-Stream Related Actions Sub-Total			**$3,020,000**	
OTHER/MISCELLANEOUS ACTIONS				
None Identified				
Other/Miscellaneous Actions Sub-Total			**$0**	
TOTAL EST. COST			**$6,205,742**	

6th Field Watershed: Upper Middle Fork Hood River (Priority = 4)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
No known culvert-fish passage barriers				
Irrigation Diversion Barriers				
Develop & Implement Upstream and Downstream Fish Improvements for Clear Branch Dam	Clear Branch Dam	1 site	undetermined	Develop & implement actions under Fisheries Mgmt. Plan per USFS Special Use Permit update (In Progress)
HRWAP Project FP-6 Coe Branch Diversion and Fish Screen Improvement	Coe Branch Diversion Dam	1 site	$944,598	Project design In Progress. Also intended to incorporated continuous sediment routing capability. Est. cost subject to revision
HRWAP Project FP-13 Eliot Diversion and Fish Screen Improvement	Eliot Branch Diversion Dam	1site	$1,124,875	Develop & implement actions under Fisheries Mgmt. Plan per USFS Special Use Permit update. Est. cost dependent on design
Fish Passage Actions Sub-Total			**$2,069,473**	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
HRWAP Project S-2 Middle Fork Hood River Flow Restoration	Middle Fork Hood River; Clear, Coe, and Eliot Branches	3 sites	undetermined	Develop & implement flow restoration actions under Fisheries Mgmt. Plan per USFS Special Use Permit update
HRWAP Project S-6 Eliot Ditch Replacement	Eliot Ditch	4,500 feet	$259,700	“low” priority in updated 2005 HRWAP
Flow Restoration Actions Sub-Total			**$259,700**	

6th Field Watershed: Upper Middle Fork Hood River (Priority = 4) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	16.1 miles	$321,754	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	0.4 miles	$1,000/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	2.8 miles	$6,987/yr	
Road-Related Actions Sub-Total			**$329,741**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	50 acres	$25,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	500 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	100 acres	$300,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$475,000**	

6th Field Watershed: Upper Middle Fork Hood River (Priority = 4) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
HRWAP Project H-12 Monitor Spawning Gravel Supply Below Clear Branch Dam	Below Clear Branch Dam	Undetermined	nominal	MFID to monitor gravel supply and introduce spawning gravel as needed during ODFW in-stream work window
Develop & Implement Woody Debris Management Plan for MFID facilities (i.e., Clear Branch Dam; Coe & Eliot Diversions)	Clear Branch Dam; Coe & Eliot Diversions	3 sites	undetermined	Develop & implement actions under Fisheries Mgmt. Plan per USFS Special Use Permit update (In Progress)
HRWAP Project H-5 Complete Upper Clear Branch LWD Placement	Upper Clear Branch	0.8 miles	$250,000	"high" priority in updated 2005 HRWAP
Pinnacle Creek Restoration/LWD Placement (New)	Pinnacle Creek	2.0 miles	$120,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Middle Fork Hood River Restoration/LWD Placement (New)	Middle Fork Hood River	0.5 miles	$80,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$450,000**	
OTHER/MISCELLANEOUS ACTIONS				
None Identified				
Other/Miscellaneous Actions Sub-Total			**$0**	
TOTAL EST. COST			**$3,583,914**	

6th Field Watershed: Hood River/Odell (Priority = 5)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Odell Creek – County CMP Fish Passage Projects (County Roads 320 and 322)	Odell Creek RM 0.2, 1.8, and 2.3	3 sites	$750,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Odell Creek/Unnamed Cr – County CMP Fish Passage Project (County Road 305)	Odell Cr/ Unnamed Cr RM 2.3	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Irrigation Diversion Barriers				
None Identified				
Fish Passage Actions Sub-Total			**$1,000,000**	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
None Identified				
Flow Restoration Actions Sub-Total			**$0**	
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	4.1 miles	$81,007	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	6.5 miles	$16,250/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	0 miles	$0	
Road-Related Actions Sub-Total			**$97,257**	

6th Field Watershed: Hood River/Odell (Priority = 5) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	100 acres	$50,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	50 acres	$15,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	50 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$215,000**	
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
Hood River Restoration/LWD Placement (New)	Mainstem Hood River	2.0 miles	$1,000,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Ditch Creek Restoration/LWD Placement (New)	Ditch Creek	0.5 miles	$400,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006). Includes dam removal
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$1,400,000**	

6th Field Watershed: Hood River/Odell (Priority = 5) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
OTHER/MISCELLANEOUS ACTIONS				
HRWAP Project WQ-7 Odell Creek Water Quality Improvements	Odell Creek	not specified	$100,000	"high" priority in updated 2005 HRWAP
Other/Miscellaneous Actions Sub-Total			**$100,000**	
TOTAL EST. COST			**$2,812,257**	

6th Field Watershed: Lower West Fork Hood River (Priority = 6)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Deer Creek – County CMP Fish Passage Project (County Road 501 Lost Lake)	Deer Creek RM 2.0	1 site	$250,000	"Group A First Priority" from Asbridge et al. (2002)
Long Branch – USFS CMP Fish Passage Project	Rd 2810 MP 4.0	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: rainbow (1.5 mi)
Green Point Creek – USFS CMP Fish Passage Projects	Rd 2810 MP 4.9, 7.8, and 9.7	3 sites	$750,000	"Group D" from Asbridge et al. (2002), fish species: rainbow (0.2, 0.6, and 0.1 mi; respectively)
Green Point Creek Trib – USFS CMP Fish Passage Project	Rd 2810 MP 9.4	1 site	$250,000	"Group D" from Asbridge et al. (2002), fish species: rainbow (0.05 mi)
North Fk Green Point Creek and Trib – USFS CMP Fish Passage Projects	Rd 2820 (MP 10.5) and Rd 2820 (MP 10.3)	2 sites	$500,000	"White" from Asbridge et al. (2002), Fish species: rainbow (0.05 mi each)
Gate Creek Trib – USFS CMP Fish Passage Project	Rd 2820 MP 9.8	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: rainbow (0.05 mi each)
Dead Point Creek Trib – USFS CMP Fish Passage Project	Rd 2820 MP 1.4	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: rainbow (0.5 mi each)
Irrigation Diversion Barriers				
HRWAP Project FP-7 Punchbowl Falls Fishway Access Ladder	Punchbowl Falls	1 site	$121,000	"medium" priority in updated 2005 HRWAP
HRWAP Project FP-8 Dee Diversion Fish Passage Investigation	West Fork Hood River	1 site	undetermined	"medium" priority in updated 2005 HRWAP
Improve Upstream and Downstream Fish Passage at North Fork Green Point Diversion Dam	North Fork Green Point	1 site	undetermined	Not identified in HRWAP (2002 or 2005 update)
Fish Passage Actions Sub-Total			**$2,621,000**	

6th Field Watershed: Lower West Fork Hood River (Priority = 6) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
HRWAP Project S-1 West Fork Hood River Flow Restoration	multiple locations	multiple actions	undetermined	"high" priority in updated 2005 HRWAP; ongoing
Flow Restoration Actions Sub-Total			**undetermined**	
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	22.3 miles	$445,690	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	8.5 miles	$21,250/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	11.0 miles	$27,403/yr	
Road-Related Actions Sub-Total			**$494,343**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	100 acres	$50,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	500 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)

6th Field Watershed: Lower West Fork Hood River (Priority = 6) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
RIPARIAN-RELATED ACTIONS - CONTINUED				
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	200 acres	$600,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$800,000**	
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
HRWAP Project H-4 West Fork Hood River LWD Placement	West Fork Hood River	0.5 mile	$150,000	"high" priority in updated 2005 HRWAP; In Progress
West Fork Hood River Restoration/LWD Placement (New)	West Fork Hood River	3.0 miles	$1,200,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Green Point Creek Restoration/LWD Placement (New)	Green Point Creek	2.0 miles	$120,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$1,470,000**	
OTHER/MISCELLANEOUS ACTIONS				
None Identified				
Other/Miscellaneous Actions Sub-Total			**$0**	
TOTAL EST. COST			**$5,385,343**	

6th Field Watershed: Upper West Fork Hood River (Priority = 7)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Elk Creek – USFS CMP Fish Passage Project	Rd 1810 MP 6.4	1 site	$250,000	"Group B – Second Priority" from Asbridge et al. (2002), Fish species: rainbow
McGee Creek – USFS CMP Fish Passage Project	Rd 1810 MP 3.5	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002), Fish species: StS (0.4 mi)
McGee Creek Trib – USFS CMP Fish Passage Project	Rd 1810 MP 2.3	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002), Fish species: rainbow (0.1 mi)
Redhill Creek – USFS CMP Fish Passage Project	Rd 18 MP 5.8	1 site	$250,000	"Group B – Second Priority" from Asbridge et al. (2002), Fish species: StS (0.75 mi)
Tumbledown Creek – USFS CMP Fish Passage Project	Rd 18 MP 3.9	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: rainbow (0.05 mi)
Marco Creek – USFS CMP Fish Passage Project	Rd 18 (MP 2.9) and Rd 16 (MP 17.4)	2 sites	$500,000	"White" from Asbridge et al. (2002), Fish species: rainbow (0.6 and 0.25 mi; respectively)
Irrigation Diversion Barriers				
None				
Fish Passage Actions Sub-Total			**$1,750,000**	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
None				
Flow Restoration Actions Sub-Total			**$0**	

6th Field Watershed: Upper West Fork Hood River (Priority = 7) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	25.9 miles	$518,853	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	22.6 miles	$56,500/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	17.9 miles	$44,755/yr	
Road-Related Actions Sub-Total			**$620,108**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	50 acres	$25,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	500 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	200 acres	$600,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$775,000**	

6th Field Watershed: Upper West Fork Hood River (Priority = 7) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
West Fork Hood River Restoration/LWD Placement (New)	West Fork Hood River	3.0 miles	$200,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Red Hill Creek Restoration/LWD Placement (New)	Red Hill Creek	1.0 mile	$75,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
McGee Creek Restoration/LWD Placement (New)	Red Hill Creek	2.0 miles	$800,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Elk Creek Restoration/LWD Placement (New)	Red Hill Creek	3.0 miles	$800,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$1,875,000**	
OTHER/MISCELLANEOUS ACTIONS				
None Identified				
Other/Miscellaneous Actions Sub-Total			**$0**	
TOTAL EST. COST			**$5,020,108**	

6th Field Watershed: Upper East Fork Hood River (Priority = 8)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Meadows Creek – State Hwy 35 CMP Fish Passage Project	Meadow Creek RM 2.1	1 site	$350,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat
Clark Creek – State Hwy 35 CMP Fish Passage Project	Clark Creek RM 6.4	1 site	$350,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Engineers Creek – State Hwy 35 CMP Fish Passage Project	Engineers Creek RM 1.8	1 site	$350,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat
Hellroaring Creek – State Hwy 35 CMP Fish Passage Project	Hellroaring Creek RM 1.6	1 site	$350,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat
East Fork Hood River – USFS CMP Fish Passage Project	Rd 3540 MP 0.8	1 site	$250,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat (3.75 mi)
Tumble Creek – USFS CMP Fish Passage Project	Rd 44 MP 2.0	1 site	$250,000	"Group D" from Asbridge et al. (2002), Fish species: cutthroat (0.5 mi)
Pocket Creek – USFS CMP Fish Passage Project	Rd 3540 MP 2.4	1 site	$250,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat (0.5 mi)
Engineers Creek – USFS CMP Fish Passage Project	Rd 3500640 MP 0.1	1 site	$250,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat (0.4 mi)
Meadows Creek – USFS CMP Fish Passage Projects	Rd 3500680 (MP 0.1), and Rd 3545 (MP 0.8)	2 sites	$500,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat (0.2 and 0.5 mi; respectively)

6th Field Watershed: Upper East Fork Hood River (Priority = 8) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS - CONTINUED				
Culvert-Fish Passage Barriers				
Culvert Creek – USFS CMP Fish Passage Projects	Rd 44 (MP 0.2) and Rd 3500740 (MP 0.5)	2 sites	$500,000	"White" from Asbridge et al. (2002), Fish species: cutthroat (0.25 and 0.4 mi; respectively)
Irrigation Diversion Barriers				
None Identified				
Fish Passage Actions Sub-Total			**$3,400,000**	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
None Identified				
Flow Restoration Actions Sub-Total			**$0**	
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	58.1 miles	$1,161,980	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	0.6 miles	$1,500/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	13.2 miles	$32,927/yr	
Road-Related Actions Sub-Total			**$1,196,407**	

6th Field Watershed: Upper East Fork Hood River (Priority = 8) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	50 acres	$25,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	100 acres	$30,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	50 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$205,000**	
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
HRWAP Project H-13 Robinhood Creek Riparian Restoration	Robinhood Creek	2.0 miles	$50,000	In Progress
East Fork Hood River Restoration/LWD Placement (New)	East Fork Hood River	4.0 miles	$250,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Pocket Creek Restoration/LWD Placement (New)	Pocket Creek	0.5 miles	$40,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)

6th Field Watershed: Upper East Fork Hood River (Priority = 8) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS - CONTINUED				
Fish Habitat Improvement/LWD Addition				
Meadows Creek Restoration/LWD Placement (New)	Meadows Creek	1.5 miles	$100,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$440,000**	
OTHER/MISCELLANEOUS ACTIONS				
Implement Erosion Control Measures for Hwy 35 & Access Road Sanding Operations	Hwy 35 and Access Road	8.0 miles	undetermined	
Other/Miscellaneous Actions Sub-Total			**undetermined**	
TOTAL EST. COST			**$5,241,407**	

6th Field Watershed: Lake Branch (Priority = 9)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Laurel Creek – USFS CMP Fish Passage Projects	Rd 1300620 (MP 0.9), Rd 1350 (MP 0.2), and Rd 13 (MP 13.5)	3 sites	$750,000	"White" from Asbridge et al. (2002), Fish species: rainbow (0.5, 0.5, and 0.05 mi; respectively)
Divers Creek – USFS CMP Fish Passage Project	Rd 1310 MP 4.5	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: rainbow (0.5mi)
No Name Creek – USFS CMP Fish Passage Project	Rd 13 MP 5.5	1 site	$250,000	"Group D" from Asbridge et al. (2002), Fish species: rainbow (0.3 mi)
Mosquito Creek – USFS CMP Fish Passage Project	Rd 13 MP 1.5	1 site	$250,000	"Group D" from Asbridge et al. (2002), Fish species: rainbow (0.25 mi)
Lake Branch Trib A – USFS CMP Fish Passage Project	Rd 13 MP 1.2	1 site	$250,000	"Group D" from Asbridge et al. (2002), Fish species: rainbow (0.25 mi)
Indian Creek – USFS CMP Fish Passage Project	Rd 13 (MP 5.3) and Rd 1311 (MP 2.0)	2 sites	$500,000	"Group D" from Asbridge et al. (2002), Fish species: rainbow (0.3 and 0.05 mi; respectively)
Irrigation Diversion Barriers				
None				
Fish Passage Actions Sub-Total			**$2,250,000**	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
None				
Flow Restoration Actions Sub-Total			**$0**	

6th Field Watershed: Lake Branch (Priority = 9) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	36.8 miles	$735,468	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	1.1 miles	$2,750/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	21.6 miles	$54,086/yr	
Road-Related Actions Sub-Total			**$792,304**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	50 acres	$25,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	500 acres	$150,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	200 acres	$600,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$775,000**	

6th Field Watershed: Lake Branch (Priority = 9) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
HRWAP Project H-14 Lake Branch Fish Habitat Improvement	Lake Branch	2.0 miles	$150,000	Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Laurel Creek Restoration/LWD Placement (New)	Laurel Creek	2.0 miles	$120,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Divers Creek Restoration/LWD Placement (New)	Divers Creek	0.5 miles	$40,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$310,000**	
OTHER/MISCELLANEOUS ACTIONS				
None Identified				
Other/Miscellaneous Actions Sub-Total			**$0**	
TOTAL EST. COST			**$4,127,304**	

6th Field Watershed: Middle East Fork Hood River (Priority = 10)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Doe Creek – County CMP Fish Passage Project (County Road 428 Cooper Spur)	Doe Creek RM 3.3	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Tilly Jane Creek – State Hwy 35 CMP Fish Passage Project	Tilly Jane Creek RM 3.4	1 site	$350,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Tilly Jane Creek – County CMP Fish Passage Project (County Road 428 Cooper Spur)	Tilly Jane Creek RM 4.6	1 site	$250,000	"White" from Asbridge et al. (2002), Fish species: cutthroat
Crystal Springs Creek – State Hwy 35 CMP Fish Passage Project	Crystal Springs Creek RM 4.5	1 site	$350,000	"White" from Asbridge et al. (2002), Fish species: StW, cutthroat
Ash Creek – State Hwy 35 CMP Fish Passage Project	Ash Creek RM 1.4	1 site	$350,000	"Group A – First Priority" from Asbridge et al. (2002), Fish species: cutthroat
Pollalie Creek – State Hwy 35 CMP Fish Passage Project	Pollalie Creek RM 7.0	1 site	$350,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat
Crystal Springs Creek – County CMP Fish Passage Project (Unused Logging Road, CTWS Survey 7/25/2001)	Crystal Springs Creek RM 0.2	1 site	$250,000	"White" from Asbridge et al. (2002)
Irrigation Diversion Barriers				
None Identified				
Fish Passage Actions Sub-Total			**$2,150,000**	

6th Field Watershed: Middle East Fork Hood River (Priority = 10) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
None				
Flow Restoration Actions Sub-Total			**$0**	
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	21.9 miles	$437,817	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	6.0 miles	$15,000/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	4.2 miles	$10,589/yr	
Road-Related Actions Sub-Total			**$463,406**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	50 acres	$25,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	50 acres	$15,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
Riparian Thinning (commercial)	watershed-wide	10 acres	$30,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$70,000**	

6th Field Watershed: Middle East Fork Hood River (Priority = 10) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
East Fork Hood River Restoration/LWD Placement (New)	East Fork Hood River	2.0 miles	$150,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$150,000**	
OTHER/MISCELLANEOUS ACTIONS				
Implement Hwy 35 Improvements to Improve Floodplain Function and Increase Channel Sinuosity	along East Fork Hood River	undetermined	undetermined	Per joint Hwy 35 Study Recommendations
Implement Erosion Control Measures for Hwy 35 & Access Road Sanding Operations	Hwy 35 and Access Road	5.0 miles	undetermined	
Other/Miscellaneous Actions Sub-Total			**undetermined**	
TOTAL EST. COST			**$2,833,406**	

6th Field Watershed: Neal Creek (Priority = 11)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
Neal Creek/Lenz Cr – County CMP Fish Passage Project (County Road 306)	Neal Cr/Lenz Cr RM 0.9	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002), Fish species: coho, cutthroat
Neal Creek/Unnamed Cr – County CMP Fish Passage Projects (County Road 209)	Neal Cr/ Unnamed Cr RM 0.3 and 2.5	2 sites	$500,000	"Group A – First Priority" from Asbridge et al. (2002), Fish species: StW, cutthroat
West Fk Neal Creek/Unnamed Cr – County CMP Fish Passage Project (County Road 315)	West Fk Neal Cr/Unnamed Cr RM 0.7	1 site	$250,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat
Neal Creek – USFS CMP Fish Passage Project	Rd 1710 MP 3.7	1 site	$250,000	"Group A – First Priority" from Asbridge et al. (2002), Fish species: cutthroat (0.10 mi)
West Fk Neal Creek – USFS CMP Fish Passage Project	Rd 17 (MP 4.8 and 6.1) and 1700630 (MP 0.1)	3 sites	$750,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat (1.30, 2.25, 0.10 mi; respectively)
West Fk Neal Creek Trib A – USFS CMP Fish Passage Project	Rd 1700110 (MP 0.1) and Rd 1710 (MP 0.1)	2 sites	$500,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat (0.6 and 0.1 mi; respectively)
West Fk Neal Creek Trib B – USFS CMP Fish Passage Project	Rd 1700730 (MP 0.1) and Rd 17 (MP 5.1)	2 sites	$500,000	"Group C – Third Priority" from Asbridge et al. (2002), Fish species: cutthroat (0.6 and 0.3 mi; respectively)
Irrigation Diversion Barriers				
HRWAP Project FP-3 Central Canal Pipeline/Neal Creek Siphon (listed below under stream-flow restoration)				
Fish Passage Actions Sub-Total			**$3,000,000**	

6th Field Watershed: Neal Creek (Priority = 11) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
HRWAP Project FP-3 Central Canal Pipeline/Neal Creek Siphon	Neal Creek		$5,000,000	"high" priority in updated 2005 HRWAP; Phase 1 complete; Also a streamflow restoration project
Flow Restoration Actions Sub-Total			**$5,000,000**	
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	14.0 miles	$279,775	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	19.8 miles	$49,500/yr	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	7.4 miles	$18,413/yr	
Road-Related Actions Sub-Total			**$347,688**	
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	100 acres	$50,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
Riparian Thinning (pre-commercial/conifer release)	watershed-wide	160 acres	$48,000	Est. of quantity from Steve Stampfli (Sept. 2006), Est. of cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (commercial)				
None Identified				
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$98,000**	

6th Field Watershed: Neal Creek (Priority = 11) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
HRWAP Project H-8 West Fork Neal Creek Floodplain and Channel Restoration	West Fork Neal Creek	1.5 miles	$70,000	Per updated 2005 HRWAP, awaits completion of HRWAP Project FP-3 Central Canal Pipeline
Neal Creek Restoration/LWD Placement (New)	Neal Creek	4.0 miles	$1,600,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
West Fork Neal Creek Restoration/LWD Placement (New)	West Fork Neal Creek	1.5 miles	$500,000	New Project Opportunity, Est. of quantity & cost from Gary Asbridge (Sept. 2006)
Other				
None Identified				
In-Stream Related Actions Sub-Total			**$2,170,000**	
Other/Miscellaneous Actions				
HRWAP Project WQ-9 Lower Neal Creek Riparian Area Improvement	Lower Neal Creek	undetermined	undetermined	"high" priority in updated 2005 HRWAP; Ongoing
HRWAP Project WQ-14 QVL/Hanel Mill Settling Pond/Drainage Improvements	West Fork Neal Creek	undetermined	undetermined	"low" priority in updated 2005 HRWAP; awaits completion of HRWAP Project FP-3 Central Canal Pipeline
Other/Miscellaneous Actions Sub-Total			**undetermined**	
TOTAL EST. COST			**$10,615,688**	

6th Field Watershed: Dog River (Priority = 12)

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
FISH PASSAGE ACTIONS				
Culvert-Fish Passage Barriers				
None Identified				
Irrigation Diversion Barriers				
Investigate Opportunities for and Implement Fish Passage Improvements	Dog River at The Dalles Diversion and Road 44	undetermined	undetermined	
Fish Passage Actions Sub-Total			**undetermined**	
FLOW RESTORATION ACTIONS				
Stream-flow Restoration				
Investigate Opportunities for and Implement Actions to Increase In-stream Flows	Dog River below The Dalles Diversion	1 site	undetermined	
Flow Restoration Actions Sub-Total			**undetermined**	
ROAD-RELATED ACTIONS				
Potential Road Decomm. and/or Storm Proofing				
USFS Roads (access rating <4 per Roads Analysis)	watershed-wide	21.3 miles	$426,898	
Annual Road Maintenance				
Non-Federal Roads (County, State, Private)	watershed-wide	0 miles	$0	
USFS Roads (access rating >4 per Roads Analysis)	watershed-wide	8.0 miles	$20,094/yr	
Road-Related Actions Sub-Total			**$446,992**	

6th Field Watershed: Dog River (Priority = 12) – Continued

Restoration Action	Specific Location/Area	Quantity	Est. Project Cost	Comments
RIPARIAN-RELATED ACTIONS				
Riparian Planting				
Riparian Planting	watershed-wide	50 acres	$25,000	Est. of quantity & cost from John Dodd & Larry Rector (Sept. 2006)
Riparian Thinning (pre-commercial)				
None Identified				
Riparian Thinning (commercial)				
None Identified				
Other				
None Identified				
Riparian-Related Actions Sub-Total			**$25,000**	
IN-STREAM RELATED ACTIONS				
Fish Habitat Improvement/LWD Addition				
Investigate Opportunities for and Implement Actions to Increase LWD Density	Dog River and Tributaries	undetermined	undetermined	
Other				
None Identified				
In-Stream Related Actions Sub-Total			**undetermined**	
OTHER/MISCELLANEOUS ACTIONS				
None Identified				
Other/Miscellaneous Actions Sub-Total			**$0**	
TOTAL EST. COST			**$471,992**	

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Chapter 4 -
Restoration Tools

Chapter 4 – Restoration Tools

Review of Various Programs for Funding Restoration Actions

There are several local, state, federal, and non-governmental programs available that provide funds or assistance in implementing watershed restoration activities. Many of these entities have their own emphasis areas, criteria, guidelines, and requirements; however, most of them emphasize cost-sharing amongst two or more partners on a given project proposal. A minimum cost-share criteria of 1:1 for federal to non-federal funding (cash and in-kind) is common. Here are some of the primary sources and programs:

American Farmland Trust

Founded in 1980, the American Farmland Trust is aimed at providing protection for farmlands in a manner that unites farmers, environmentalists, and policymakers. The Trust's three strategies are:

1) **Protect the best land** through publicly funded agricultural conservation easement programs;
2) **Plan for growth with agriculture in mind** through effective community planning and growth management; and
3) **Keep the land healthy** for farmland through encouraging stewardship and conservation practices.

Visit: http://www.farmland.org

Bonneville Power Administration

Through its Integrated Fish and Wildlife Program, the Bonneville Power Administration provides roughly $500 million annually to mitigate, protect, enhance, and recover fish and wildlife populations and their habitat in the Columbia River Basin. BPA has funded several projects in the Hood River Basin over the last three decades. Priorities established in the Northwest Power and Conservation Planning Council Subbasin Plan for the basin will serve as the primary basis for funding future project proposals.

Visit: http://www.efw.bpa.gov/Integrated_Fish_and_Wildlife_Program

National Fish and Wildlife Foundation

The National Fish and Wildlife Foundation has a mission to conserve healthy populations of fish, wildlife, and plants on land and in the sea, through creative and respectful partnerships, sustainable solutions, and better education. The Foundation awards matching grants to projects that benefit education, habitat protection and restoration, and natural resource management. It offers two types of programs:

1) General Matching Grant Program, and
2) Special Grant Programs

Visit: http://www.nfwf.org

National Forest Foundation

Created by Congress at the official non-profit partner of the USDA Forest Service, the National Forest Foundation engages communities in activities that promote the health and public enjoyment of National Forest System lands across the country. The foundation encourages local involvement and grassroots participation in forest stewardship. It administers both private and corporate gifts of funds and land for the benefit of national forests.

Visit: http://www.natlforests.org

Oregon Department of Environmental Quality

The Oregon Department of Environmental Quality offers Nonpoint Source Pollution 319 Grants each year to address water quality impairments caused by nonpoint source pollution. These are federal funds provided to ODEQ by the Environmental Protection Agency. In fiscal year 2005, ODEQ awarded over $2 million in grants to government agencies and nonprofit organizations. Project proposals must demonstrate meeting needs related to the program's tem major elements.

Visit: http://www.deq.state.or.us/wq/nonpoint/wq319gt.htm

Oregon Department of Fish and Wildlife

The Oregon Department of Fish and Wildlife offers several programs in support of local watershed restoration opportunities. Some of the main programs are: 1) the Restoration and Enhancement Program that offers funds to implement fish restoration and enhancement projects; 2) the Salmon and Trout Enhancement Program that coordinates donated money, materials, equipment, and labor to accomplish stream habitat improvements, stream surveys, education projects, and hatch-box programs; 3) the Riparian Tax Incentive Program that provides a property tax incentive to private land owners for improving or maintaining riparian lands; 4) the Landowner Incentive Program that is coordinated through the U.S. Fish and Wildlife Service and provides funding for projects on private lands that enhance, protect, or restore habitats that benefit at-risk species; and 5) the Western Oregon Stream Restoration Program that provides direct technical support to watershed councils and private landowners in western Oregon to implement Oregon Plan measures to improve fish habitat.

Visit: http://www.dfw.state.or.us

Oregon Department of Land Conservation and Development

The Oregon Department of Land Conservation and Development offers Periodic Review and Technical Assistance Grants to local jurisdictions and tribal governments to completed projects to update and modernize comprehensive land-use plans and regulations. The grants are provide to jurisdictions that are completing a structured periodic review process and, through Technical Assistance grants, to jurisdictions with planning projects outside the structured plan update process. Periodic Review grants are used for completing tasks on established work programs.

Visit: http://www.lcd.state.or.us/LSC/grants.shtml

Oregon State University Extension Service

Oregon State University offers a number of applicable extension services for aquatic restoration opportunities. The OSU Watershed Extension Service is just one of these services, and its mission is to increase the capacity of groups and communities for conserving, improving, protecting, and sustaining watershed functions and values. Increasing capacity is achieved through research-based education, skill-building projects, and new partnerships among residents, local organizations, businesses, agencies, and educational institutions. To learn more about specific opportunities with this extension service and others,

Visit: http://extension.oregonstate.edu/index.php

Oregon Watershed Enhancement Board

The Oregon Watershed Enhancement Board provides annual grant funding to many types of projects including restoration, monitoring, assessment, watershed council support, land acquisition, and education.

Visit: http://www.oweb.state.or.us

Natural Resources Conservation Service

The Natural Resources Conservation Service provides technical services and assistance as well as grant funding and special initiatives. One of their many programs is the Environmental Quality Incentives Program which was reauthorized in the Farm Security and Rural Investment Act of 2002 (the Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agriculatural production and environmental quality as compatible national goals. The program offers both financial and technical assistance to assist farmers and ranchers install or implement structural and management practices on their eligible lands. To learn more about this program and many others,

Visit: http://www.nrcs.usda.gov

National Marine Fisheries Service

In 2000, National Marine Fisheries Service began implementing the Pacific Coastal Salmon Recovery Fund providing grants to state and tribal governments to assist in conservation and recovery actions. The purposes of this program are to: 1) Supplement existing state, tribal, and federal programs that foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation and 2) Promote efficiencies and effectiveness in recovery efforts through enhanced sharing and pooling of capabilities, expertise, and information.

Visit: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/PCSRF

River Network

River Network is a national non-profit organization dedicated to helping people understand, protect and restore rivers and their watersheds. The organization provides a vast array of information on tools and resources to accomplish watershed restoration activities. One such resource is the quarterly River Fundraising Alert which is designed to help river and watershed organizations support themselves financially and provides upcoming funding opportunities and deadlines. The organization also provides workshops that provide training on strategic planning, fundraising, river monitoring, and more.

Visit: http://www.rivernetwork.org

U.S. Environmental Protection Agency

The U. S. Environmental Protection Agency offers numerous watershed funding programs at the national level, including nonpoint source pollution funding, target watersheds grants, wetlands funding, and environmental education grants. In addition, Region 10 of the EPA offers specific grant opportunities to the states of Oregon, Washington, Idaho, and Alaska.

Visit: http://www.epa.gov/owow/funding/watershedfunding.html

U.S. Fish and Wildlife Service

The U. S. Fish and Wildlife Service offers several programs that promote watershed restoration and educational activities. One such program is the Partners for Fish and Wildlife Program established in 1987 aimed at working with landowners to improve habitat on private lands. Another is the Jobs in the Woods Program which is the Service's contribution to funding watershed restoration activities as part of the Northwest Forest Plan. The Service uses congressionally appropriated funds to assist in implementing restoration activities on nonfederal lands. Other assistance and funding opportunities are provided by the Fisheries Restoration and Irrigation Mitigation Act of 2000 (PL 106-502) and the North American Wetlands Conservation Act.

Visit: http://www.fws.gov/pacific

U.S.D.A. Forest Service

The U.S.D.A. Forest Service offers both technical assistance and funding for implementing watershed restoration activities. Congressionally appropriated funding is provided through several programs, some of the more common included the Challenge Cost Share Program, Joint Venture Aquatic Restoration Program, and the Title II Payments to Counties Program (PL 106-393). Exercising the Wyden Authority allows these funds to be used on non-federal lands where benefits to federal resources can be demonstrated. For more information,

Contact: District Fish Biologist, Hood River Ranger District, (541) 352-6002

Technical Assistance/Outreach and Conservation Education

The working group identified technical assistance/outreach and conservation education as two additional critical components of an effective aquatic habitat restoration strategy for the basin. Clearly, the human element of a restoration strategy is critical for its long term success. In other words, ensuring that citizens and communities are engaged in watershed restoration activities is pivotal in securing support for long term watershed stewardship and managing for sustainable watershed resources. Providing technical assistance and outreach through various programs to private landowners, user groups, residents, recreationists and other stakeholders in the basin is fundamental to adjusting practices and behaviors in such ways that promote more wise use of resources and afford them greater protection. Examples may include increasing awareness and application of improved irrigation technologies that conserve water, assisting in the development and application of best management practices for small timberland operations to reduce sediment delivery to streams, or providing information to community citizens on the effects of lawn chemicals and fertilizers to aquatic resources. All of the improvements brought about through technical assistance and outreach, including those brought about through active restoration actions outlined in Chapter 3, can be easily be undermined or reversed if future generations are not provided the educational opportunities to learn about their connections to the watershed and their impacts on the land. Hence, conservation education for school children, as well as adults, is the second additional critical component of an effective strategy.

These two components are recognized in the 2002 HRWG Hood River Watershed Action Plan (Coccoli 2002) through the established goal to ***"recommend ongoing education and awareness projects to educate the public about watershed issues and promote improved stewardship of land and water."*** The working group was not able to develop a detailed strategy addressing technical assistance/outreach and conservation education within the timeframe it worked under. However, it was able to establish an overall framework for the basin that will allow for future development and establishment of:

1) Priority needs,
2) Target recipients, and
3) Key locations within the basin.

The initial framework for developing a Hood River Basin Citizen Education and Outreach Strategy is contained in Appendix C.

Chapter 5 -
Critical Information Gaps

Chapter 5 – Critical Information Gaps

Several information gaps emerged during the development of this strategy. By highlighting these information gaps, the working group hopes this will inform future decisions regarding monitoring, inventory, and refined assessment efforts in the basin. Listed in random order, the key information gaps were:

- Lack of a basin-wide streamflow assessment that characterizes natural streamflows and results of water withdrawals.

- Lack of a recent basin-wide inventory and continued monitoring of chemical pollutants in streams and rivers.

- Lack of biological information regarding the distribution and abundance of the following fish species: fall Chinook, coho, and Pacific lamprey.

- Lack of biological information regarding the key spawning and rearing areas, known as "hot spots," for most fish species.

- Lack of consistent and comparable watershed condition data in a GIS format that would allow a more quantitative evaluation of conditions throughout the basin.

- Lack of on-the-ground knowledge or validation of many potential watershed restoration activities in most of the 6th field watersheds throughout the basin.

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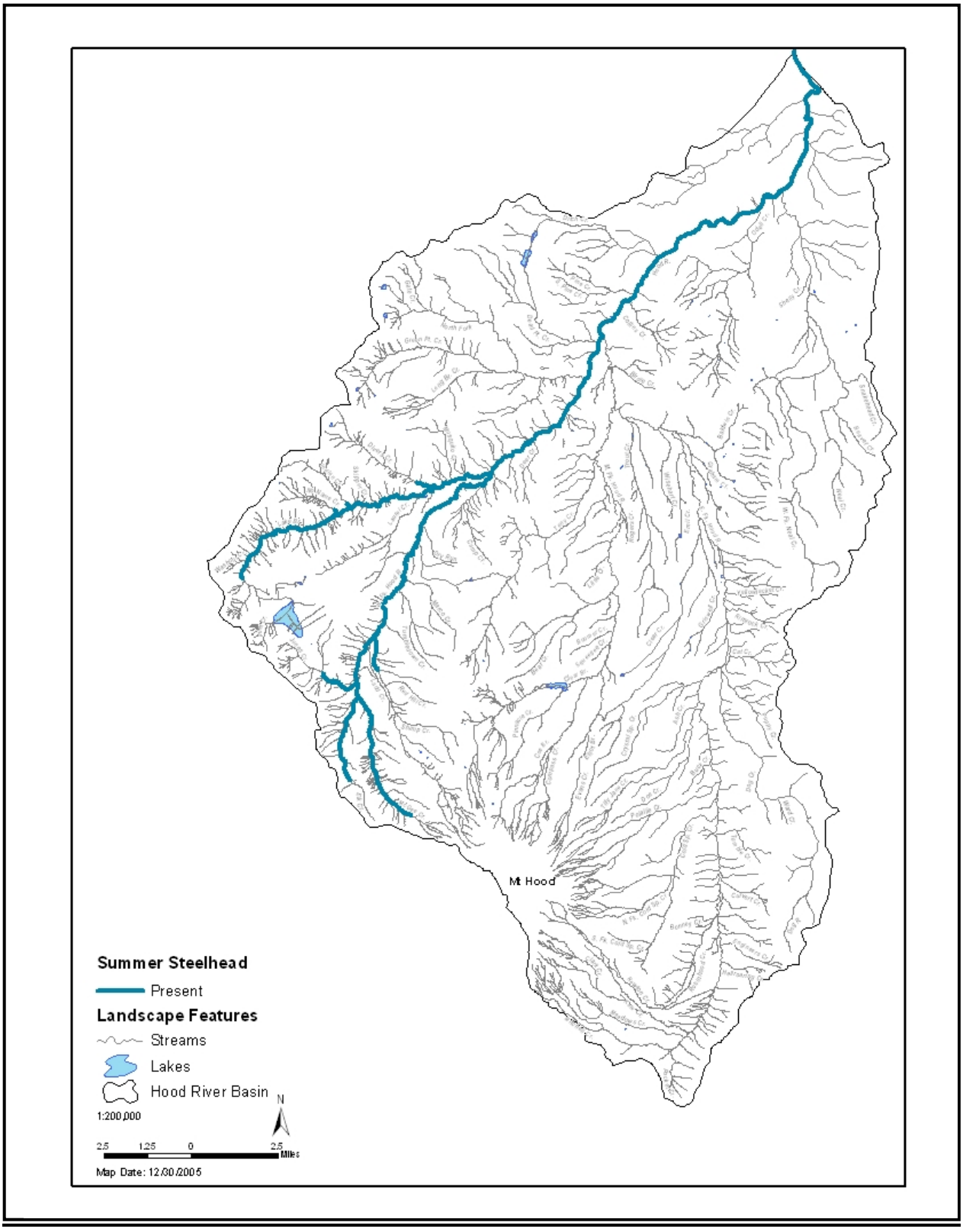
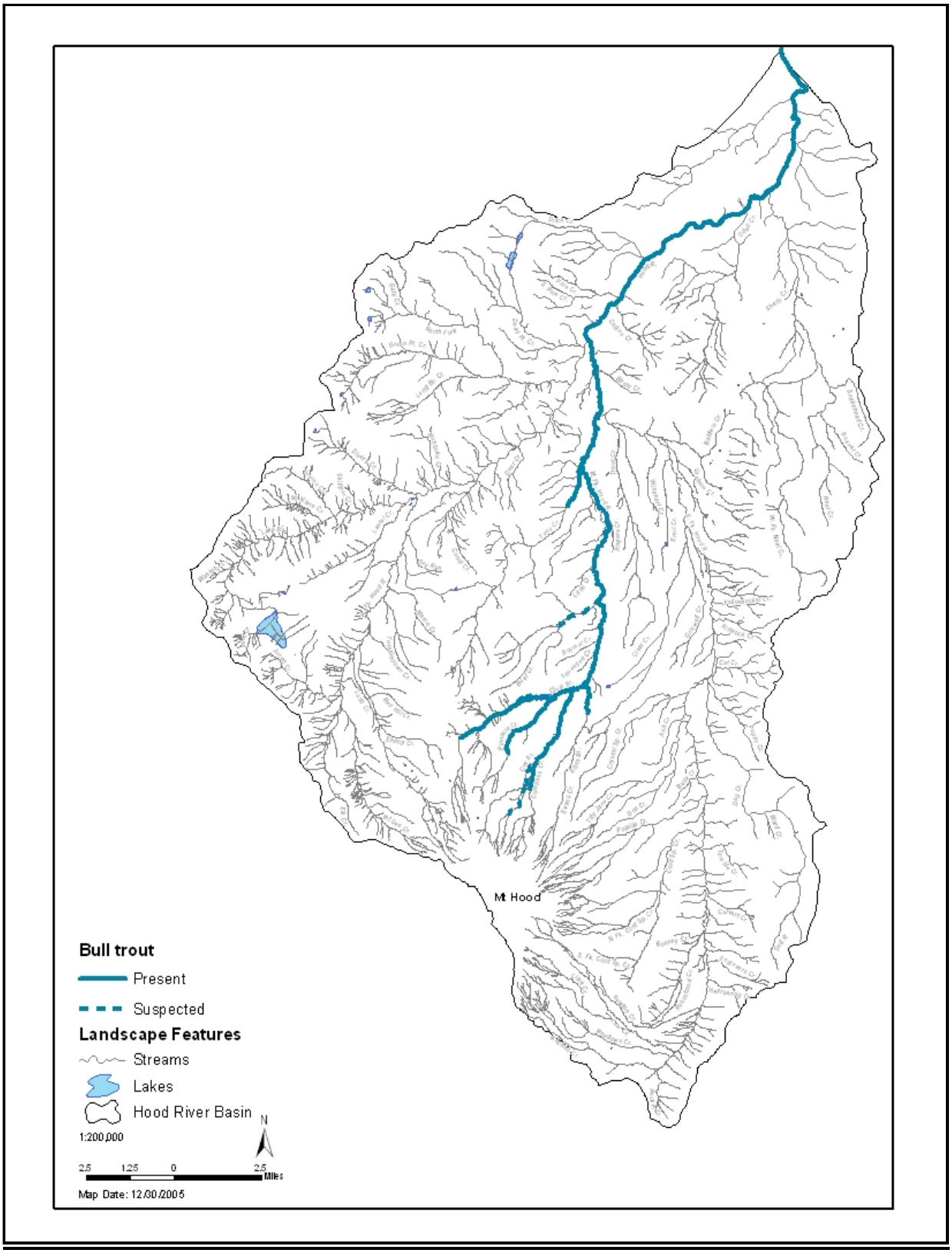
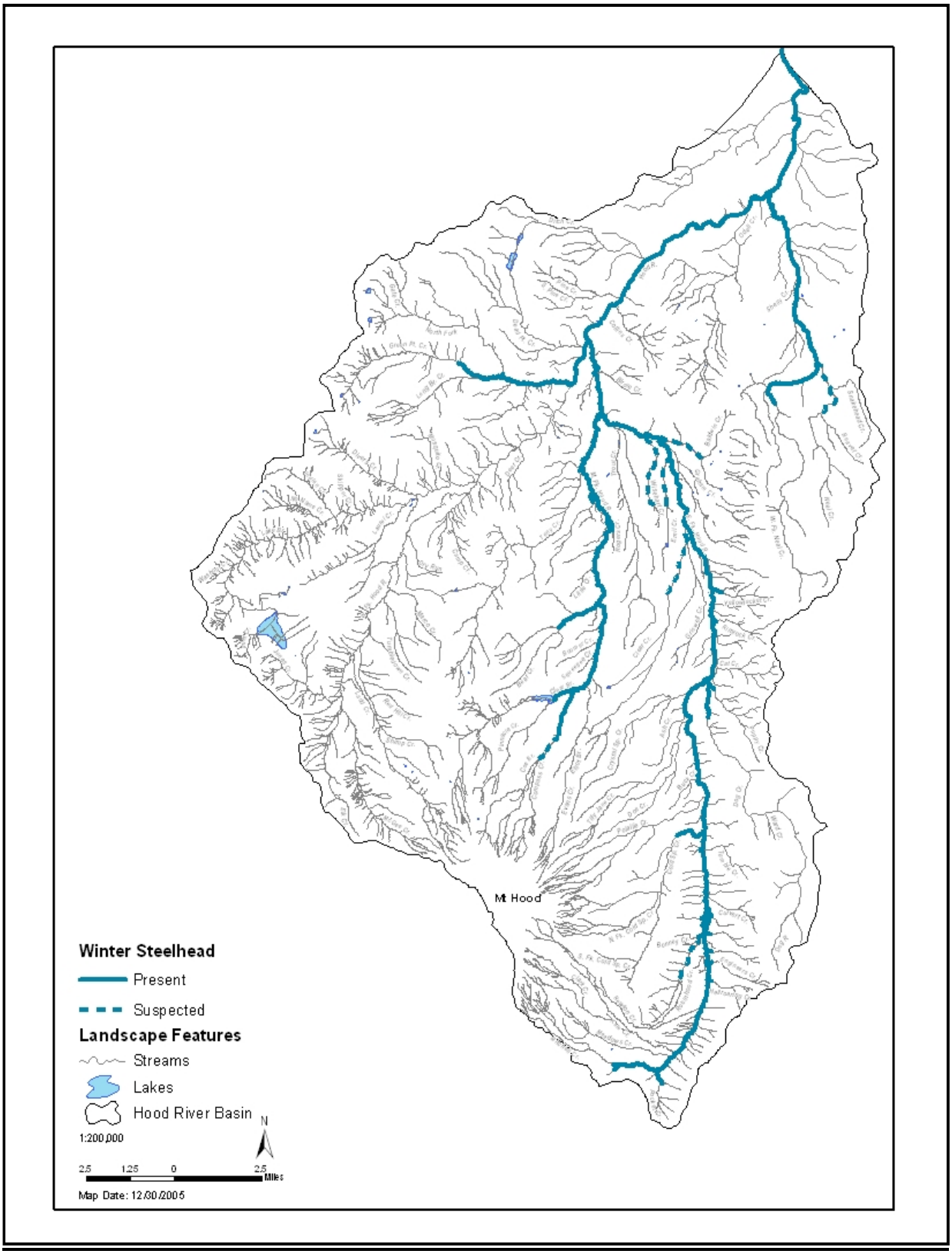
Appendix A –
Fish Population Distribution Maps for the Hood River Basin



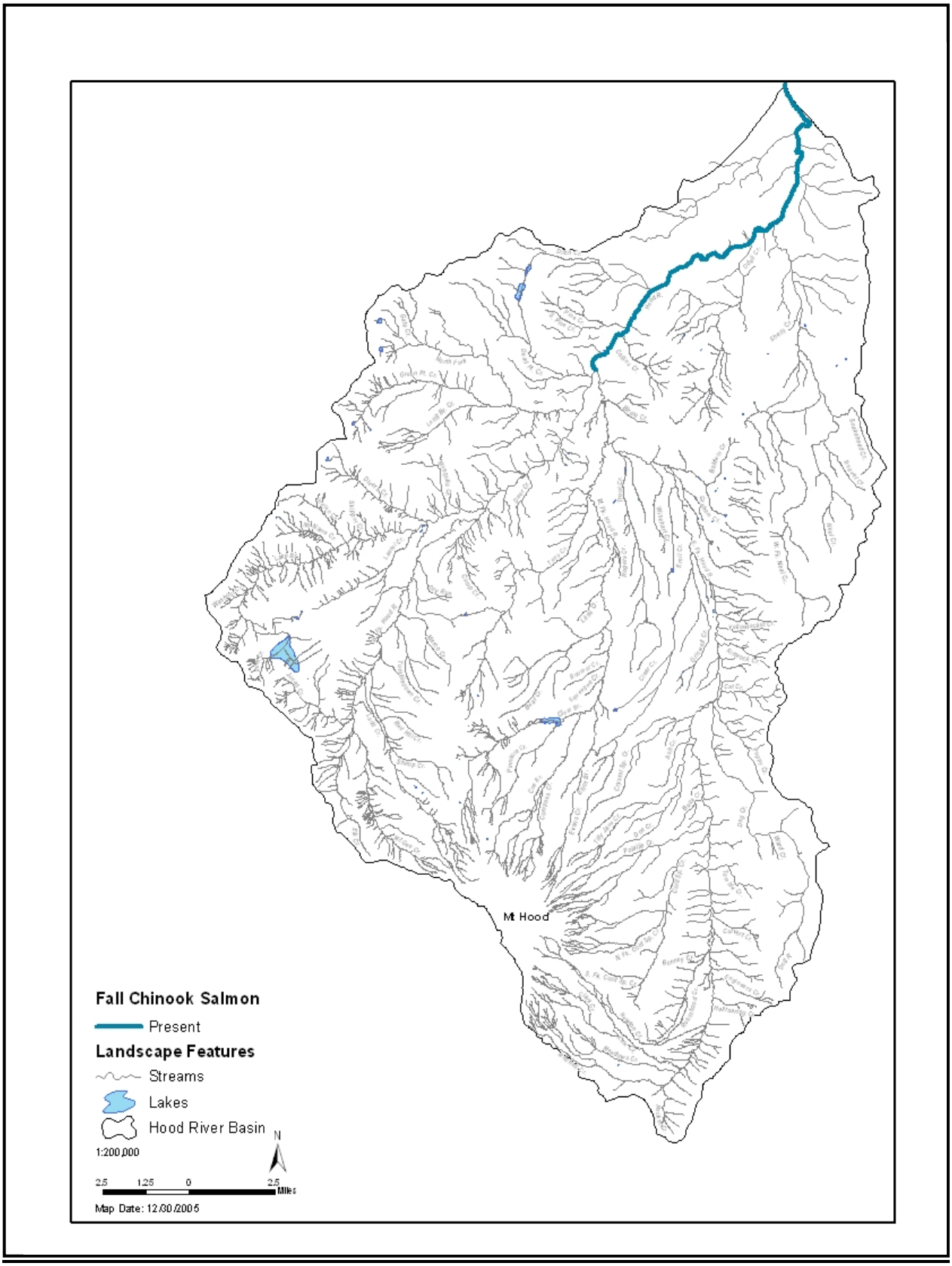
Map A1. Summer Steelhead Distribution in the Hood River Basin.



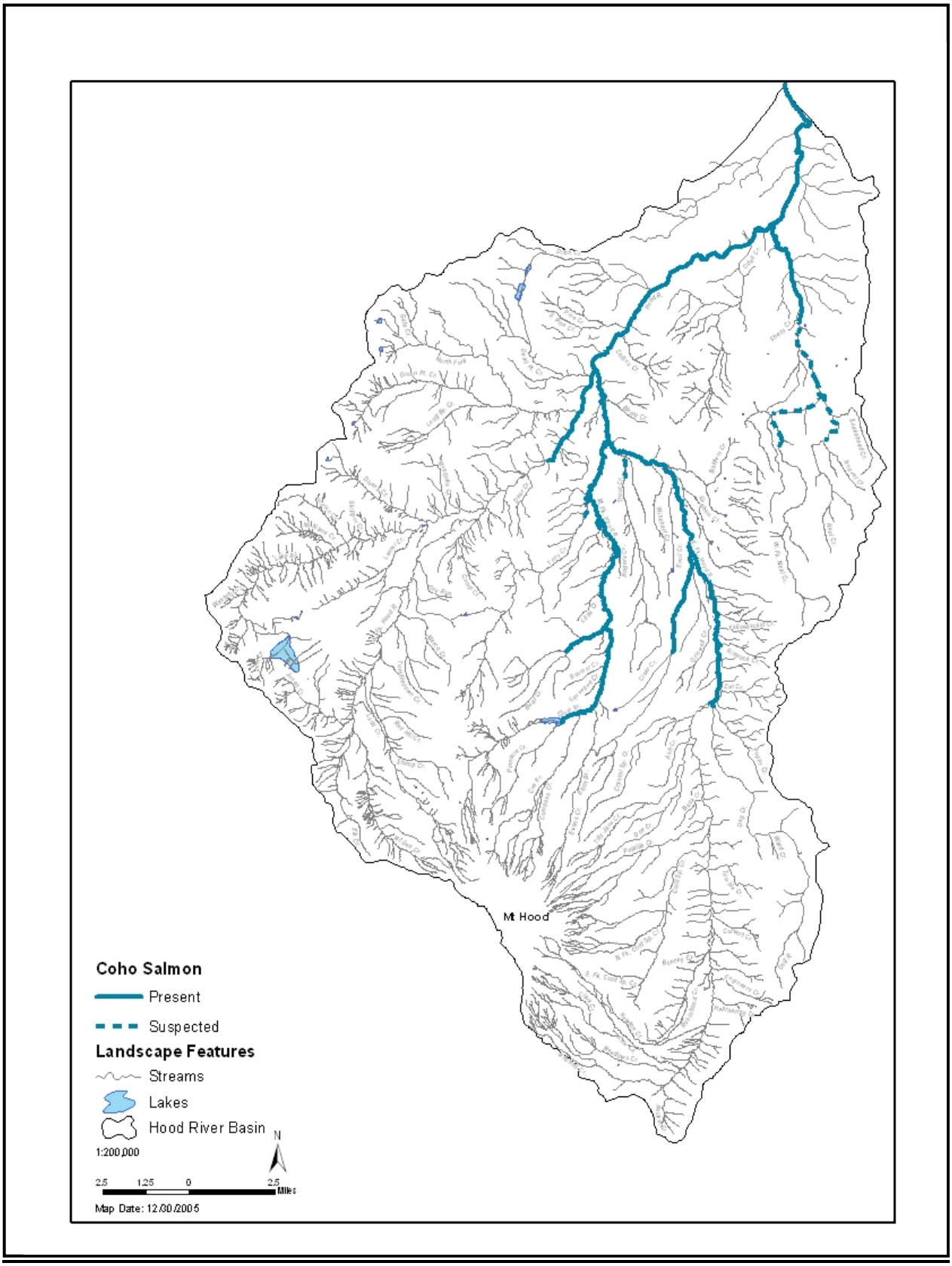
Map A2. Bull Trout Distribution in the Hood River Basin.



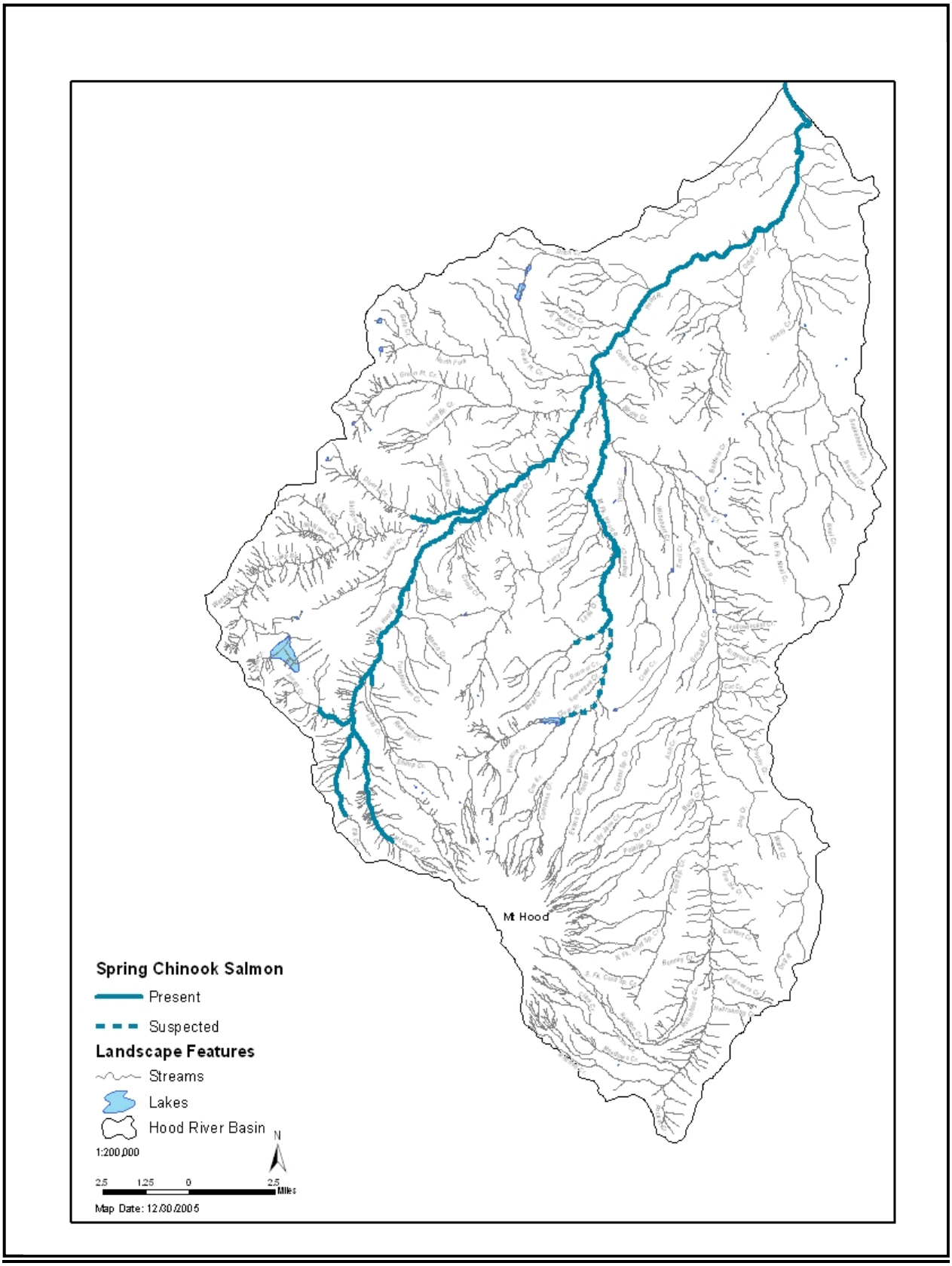
Map A3. Winter Steelhead Distribution in the Hood River Basin.



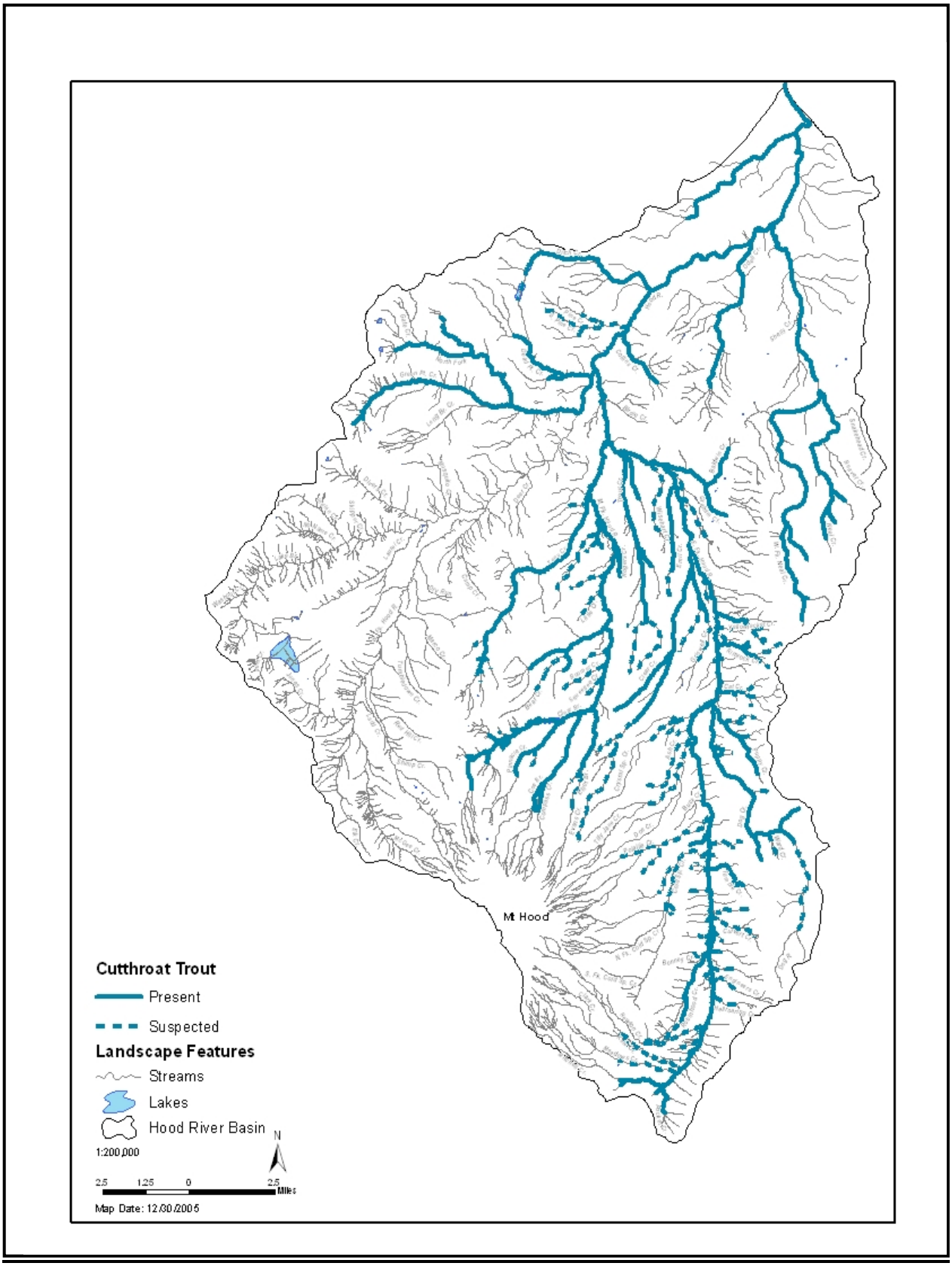
Map A4. Fall Chinook Distribution in the Hood River Basin.



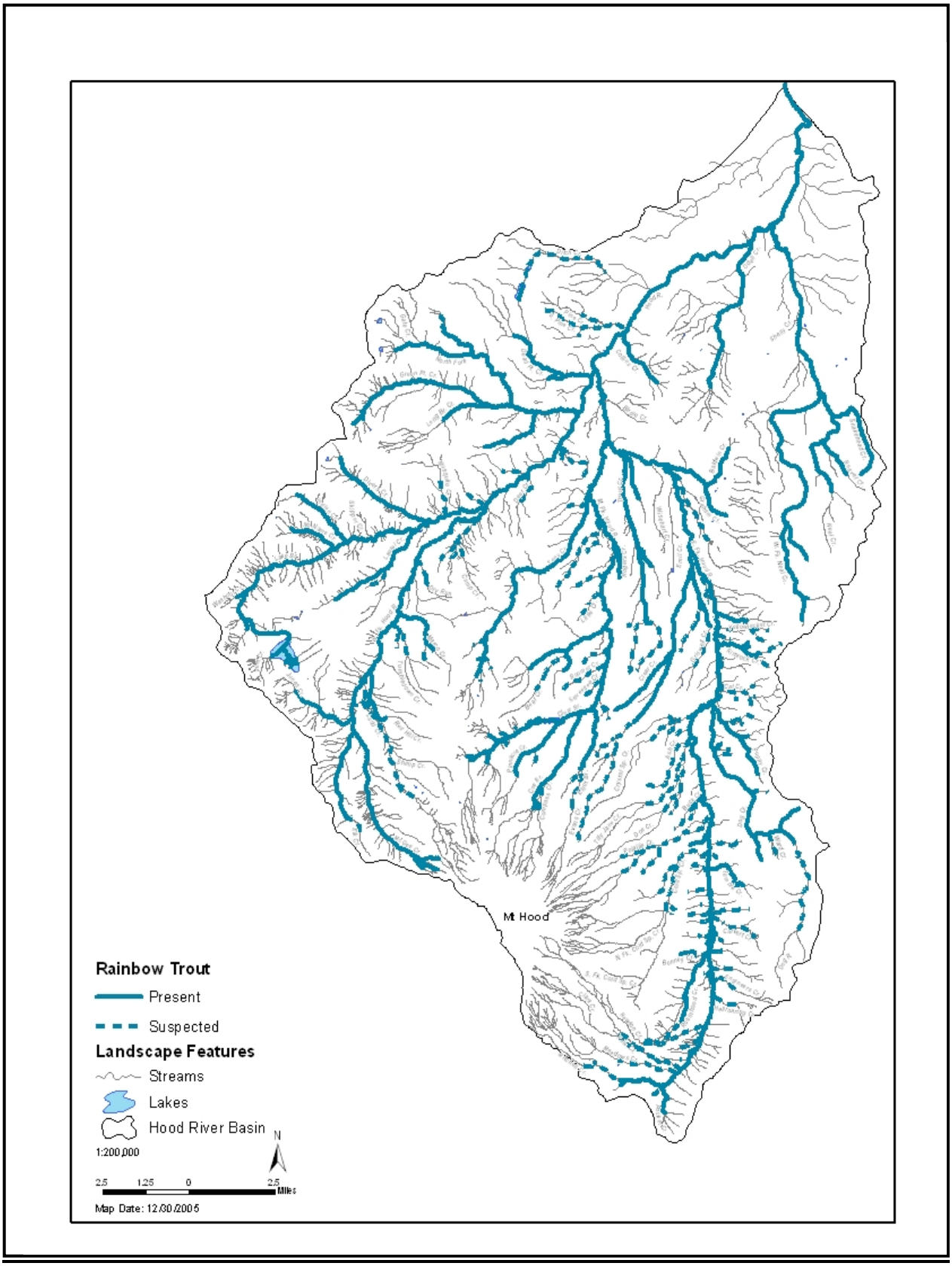
Map A5. Coho Distribution in the Hood River Basin.



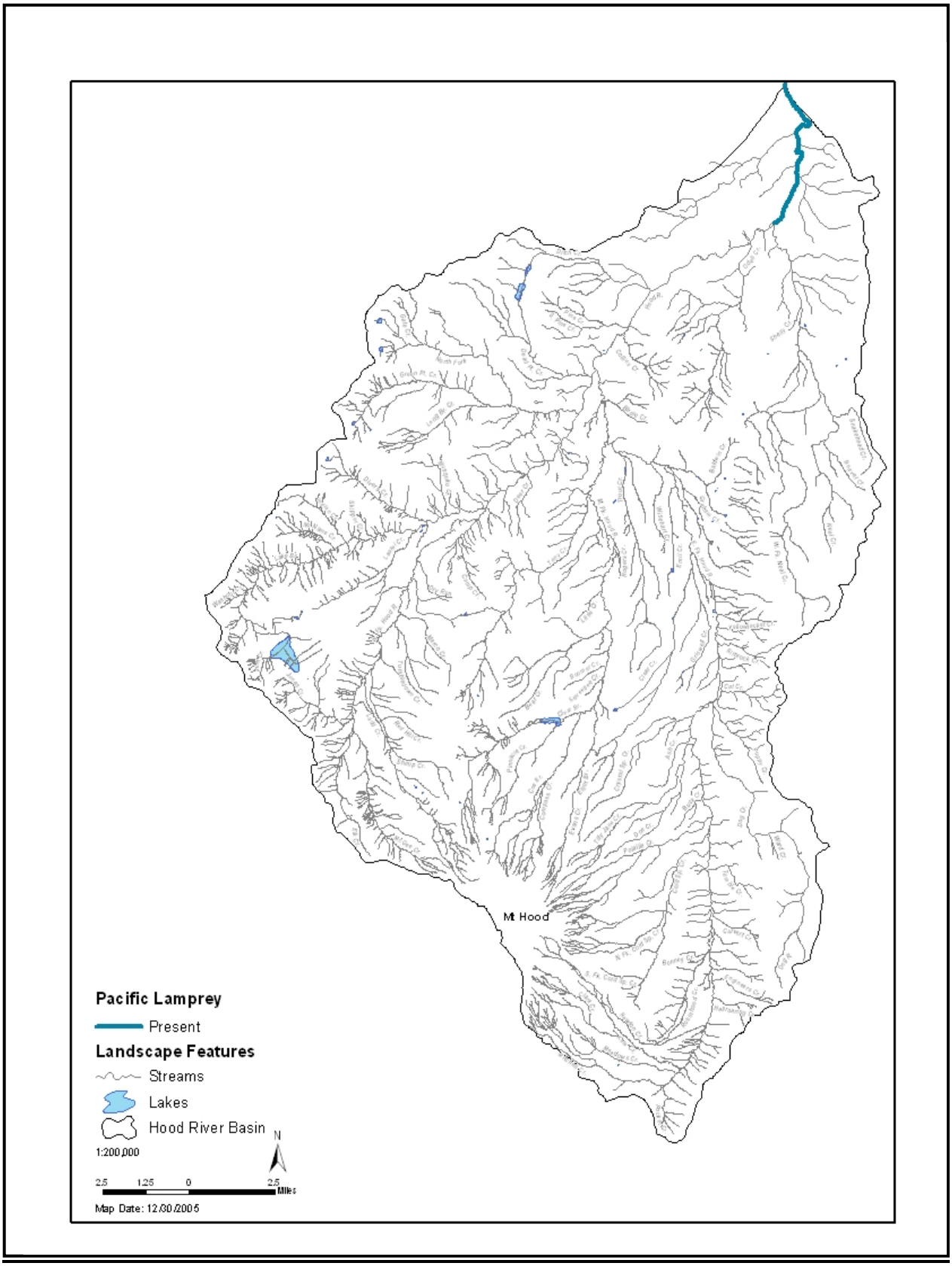
Map A6. Spring Chinook Distribution in the Hood River Basin.



Map A7. Cutthroat Trout Distribution in the Hood River Basin.

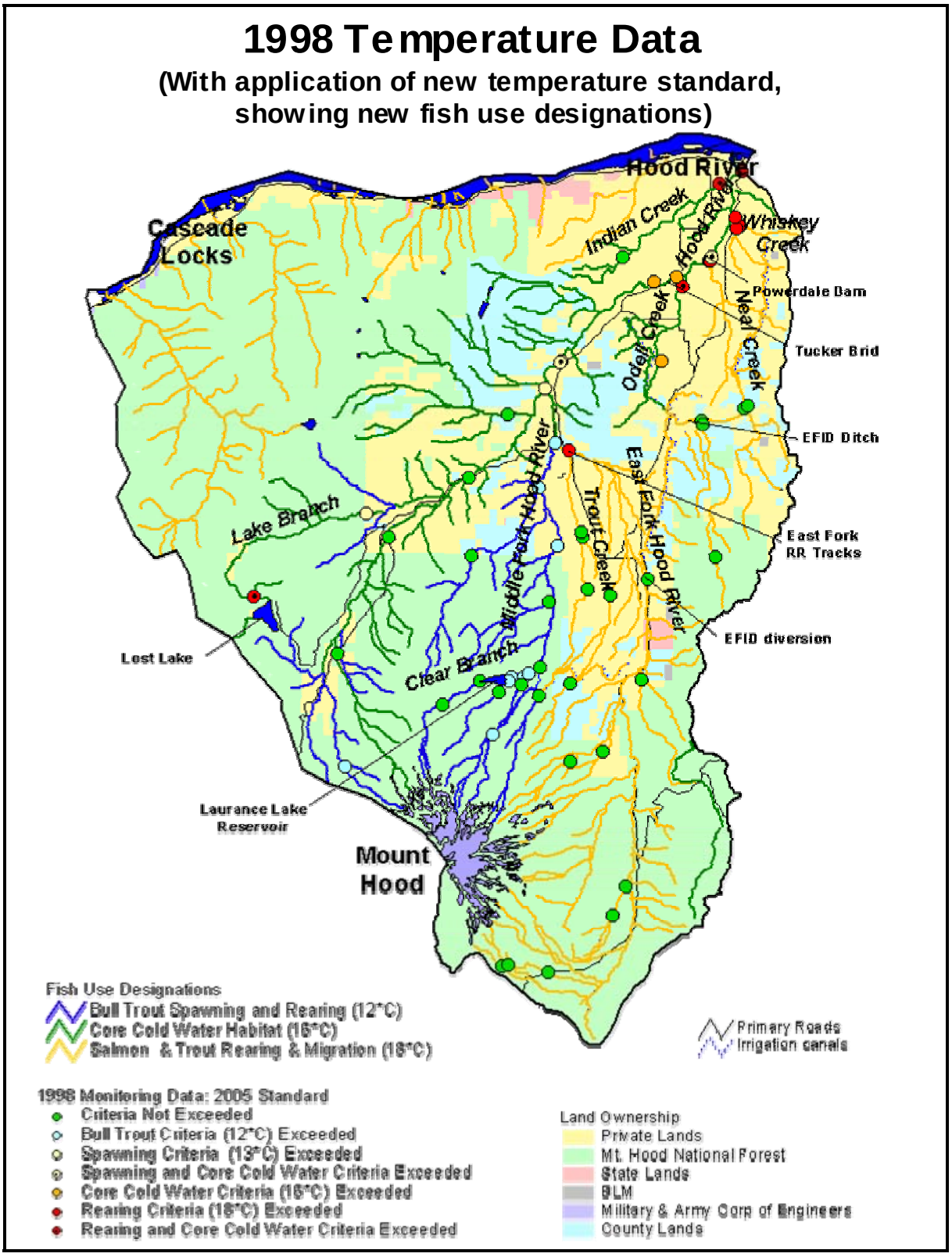


Map A8. Rainbow Trout Distribution in the Hood River Basin.

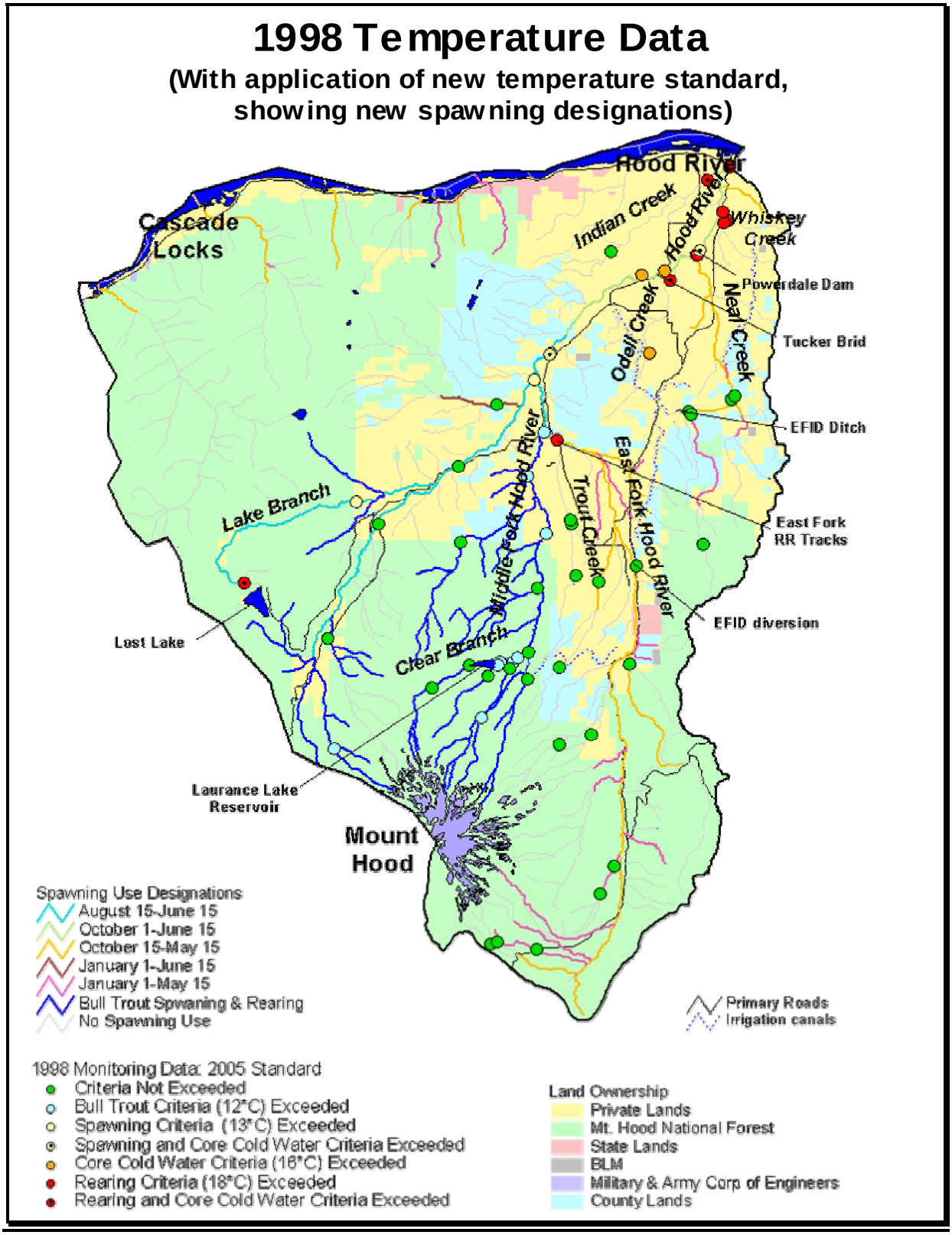


Map A9. Pacific Lamprey Distribution in the Hood River Basin.

Appendix B –
1998 Stream Temperature Monitoring Results in Relation to 2004 ODEQ Standards



Map B1. 1998 Temperature Data in the Hood River Basin (With application of new temperature standards, showing new fish use designations for bull trout spawning & rearing, Core cold water habitat, and salmon & trout rearing and migration).



Map B2. 1998 Temperature Data in the Hood River Basin (With application of new temperature standards, showing new fish spawning designations).

Appendix C –
Initial Framework for Developing a Hood River Basin Citizen Education and Outreach Strategy

Appendix C - Initial Framework for Developing a Hood River Basin Citizen Education and Outreach Strategy (prepared by Steve Stampfli, HRWG)

The primary goal of the actions proposed below is to promote elevated education and awareness among students and adults surrounding the primary issues listed.

Issue 1: Improving Agricultural Water Conservation Efficiency

Student (K-12) Opportunities

- **"Parkdale Elementary Water Conservation Awareness Week Project."**
  Sponsor: MFID. Date Planned: xx/xx/xx.

Adult Opportunities

- **"How Your Farm Can Convert to Microsprinklers Today!" Adult Education Class Series.**
  Sponsor: EFID and HR Continuing Education. Date Planned: xx/xx/xx.

- **"Conversion to Efficient Irrigation and Use of Modern Soil Monitoring to Optimize Tree Fruit Irrigation Project."**
  Sponsor: FID, OSU Extension and AgriMet Inc. Date Planned: xx/xx/xx.

- **"Anne's Rules of the Road for Efficient Watering of Organic Fruit Crops Lecture Series."**
  Sponsors: OSU Master Gardeners, OSU Extension and Anne's Organic Orchards Corp.

Issue 2: Improving Residential Water Conservation Efficiency

Student (K-12) Opportunities

- **"WaterWise 4th Grade Curriculum."**
  Sponsor: City of HR. Date Planned: xx/xx/xx.

Adult Opportunities

- **"Water Conserving Turf Grass Options" Adult Education Class Series.**
  Sponsor: City of HR and HR Continuing Education. Date Planned: xx/xx/xx.

- **"Clinton Residence Low Water Turfgrass Demonstration Project."**
  Sponsor: OWEB Small Grants and City of HR. Date Planned: xx/xx/xx.

Issue 3: Increasing Application of Modern Pesticide Application Principles in Commercial Orchards

Student (K-12) Opportunities

NA

Adult Opportunities

- **"Pesticide Application BMP's Recommended by the HRSGSA for the Hood River Valley" Ag Field Day Class Series.**
  Sponsor: HRGSA and OSU Extension. Date Planned: xx/xx/xx.

Issue 4: Elimination of Residential Fruit Trees to Decrease Tree Fruit Disease and Amounts of Chemical Needed

Student (K-12) Opportunities

NA

Adult Opportunities

- **"Backyard Tree Fruit Program."**
  Sponsor: HRGSA and OSU Extension. Date Planned: xx/xx/xx.

- **"Backyard Tree Fruit Bounty Program."**
  Sponsor: HRGSA and OSU Extension. Date Planned: xx/xx/xx.

Issue 5: Increasing General Awareness of the HR Cultural History, Watershed Natural Processes, Challenges, Solutions and Current Activities (split these up??)

Student (K-12) Opportunities

- **"Hood River Middle School StreamWalk Curriculum."**
  Sponsor: HR Valley School District and HRWG. Date Planned: Fall Terms.

- **"Voices for the HR Interpretive Sign Project."**
  Sponsor: xxx. Date Planned:xxx.

- **"HR Schools Storm Drain Stenciling Project."**
  Sponsor: HR School District, Millersville Paint, Home Depot and HRWG.

Adult Opportunities

- **"HR Watershed Delineation Signage Project."**
  Sponsor: HRWG, USFS, ODOT and HR County. Date Planned: xx/xx/xx.

- **"HRWG Bumper Sticker Project."**
  Sponsor: HRWG and Hood River Glades Ski Area. Date Planned: xx/xx/xx.

Issue 6: Reducing Loss of Important Fish Caused by Counter-Productive Sport Fishing Behavior

Student (K-12) Opportunities

- **"Big Greg's Tales of Angling for School Kids."**
  Sponsor: Big Greg and Luhr Jenson Inc. Date Planned: xx/xx/xx.

Adult Opportunities

- "Bull Trout Identification Pamphlet Series."
  Sponsor: USFS. Date Planned:xxx.